Australian Institute of
Occupational Hygienists Inc

28th Annual Conference & Exhibition

GREEN BUT CLEAN?

What is behind our clean green future?

CONFERENCE PROCEEDINGS

4th - 8th December 2010

Hotel Grand Chancellor
Hobart, Tasmania

www.aioh.org.au

28th Annual Conference & Exhibition of the
Australian Institute of Occupational Hygienists Inc

5th to 8th December 2010

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2010 CONFERENCE PROCEEDINGS

Editor Dr Brian Davies

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The Australian Institute of Occupational Hygienists Inc. is a non profit organisation dedicated to the advancement of occupational hygiene and to the improvement of the knowledge, competence and standing of its practitioners. It is affiliated with the International Occupational Hygiene Association.

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Welcome to the 28th AIOH Annual Conference
GREEN BUT CLEAN? What is behind our clean green future?

On behalf of the Conference Organising Committee, it is my pleasure to welcome delegates, speakers, and exhibitors to the 28th AIOH Annual Conference in Hobart, Tasmania. If you have never attended an AIOH Conference before, or you have travelled from overseas, I wish you an especially warm welcome.

The theme of this Conference is "Clean but Green - what's behind a clean green future?" The Scientific Committee chaired by Dr Brian Davies has assembled a varied and thought provoking programme; papers and roundtable discussions on corporate sustainability, professional ethics and practice, core competencies, national and global harmonisation, and risk communication. We seek to encourage you to explore issues around our 'clean green future', so we are better equipped as professionals for the responsibilities and opportunities ahead.

We are hosting a full programme of continuing education sessions and papers providing introductory professional development opportunities right through to cutting edge updates on managing the hazards of a modern workplace.

This year the conference program includes the opportunity to spend time with four recognised leaders in specialist occupational hygiene fields, at our innovative 'Breakfast with the Experts' sessions.

Five local organisations are hosting technical tours for small groups of delegates. This is a fantastic opportunity for Occupational Hygiene professionals to see first-hand, classic industrial and manufacturing processes.

I would like to thank our generous sponsors, who help make AIOH conferences such a success. Some of our sponsors have provided ongoing support for the AIOH and the occupational hygiene profession for many years. We value these partnerships and hope we can continue to grow together.

I would also like to thank our Exhibitors who tirelessly provide us with the opportunity to view their products and services. I encourage delegates to spend time in the Trade Exhibition and get to know our Exhibitors.

Although Tasmania is Australia's smallest state, we like to think we provide a 'big old fashioned' welcome. It has been 18 year since Tasmania hosted an AIOH Annual Conference, in Launceston in 1992. We welcome delegates back and hope you find this conference thought provoking, stimulating, informative and enjoyable. Relax and enjoy our spectacular island.

Caroline Langley
Chairperson
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BIOGRAPHICAL NOTES ON THE PLENARY SPEAKERS

Mr Rich Metzler

Richard W. Metzler is a Respiratory Protection Consultant and retired Director of the National Personal Protection Technology Laboratory (NPPTL) of the Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health (CDC/NIOSH). Rich has 36 year's experience in the U.S. Government safety and health product certification programs. He administered the transfer of the US Bureau of Mines research laboratories into NIOSH, directed the Institute's respirator certification program and supervised several laboratories within the Department of Labor, Mine Safety and Health Administration including electrical, mechanical, materials and explosion testing laboratories. His experience includes conducting engineering investigations associated with workplace fatalities and injuries, establishing and managing product testing laboratories and establishing national and international safety equipment standards.

Rich has served as a director and president of the International Society for Respiratory Protection (ISRP), administrator for the US ANSI participation in ISO, TC 94/SC 15 TAG - Respiratory Protective Devices and has also served as chairman for the ISO Air-Purifying Respirator systems standards. Rich led NIOSH successful rulemaking efforts in promulgating Title 42 Code of Federal Regulations Part 42 and the development of respirator Chemical, Biological, Radiological, and Nuclear (CBRN) approval standards. Rich is currently a member of the ANSI Z88 Respiratory Protection Standards Committee and past president of the AIHA Respiratory Protection Committee.

Rich holds a Bachelor of Science Degree in Systems Engineering from Wright State University in Dayton, Ohio and a Master's degree in Industrial Engineering Management from the University of Pittsburgh, Pittsburgh, PA.

Dr Martin Moore-Ede

For 30 years, Dr. Martin Moore-Ede has been a leading expert on managing the risks of human fatigue in transportation and industrial businesses that operate 24/7. After experiencing the challenges of fatigue as a surgeon-in-training working 36-hour shifts, Dr. Moore- Ede was one of the first to define the challenges of living, working and sleeping in a 24 hour a day, 7-day a week world. As a Harvard Medical School professor (1975 – 1998), he led the team that discovered the biological clock in the human brain that controls the timing of sleep and wakefulness. He pioneered research on how the human body can safely adapt to working around the clock and sustain optimum physical and mental performance.

In 1983 Dr. Moore-Ede founded CIRCADIAN® and as Chairman and CEO, he has guided its growth so that CIRCADIAN® now advises over half the Fortune 500 companies on 24/7 workforce solutions.

Dr. Moore-Ede graduated with a First Class Honors degree in Physiology from the University of London, and received his medical degrees from Guy's Hospital Medical School, and his Ph.D. in Physiology from Harvard University. He has published 10 books, and more than 145 scientific papers on human fatigue, errors and accidents and the physiology of sleep deprivation and circadian rhythms. He has served on multiple national and international committees, and has won numerous awards. He is a frequent guest on television, radio and print. He regularly testifies before Congressional committees, and advises government agencies on Hours of Service regulations in the US, Canada and the UK.

Ms Margaret Donnan

Margaret was appointed Chief Executive of PACIA in December 2007. The Plastics and Chemicals Industries Association (PACIA) is the peak national body representing the Australian chemicals and plastics sector. Margaret has had a strong focus on working with government, industry and community stakeholders on legislative reform and other issues impacting on the chemical industry and is committed to sustainability and industry leadership.

Margaret has particular expertise in chemicals management and regulation, and has worked actively with the COAG and the Productivity Commission processes focussing on reform of the regulatory environment over chemicals and plastics – identified as one of COAG's "regulatory hotspots".

Prior to joining PACIA in 2002, Margaret worked in government for many years in health and safety at the state and national level, and operated in a range of senior management positions at WorkSafe Victoria. Margaret served as an expert Director of the Advisory Board for the National Offshore Petroleum Safety Authority, appointed in 2004 by then Industry Minister Ian Macfarlane and reappointed in 2008 by Resources and Energy Minister Martin Ferguson.

As Chief Executive of PACIA, Margaret is responsible to the Board of PACIA for the national operations of the Association. Her role includes extensive communication with Ministers and senior officers within the Australian Government and State Governments, the provision of services and advice to senior executives of member companies, and representation of the chemicals and plastics sector in industry meetings and public forums.

Mr Michael Tooma

Michael Tooma is recognised as one of Australia's leading occupational health and safety lawyers. He is the leader of Norton Rose Australia's Occupational Health, Safety and Security practice.

Michael has extensive experience in the construction industry including experience advising consulting engineers such as Hatch, Aurecon and GHD on their pro-active compliance needs.

Michael is the author of several books on OHS law including Tooma's Annotated Occupational Health and Safety Act 2000: NSW, Thomson Reuters now in its 3rd edition 2009 and Safety Security Health and Environmental Law, Federation Press, 2008. These are standard prescribed text for OHS law at most Australian universities.

Michael is an Adjunct Professor of Law at Edith Cowan University, and Senior Visiting Fellow of the School of Safety Science, University of New South Wales. He has also lectured at the School of Behavioural Science at the University of Wollongong.

Michael also advises both state and federal governments in relation to OHS matters. In 2007, he undertook a review of OHS Regulations on behalf of the then Commonwealth Government. He is currently drafting National Model Mine Safety legislation. He has also reviewed the NSW Rail Safety legislation on behalf of the NSW Rail Regulator.

Michael has a Certificate IV in Workplace Safety, has a certificate in Construction Safety induction, has formal training in OHS auditing and is a Chartered Professional Member of the Safety Institute of Australia and a Registered Safety Practitioner. He is a regular speaker at industry conferences and seminars on employment and OHS laws.

Mr Martyn Bradfield

Martyn is Managing Director of Injury Prevention & Management, an OH&S Consultant, Occupational Hygienist, Trainer and OH&S coach. Martyn has been a provisional member of AIOH for over 20 years, has a Diploma in Safety Management (Occupational Hygiene) and a Bachelor of Science (Chemistry), and is a Workplace Trainer and Assessor.

Martyn has over 15 years experience consulting in OH&S, Occupational Hygiene and Training and leads a team of nine specialist consultants at Injury Prevention & Management, providing a broad range of OH&S services to public and private sector organisations.

Martyn’s passion is in making a difference to workplace health & safety so that everyone goes home fit every day and can live full and rewarding lives.

Ms Denise Donnelly

Denise Donnelly is a graduate of Rutgers University with a B. A. in Biochemistry, and is finishing her Master’s degree in Environmental Policy and Management from the University of Denver. Denise is the Institutional Biosafety officer for the University of Colorado at Boulder and manages the Biosafety program for the Campus. She has more than 17 years of experience as an Occupational Safety Specialist, Industrial Hygienist, and Program Manager. Denise is also an active Board member of the local AIHA-Rocky Mountain Section and an active member of ABSA.

Prof J Torey Nalbone

Dr. J. Torey Nalbone received a Bachelor of Science degree in Biology from Baylor University in 1977. After completing some graduate study in Forensic Toxicology at University of Texas School he entered an Environmental Science and Engineering Program at the University of Texas at Dallas. He received a Master of Science in 1993. He then entered Texas A&M University for study in engineering and received a Doctor of Philosophy degree in Interdisciplinary Engineering (Health Protection) in 2004. As a doctoral candidate he focused on human health effects of the environment, performing assessments of the indoor environment.

He is a Certified Industrial Hygienist (CIH), and a member of the ACGIH, the American Industrial Hygiene Association, the Academy of Industrial Hygiene and a Diplomate of the American Board of Industrial Hygiene.

In 2009 Dr. Nalbone was elected Chair of the ABIH, an international certification board for the professional practice of Industrial Hygiene. He has authored presentations for national and international meetings in exposure control, noise, indoor environment and occupational health and injuries in a variety of industries. He has also been an invited speaker at professional conferences in the U.S. and internationally on the topic of professional practice ethics.

His current position is Associate Professor, Department of Civil Engineering College of Engineering and Computer Science University of Texas at Tyler Texas.

Dr Robert Turner

Robert Turner graduated from Manchester University in 1974 with a PhD in Chemistry, and after several years in the chemical and printing industries joined HSE as a Specialist Occupational Hygiene Inspector in 1980. Over the 30 years since then he has held a number of posts within HSE as Principal and Superintending Specialist Inspector, including Head of Pesticide, New and Existing Chemicals and Major Hazards Assessment Units. After a secondment to assist with improving risk management within UK government he returned to HSE and took up the post of Head of Occupational Hygiene in 2004, from which he has recently retired. Dr Turner was elected President of the British Occupational Hygiene Society (BOHS) in April 2010.

Dr Sharann Johnson

Sharann has over 30 years of experience working in occupational health and safety. She completed a PhD in Chemistry at Monash University and the Sydney University course in occupational hygiene.

Sharann joined BP Australia and led the Company in occupational hygiene in all down stream oil activities and in metalliferous and coal mining industry, as well as product stewardship services for their products, waste and intermediatory feedstocks. She was seconded to London to work for BP Oil International in the Group Health, Safety and Environment team again to lead on Product Stewardship and Occupational Health initiatives. She then returned to Australia to become the Health, Safety and Environment Manager for two international businesses.

Sharann has participated in a number of national and State OHS working committees including the National Occupational Health & Safety Committee, Hazardous Substances Working Group and has co-authored a book on the management of hazardous chemicals for the mining industry.

Sharann is a founding member of the Australian Institute of Occupational Hygienists, and recently served as their President.

Currently, Sharann operates her own OHS consulting company and advises industries on a variety of occupational health and product stewardship issues.

Dr Ross Di Corleto

Ross began a health & safety career in the power generation industry in Victoria over 30 years ago. Looking for a change he followed the sun north and took up a role as an Occupational Hygienist in the alumina refining industry and a number of years later became a consultant to mining and heavy industry in Australia and Africa. In 2001 he rejoined the corporate world as a hygienist at a Rio Tinto smelter.

Ross has a Bachelor of Applied Science, Post Graduate Diploma in Occupational Hygiene, a Master of Science by research, and he has recently completed a PhD in relation to the monitoring of PAHs in the aluminium smelting industry.

He is a fellow and past president of the Australian Institute of Occupational Hygienists and a fellow of the Safety Institute of Australia. His areas of particular interest include the thermal environment, biological monitoring and PAHs.

Ross is currently the Principal Adviser Industrial Hygiene for the Rio Tinto group, based in Brisbane

Dr Brian Davies

Brian has worked in the field of Occupational Hygiene for approximately 35 years and has experience in the mining, steel and aviation industries. Brian has a long association with the use of statistics in exposure assessment and has developed statistical based monitoring programmes for numerous companies.

In 2002 Brian was the recipient of the William P Yant Award presented by the American Industrial Hygiene Association for outstanding contribution to the scientific field of industrial hygiene. In 2003 the William Steiger Memorial Award was presented to Brian by the ACGIH for efforts contributing to the advancement of occupational health and safety. Recently Brian was advised that he was the joint recipient of the IOHA Lifetime Achievement Award which was presented in September 2010 at the Rome IOHA Conference.

In 2005 Brian was appointed as a Member of the Order of Australia (AM) for service to Occupational Health & Hygiene, particularly in relation to the coal industry and through the Australian Institute of Occupational Hygienists.

Brian is currently an Associate Professor at the University of Wollongong where he lectures in the field of Occupational Hygiene.

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Poster Abstracts

Product Standards in the Global Economy - Cause for Confidence or False Sense of Security?

Richard Metzler
Richard Metzler Inc, USA

Abstract

Occupational safety and health product standards whether regulatory or voluntary provide minimum specifications for acceptable levels of product performance, quality and reliability. The seals of approval carried by products are symbols to workers that a product is safe and effective for their use or personal protection. The truth is that product standards can be a benefit or detriment to worker safety or health.

Product voluntary consensus standards and regulations usually lag technological advancements and are thus somewhat already dated when they are implemented. Antiquated product standards can have the adverse effect of limiting protection to workers and are barriers for product improvements. However, the speed of product innovation is not the principal reason for standards being outdated.

There are many global and local factors that affect the speed of development and implementation of standards. Globally, the health of the economy, political interests, national disasters or occupational tragedies all have substantial influence on the speed at which regulatory agencies and standards development organizations complete their important work. Acceleration or delay in addressing needed improvements in standards and thus worker protection are also greatly influenced at the local level by the efficiency of the standards development organization and its processes. Other local factors include the resistance to or push for change by special interest groups: those holding the greater market share ("The Haves"); those without the proposed capability (The Have Not's); and those with the advanced capability ("Wanta Be's"). At the local level there are also disputes over the fairness of proceedings, questions over the applicability of scientific protocols and data used to establish the new requirements.

The presentation addresses the need of regulatory agencies, standards development organizations and industrial hygiene community for greater vigilance and skillful management of standards development processes. This is especially true now during the substantial downturn in the global economy and rapid transition to so called "clean and green" technologies which have labels that obscure threats to worker and public health and safety. Both the accelerators and impediments to improving product standards and their consequences will be discussed. New strategies for updating standards may well be needed.

Occupational Risks of the 24/7 Workplace: Emergence of Fatigue Risk Management Systems as Internationally Accepted Best Practice

Martin Moore-Ede, M.D., Ph.D.
CIRCADIAN Inc, USA

Abstract

Over the past five years, a broad international consensus has emerged across many 24/7 industries that the optimal way to manage and reduce employee fatigue risk is through a systematic process called a Fatigue Risk Management System (FRMS). Government regulatory agencies, industry associations, and many corporations with 24/7 operations have recently incorporated FRMS into their regulations, industry standards, and corporate policies. The adoption of FRMS as an effective alternative to hours of service regulations, which started in Australia, has now spread worldwide. Just in the last two years

- The American Petroleum Institute has developed an ANSI standard that makes FRMS the operating requirement for managing employee fatigue risk in the petrochemical industry.
- The European Aviation Safety Agency (EASA) has made having an FRMS a requirement for airlines operating in Europe.
- All US airlines were given a mere three months by a new H.R. 5900 law to develop a plan to implement a comprehensive FRMS for their pilots.

A fundamental precept of FRMS is that it is a science-based data-driven risk management system. As such we also need to be evidence-based in defining the problem and the solutions to employee fatigue. While some have argued that FRMS is all about managing sleep opportunity and sleep behavior, the data suggests otherwise.

The 24/7 workforce faces other distinct sources of risk besides sleep disruption. Exposure to light at night has now been associated with a wide range of neuroendocrine and pathophysiological sequelae ranging from metabolic syndrome, to depression and cancer risk. In addition the extended work hours have a significant impact on family-social stress which interacts with fatigue. It is therefore appropriate to consider the exposure to the 24/7 workplace as a multifactorial occupational hazard.

In particular our understanding of the impact of nocturnal light has created a dilemma. In the 1990's increased workplace lighting was shown to increase safety and performance at night. More recently, however, the significant adverse health consequences of nocturnal light have been recognized. Fortunately a solution has been discovered. Blocking a narrow 10 nm wavelength band prevents the adverse health effects.

A Sustainable Chemical Industry in Australia

Margaret Donnan
PACIA

Abstract

The Australian chemical industry accounts for 10% of Australia's total manufacturing activity, directly employs 85,000 people, pays $4.7 billion in wages a year, and provides essential products, inputs and services to virtually every other industry in the country. On a global scale, the Australian industry ranks 22nd and represents 0.7% of the very competitive world trade in chemicals.

The industry, as a solutions provider, is actively responding to today's challenges of clean production, climate change, water shortage, population increase, resource constraints, and society's expectations for its products and services. Getting the right government policy settings is critical to the future capability and viability of the Australian industry.

PACIA Chief Executive, Margaret Donnan, will outline how PACIA and its members are working with governments and implementing strategies to meet these key challenges.

Legal Traps in the Rush to be Green

Michael Tooma
Norton Rose

Abstract

This paper will explore the legal implications of the push to be green. The presentation will explore the recent experience with the insulation scheme debacle and explore the safety issues associated with solar technology and other clean energy technology. The paper will ask the question, are we compromising safety in the rush to be green?

Occupational Hygienists can be Sustainability Change Agents

Martyn Bradfield and Sarah Lowe
Injury Prevention & Management Pty Ltd

Abstract

Occupational Hygienists and occupational health and safety (OH&S) practitioners are well positioned to influence the uptake of sustainability in workplaces. First and foremost we care about people, a fundamental principle of sustainability, which crosses the three interconnected systems: social, economic and environmental. Within each of these integrated areas, human behaviour is the key enabler when it comes to sustainability change initiatives.

OH&S compliance is also a critical building block. Proactive sustainability requires a compliance "plus" approach in the workplace, otherwise known as voluntary compliance. This arises in organizations that have "internalised" OH&S and other legislative frameworks, making them meaningful and aligned to the success of the workplace and its people. This puts us in a unique position to be change agents within our organizations and communities.

So how do we bring this about? Through a behavioural change process that impacts the culture of an organisation. This starts at the top, and becomes evident in strategic intent and leadership aligning to sustainability. Occupational Hygienists are well positioned to incorporate sustainability.

This paper will explore key impediments to improving sustainability and why Occupational Hygienists are in a strong position to facilitate the changes required and why effective communication and engagement are essential to achieve the necessary cultural shift.

Lean and Green: Integrating Sustainability Practices in a Biosafety Program

Denise Donnelly
University of Colorado, Boulder
Department of Environmental Health and Safety

Abstract

The Biosafety Program has integrated sustainability practices that will help support and define a greener future in the biological and biotechnology research areas that are conducted at the University of Colorado, Boulder campus. All program elements such as laboratory audits, biological agent inventories, autoclave and biosafety cabinet inspections, employ a paperless design system. Research committees which are responsible for the review, approval, and oversight of research involving biological agents, human subjects, and animals also use a paperless system.

Biological waste is processed on campus as an alternative to incineration. Waste minimization efforts are utilized in the laboratories and energy saving design features has been added to existing lab equipment to further reduce the campus's carbon footprint. Implementing a lean and green Biosafety program has been extremely beneficial and important in supporting the University's mission for sustainability excellence.

The Road to Competent Hygiene Practice, as easy as PIE (professionalism, integrity and ethics)

Professor J.Torey Nalbone
University of Texas
ABIH, USA

Abstract

Lustum fac (Latin) “Do the right thing” should somehow have become the motto of our profession, let alone countless others. We are in a unique situation as practicing hygienists in that the individuals that benefit (or suffer) the most from our work are not usually the ones paying our salaries or contract fees. The workers are the benefactors of our technical expertise, training and dedication to our craft, but they seldom are the individuals actually contracting us for our services. In that respect we as hygienists have an imperative to live up to, and practice with the utmost professionalism, integrity and ethical behavior. All three of these qualities are essential for personal success and the credibility of the profession. Just like those practicing engineering, medicine, nursing or law, we have an obligation to the “public” (those not directly paying for our time), to do the best job possible. It seems that beginning at the foundation is to address first professionalism. Professionalism can be construed as the overarching principles or set of values to which a particular practicing professional is held. Professionalism for the occupational/industrial hygienist, health and safety professional is multifaceted, in that it includes the individual capabilities to recognize hazards, the selection of appropriate sampling methodologies, proper selection of occupational exposure limits, the use of proper analytical methods for determining the exposure and the insight to deliver a report and recommendation with all the nuances and specifics to both be adequately protective and mindful of economical efficiencies. Professionalism also includes for our profession the legal aspects of our practice wherever we happen to be we need tp ensure that the methods, evaluations and advice (recommendations) we provide are within the legal limits or responsibilities. Integrity is being straightforward and honest in our professional relationships. We need to provide fair and truthful dealings not being associated with deceptive, false or misleading information but furnishing information that is grounded, not reckless. These behaviors in turn engender trust of and respect for your opinion. Integrity can also inspire loyalty in long-term relations in clients including management and workers. Ethics seems to be the toughest of these practice tenants to define. One can research the writings of Aristotle and others and conclude that ethics is a mixture of virtue, moral imperative and the guiding principle of the greatest good for the greatest number. My presentation is not intended to increase you knowledge of professionalism, integrity or ethical behavior, but only to incite you to think about these daily components of your practice. All should acknowledge that these have to be part of our practice guidelines, corporate and individual value statements, if you will. The key is to conduct yourself as a professional practitioner, with dignity for the worker, honor for your client and respect for the complicated environment in which we are striving everyday to ensure that workers who arrive at work health and safe return to their families in the same manner. We would be much better to feel obligated individually to *lustum fac* , rather than find ourselves in an imperative situation where we are commanded to *recte age* “Behave correctly.“

Addressing Human Barriers to Good Control Practice

Dr Robert Turner
Health & Safety Executive
British Occupational Hygiene Society, UK

Abstract

Human behaviour is an implicit (even if not always explicit) essential element of occupational hygiene practice but it is often not given sufficient attention to ensure that the barriers it can present to achieving and maintaining good practice control are successfully overcome.

There is a continuing high level of work related ill-health with many instances arising from substances and industries where the hazards and risks are well established and effective control measures have been developed and are readily available. However, whilst technical difficulties may have been overcome human barriers (both employer and employee) often mean that these control measures are not applied or used effectively in the workplace.

What are the barriers?

A key issue is an absence of real knowledge and awareness of the hazards and risks from exposure and hence a lack a lack of real understanding and engagement with the need to implement exposure controls. Other issues include a lack of understanding of the available controls and hence poor design, implementation and/or poor application; resistance to changing work practices to accommodate controls; inadequate monitoring and feedback leading, over time, to a drift away from good control.

Failure to fully address these barriers can be seen in the use of control measures such as local exhaust ventilation (LEV) and respiratory protective equipment (RPE). Over time their potential for effective control over a wider range of applications has significantly improved but problems remain with inadequate uptake, inappropriate systems, inappropriate equipment, poor and incorrect use etc. Indeed a recent study of RPE use indicated that even where good control has been achieved the basis for this may not be understood and hence good control is unlikely to be maintained. Studies for specific industries provide illustration of these issues including particular difficulties in addressing dermal and ingestion (eg contaminated rest room facilities) uptake and difficulties with overcoming established work practices and specific difficulties with some tasks (eg LEV hood obstructs welding tool).

How do we influence human behaviour to overcome these barriers?

Gaining acceptance of the need to change behaviour is fundamental to overcoming human barriers. To this end it is essential to understand the factors influencing the behaviour and so shape the intervention to the industry and people involved.

A key starting point is ensuring there is awareness and knowledge of hazards and risks to motivate understanding of the need to change but this is not enough it must be followed by motivation to actually change and then to continue to pursue this new behaviour over time. One effective approach for these latter aspects is the personalisation of the hazards and risks so that employers fully understand that exposure and ill-health is a serious risk in their workplace and employees believe that exposure and ill-health can happen to them. Visualisation tools such as the dust lamp

and video can be very effective here as can techniques such a biological sampling whereby a person's individual exposure can be illustrated. This latter can be particularly useful where reliance is placed on personal protective equipment (PPE) including RPE and in situations where the main route of absorption is skin or oral. It can also be very powerful in monitoring the maintenance of exposure controls.

In general all people in the company (employers and employees) must have the right information at right time to enable them to understand the need to change and the knowledge and tools to enable them to pursue the correct actions to implement, use and maintain the right controls.

Experiences with the Implementation of the GHS in the Mining Industry

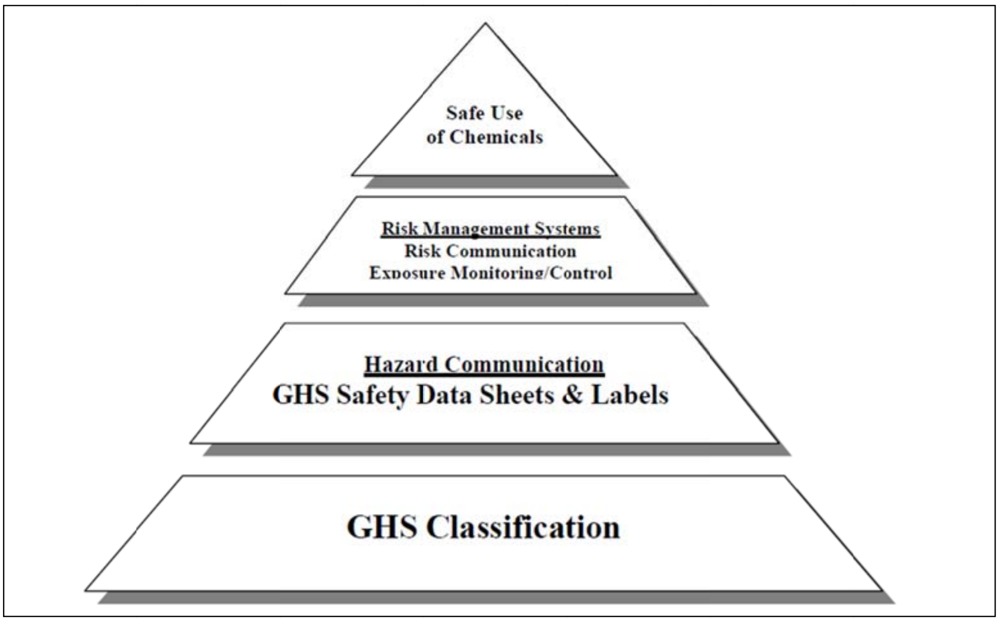
Dr Sharann Johnson
Callander & Johnson Consulting Services

Abstract

The following provides an insight into the events which have occurred with the introduction of the Class 9 Environmentally Hazardous classification in ADG7. The views, opinions and interpretation are those of the author and do not represent the views of the mining industry nor the mining companies I have worked for.

The need for a Globally Harmonized System (GHS) for chemicals and materials has been recognized for many years by OHS professions. Over the past 50 years, countries had implemented hazard criteria and labeling requirements for products which were different and this is no longer acceptable for international trade in a global economy. The goal should be to have level playing field for hazard classification, clarity and transparency about the process.

The processes have been shown in the diagram below, extracted from the publication titled, "Understanding the **G**lobally **H**armonized **S**ystem of Classification and Labelling of Chemicals (GHS)", 2008,



The foundation of GHS is the Hazard Classification system, and this is of fundamental importance to companies marketing their products as it impacts on regulatory compliance and commercial acceptability. This triangle is based on a fundamental that there are agreed criteria which will be used globally to classify for global products.

The case for mammalian toxicity has been well defined however the criteria for environmentally hazardous been more variable and problematic. Currently, products from Australian mines may be classified as Dangerous Goods, where the same product from another country will not be classified. Hence, this differential in classification schemes has the potential to deliver different risk assessment outcomes as well as have commercial impacts.

Although in principle countries agree to GHS, unfortunately the time frame for implementation into national legislation is variable, extending to years.

In 1993, the EU Dangerous Substances Directive included specific criteria for the classification of substances for environmental hazards, the focus being on the aquatic environment;

- Toxicity (Acute and Chronic)
- Bioaccumulation
- Biodegradation

In principle, it seemed appropriate in 1993 as there was a lot less environmental legislation to control chemicals. However this has posed serious challenges to industry to redesign test methodology for mixtures which are complex (and variable) as well as have low solubility. In fact, the opportunity with REACH (Registration, Evaluation and Assessment of Chemicals) has driven industry groups to collaborate and establish the Criteria for Transformation/Dissolution, (Bioavailability) test results for metal containing compounds such as metal concentrates produced by the mining industry.

In 2007, the 7th version of Australian Dangerous Goods Code (ADG7) published the reference to the OECD test methodology for Class 9, UN 3077 Environmentally Hazardous Solid. Previously metal concentrates such as nickel, copper, lead and zinc concentrates were not classified by the ADG however this new testing for UN3077 would now be applicable. However, the various international criteria for global commodities were missing to complete the Environmentally Hazardous assessment. Consequently, the implementation of ADG7 for Environmentally Hazardous metallic products generated in the mining industry has been problematic.

GHS is the way forward for our global market place, however it will take many years to become embedded internationally and achieve the long sort after goals for the workers and community. There is already a mature and effective OHS and environmental regulatory framework for product risks in Australia.

The events associated with ADG7 highlight the need for regulators and industry to work closely together to protect Australia's products and industry in the global marketplace. In addition, the introduction of new OHS regulatory requirements must add value to protect of workers, community and the environment.

The Monitoring and Assessment of Polyaromatic Hydrocarbons (PAHs) in the Occupational Environment. Is it time for a re-think?

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Rio Tinto

Abstract

Polyaromatic hydrocarbons (PAHs) are ubiquitous compounds found in the occupational and everyday environment. There are hundreds of different configurations and combinations with some sources claiming up to 500 different PAH constituents; however, the vast majority of these compounds are rarely monitored. For many years the standard approach to assessing the risk associated with exposure to PAHs has been the use of air monitoring methods such as the benzene soluble fraction. As a consequence, Regulatory OELs and requirements have as such been based on this methodology. It has also been known that there are other routes of entry into the body for PAHs, notably the skin, and some methods have developed in recent years such as 1-hydroxypyrene or 3-hydroxy benzo(a)pyrene in urine to attempt to provide some quantification of this impact. There are many variables that can impact on the actual dose of carcinogenic PAHs to which an individual can be exposed but are these all taken into account in the accepted standard approach? In this presentation the benefits and limitations of the respective methods are broadly discussed and some significant aspects relating to the application of a "one size fits all" monitoring mentality challenged.

Background

In 1775, Sir Percival Pott, an English surgeon, published the first detailed description of an occupationally-induced cancer – chimney-sweeps' cancer of the scrotum. This was attributed to soot penetrating the clothing of chimney sweeps and poor hygiene practices, resulting in prolonged contact of the scrotal skin where cancers were developed (Pott, 1775). Chimney soot is now known to contain high levels of polycyclic aromatic hydrocarbons (PAHs) (Doll, 1975).

PAHs are a mixture of organic compounds comprised of aromatic hydrocarbons. The major building block of their structure is the benzene ring, resulting in molecules containing fused-ring systems. This structure includes the most basic two-ring naphthalene or four-ring pyrene and higher five-ring benzo[a]pyrene and six-ring dibenzo[a,e]pyrene molecular compounds (Figure 1). PAHs with three or fewer benzene ring structures exist predominately in the vapour phase with boiling points between 217 and 295ºC. Those with four rings can exist in both the vapour and particulate phases. Where the compound comprises five or more rings with boiling points greater than 375ºC, they mainly exist in the particulate phase (Cirla et al., 2007). The key carcinogenic PAH compounds of interest tend to be in the 4-6 ring structures, i.e., benzo(a)pyrene. There are hundreds of different PAH ring configurations with some sources claiming up to 500 different PAH constituents (Lauwerys & Hoet, 2001); however, the vast majority of these compounds are rarely monitored.

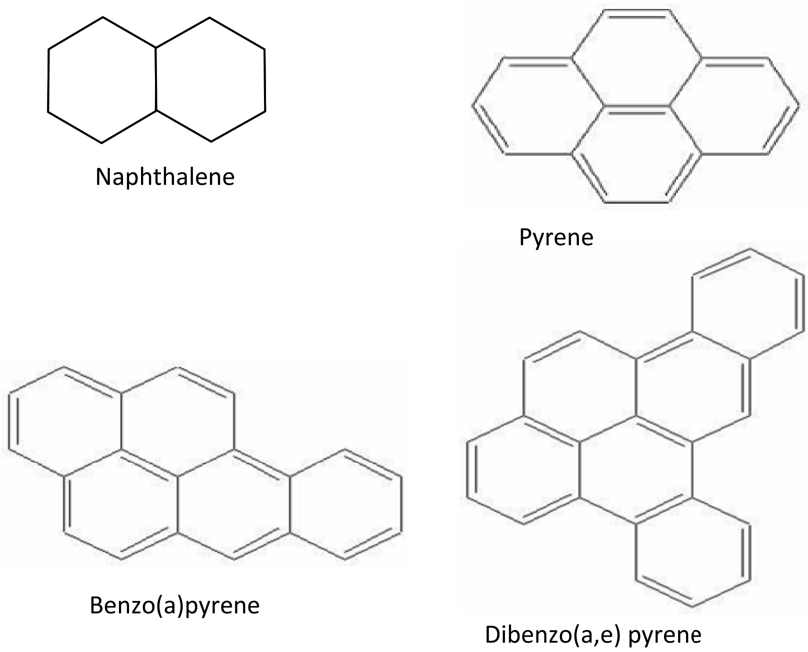

Figure 1: PAH ring structures of naphthalene, pyrene, benzo[a]pyrene and dibenzo[a,e]pyrene (Freeman, 2008)

Sources can include motor vehicle combustion engines, residential coal- or oil-fired heating systems, industrial environments, and natural sources such as bush fires and volcanoes. PAHs also can be found in substances such as crude oil, coal, coal-tar pitch, creosote, dyes, plastics, pesticides and, in a few instances, medical preparations. Due to their low vapour pressures, most PAHs entering the atmosphere as vapour will be adsorbed onto existing particles condense on particles such as soot or form very small particles themselves. Their presence in the environment is not restricted to the air; they are often found in surface waters as a result of airborne fallout or industrial discharges, and also in the soil. Human exposure occurs through a variety of sources, including diet, tobacco smoking, pollution and occupational exposure. The route of entry to the body may be via inhalation, ingestion or dermal absorption.

Historically exposure monitoring has involved the airborne monitoring of particulates and fumes, which have been analysed for the benzene-soluble fraction (BSF). This is then related to occupational exposure limits as set by bodies such as the American Conference of Governmental Industrial Hygienists (ACGIH) in the US and the Health and Safety Executive (HSE) in the United Kingdom.

More recently researchers have discovered that there is also a significant contribution to exposure as a result of absorption through the skin. In 1992, VanRooij et al. (1992) reported on dermal exposure assessment performed at a smelter in the Netherlands. Coal tar pitch exposures via this route were estimated at 3-5 times greater then exposure via inhalation.

Although biological monitoring can provide a measure of combined exposures from all routes and is being used at some sites, it has not been adopted as a routine method for exposure characterisation in industry because the key route of exposure is still regarded as airborne. Despite the potential for exposure via inhalation, ingestion and dermal adsorption, to date occupational exposure limits exist only for airborne contaminants. As a result, regulatory and surveillance process-control monitoring is undertaken using personal air sampling or for processes, static air sampling.

Both of these methods are utilised in this study as they are the current methodology in use in the primary aluminium industry. Although international guideline values exist, no biological exposure limits for PAHs are used by a regulatory body in Australia.

A study was conducted at a prebake aluminium smelter in Australia, which compared exposures of workers who came in contact with PAHs from coal-tar pitch in the smelter's anode plant and cell-reconstruction area. The relationships of these SEGs within the smelter are illustrated in Figure 2.

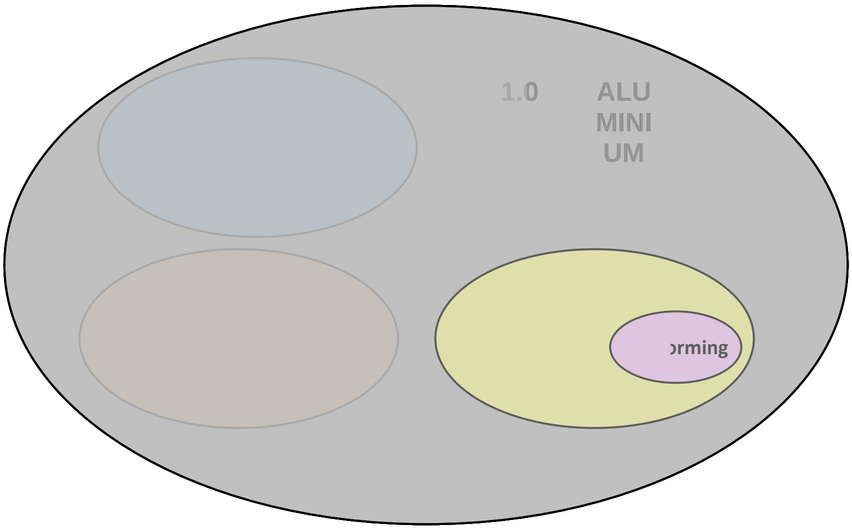

Figure 2: Relationship of SEGs studied within the prebake smelter

In this study the levels of static and personal airborne exposure across the two key areas of a prebake aluminium smelter in Australia were quantified. It investigated correlations between airborne and biological levels to elucidate the exposure profile in a prebake smelter, in particular what are the important routes of exposure and proposed the most effective monitoring approach. One significant question to be addressed was:

- Is the focus on airborne monitoring of PAHs (e.g. BSF and/or BaP) in the aluminium industry adequate to accurately characterise total occupational exposure to PAHs?

Results

For static air BSF levels in the anode plant, the median was, almost twice as high as in the cell-reconstruction area. In contrast, median BSF personal exposure in the anode plant was significantly lower than the median measured in the reconstruction area. The observation that median 1-OHP levels in urine were significantly higher in the anode plant than in the reconstruction area parallels the static air measurements of BSF rather than the personal air monitoring results. Results of air measurements and biological monitoring show that tasks associated with paste mixing and anode forming in the forming area of the anode plant resulted in higher PAH exposure than tasks in the non-forming areas; median 1-OHP levels in urine from workers in the forming area were almost four times higher than those obtained from workers in the non-forming area.

The third assessment was based around the 58 personal samples for BSF and 58 sets of urine samples for 1-OHP collected during the same work period. This was utilised to investigate the predictive ability of the personal BSF of airborne samples in relation to the level of 1-OHP in urine of the workers in the plant.

Multivariate regression analyses were undertaken on the data, which were presented in four models:

1. All groups combined)
2. Anode plant
3. Anode plant forming area
4. Anode plant non-forming area

Each model was assessed by comparing the 1-OHP concentration in urine against:

- BSF in air personal monitoring;
- smoking;
- PPE; and
- BSF, smoking and PPE.

Results of paired personal air monitoring samples and samples collected for 1-OHP in urine monitoring do not correlate. Predictive ability of the benzene-soluble fraction (BSF) in personal air monitoring in relation to the 1-OHP levels in urine is poor and was below 1.0% on all occasions except one (11.4%) even after adjustment for potential confounders of smoking status and use of personal protective equipment

Results justify use of biological monitoring as an important adjunct to existing measures of PAH exposure in the aluminium industry. Although monitoring of 1-OHP in urine may not be an accurate measure of biological effect on an individual, it is a better indicator of total PAH exposure than BSF in air.

In January 2005, interim study results prompted a plant management decision to modify control measures to reduce skin exposure. Comparison of 1-OHP in urine from workers pre- and post-modifications showed substantial downward trends. Exposure via the dermal route was identified as a contributor to overall dose. Reduction in 1-OHP urine concentrations achieved by reducing skin exposure demonstrate the importance of exposure via this alternative pathway.

Discussion

Is 1-OHP a valuable tool for the identification of levels of general exposure to PAHs in a smelting environment?

Yes it is. Often professions or disciplines can become fixated on the requirement of a value against which to measure and regulate. This prescriptive mindset has been the approach for many years and, while easy to adopt and administer, it may not be the most suitable approach for the monitoring and control of PAHs in some industries. The results of this study suggest that, regardless of exposure route, fluctuations in observed concentrations of 1-OHP indicative of PAH exposure are more useful in an OHS context than an absolute concentration limit to determine action levels. This is where one of the main benefits of monitoring 1-OHP lies. To continue to monitor the air with the belief that it is providing an accurate representation of exposure to PAHs in all environments is misguided and erroneous and, whilst the monitoring of 1-OHP in urine may not be an accurate measure of biological effect on an individual, it is far better than continuing with just air monitoring.

Despite the absence of a biological exposure level to relate to the utilisation of this method, it is still a valid and potentially powerful tool.

Is there a point in a multifactorial exposure regime at which BSF estimations cease to have any occupational relevance, or can they be used only if dermal exposure is controlled or excluded?

There is of course a key factor that needs to be addressed first and that is whether the main route of exposure is inhalation and that the component of exposure related to skin absorption is minimal. Where this is not the case then the value of this monitoring approach diminishes and in some cases may even be irrelevant. Situations such as maintenance personnel working on cold equipment contaminated with coal tar pitch paste, such as in smelter anode plants, have a small risk associated with inhalation exposure however their risk associated with skin contact can be quite high. Hence there would be minimal if any value associated with BSF monitoring in this scenario. Similarly in the situation where a respiratory protection program is in place and no other engineering modifications can be made then the benefit achieved by monitoring air exposures is very questionable.

What are the implications of the inadequacies of the current risk assessment metrics (in both the past and the future) for the primary aluminium industry and other occupations where there may be exposure to PAHs?

One of the key aspects of this question comes back to having a thorough understanding of what the actual exposure profile is. It is not as simple as saying an industry needs to undertake air monitoring as that is the only OEL in place. As has been previously discussed, this approach may be totally irrelevant in situations where there is minimal air exposure but significant potential for skin contact. It can also apply in the reverse where skin exposure is limited but inhalation is the key form of exposure.

There is also another side to this for those industries that have been measuring high total BSF in air which are predominately at the lower level of <4 ring benzoics. Many regulators mandate stringent health surveillance requirements where potential exposure to PAHs exists, which are expensive and complex to administer, especially for small- to medium-sized manufacturers. Where the mixture profile indicates a presence of the carcinogenic >4 ring compounds, then this is a valid approach but what of the industries where a high BSF in air is as a result of high levels of naphthalene or similar compound without the same toxicity? Should they also be encumbered with the same requirements of an industry such as those that use coal tar?

In the industries where the 4-6 ring compounds are either not present or in very minor quantities and the main exposures of concern are the lower level PAHs, then BSF monitoring will be the preferred approach and the benzo(a)pyrene monitoring of limited value. The United Kingdom Health and Safety Executive (UK HSE) has not adopted an exposure strategy based on an airborne exposure level to BaP as it was deemed to be a poor predictive marker for exposure to the 2-4 ring gaseous compounds which were the largest group of highly exposed workers in the UK. (Unwin et al, 2006)

Some sectors of the aluminium industry (and other industries) in the past have focused their attention on the reduction of exposure to airborne PAHs and have successfully reduced them to levels below the regulatory exposure limits. This has been the benchmark standard that businesses have sought to achieve and have been measured against by regulators. The question remains, have they been addressing the right source of contamination? Without taking into account the issue of ingestion and/or skin absorption, there is the possibility to build an erroneous risk profile with a key piece of the jigsaw missing. This has the potential to direct control strategies and resources towards areas that may not be the key source of exposure. This could result in the waste of scarce resources, both financial and human and the inadvertent continued exposure of individuals to a hazardous material.

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IOHA Lifetime Achievement Award Lecture
Occupational Hygiene Education - The Global Approach

Dr Brian Davies
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Abstract

Access to occupational hygiene education has historically been linked to those countries with a developed economy or countries where professional expertise has been available to establish and foster such programmes.

As industry has located operations in countries where no occupational hygiene education programmes have existed, there has been a reliance on expatriate resources or the training of local resources in foreign countries. While such actions have solved immediate issues they have not led to increased local educational resources and thus limited local training has occurred, giving rise to critical shortages in many developing countries.

In 2006 a number of senior occupational hygienists from multinational corporations, pooled their collective ideas as to how this demand for occupational hygienists (and occupational hygiene technicians) could be addressed.

From these early concepts the process has grown into a truly multinational project to improve worker health through the provision of appropriate education under the banner of the 'Occupational Hygiene Training Association (OHTA)'. This project is supported by the International Occupational Hygiene Association (IOHA) and its member organisations.

The OHTA project delivers a means of growing occupational hygiene skills using a modular system of training and qualifications. The system has been developed through extensive consultation over the last four years and provides a system of standard training packages that can be accessed free of charge anywhere in the world from www.OHlearning.com. All materials have been peer reviewed and trialled before release. The concept is based on standardised, modular training and student assessment to a consistent format. It focuses initially on the development of basic and practical occupational hygiene skills at the technical level to identify, assess and control risk.

While the initial focus has been at the technical level, several members of the OHTA Leadership Group have been working to develop specialist modules in a number of areas for incorporation into academic programmes at the Masters Degree level. To date, two universities, located in Australia and Chile, are offering programmes based on the OHTA modules and more specialists areas of expertise (eg Mining, Oil & Gas, Hypoxia). It is envisaged that other universities will also progress down this pathway and ultimately seek national (or international) accreditation of their courses.

OHTA, through the support of many individuals and organisations across the world, has evolved quickly and with the launch of www.OHlearning.com has the potential to change the way occupational hygiene education has been delivered. The OHTA approach to education materials, facilitates translation into other languages, reduces costs and increases the potential for local development of occupational hygiene education and occupational hygienists.

Validation of a range of heat stress indices in an off-shore LPNG Facility in WA

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Abstract

Background: Heat loads and exposure levels can vary between occupational groups due to location, geography and terrain. Typically, one environmental heat stress index is implemented on a work site and this could potentially over or under protect workers.

Purpose: The applicability of several heat stress indices was investigated in order to identify an index that could be utilised for both on and off shore workers in the liquefied natural gas industry (LNG).

Methods: Onshore and offshore occupations were investigated and physiological measurements were assessed. These data were compared against several heat stress indices, namely; ISO 7243, ISO 7933, ISO 8996, and Predicted four hour Sweat Rate (P_4SR).

Conclusion: P_4SR was found to be the most appropriate index for use in both onshore and offshore environments. Therefore, hygienists should educate and implement in all workers the appropriateness of hydrating strategies to assist the P_4SR as a heat stress management tool.

Providing a warning but minimising the annoyance from reversing alarms on construction sites

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Abstract

Warning of a hazard is a necessary requirement for safety on a worksite. The most common warning signal for a reversing vehicle on a construction site is an audible pulsed tonal alarm which needs to be loud enough to convey the warning. As a consequence there can be problems with the sound signal causing annoyance and disturbance on-site. Unless the alarm is specially focussed in the hazard risk area, the sound does not stay within the site boundary and the pulsed tonal reversing alarm can a major source of noise complaints from residential areas around construction sites. In this paper the options for alternative reversing alarms, including a broadband alarm, will be discussed. Also some guidelines are given for those required to undertake a risk assessment to approve the use of alternative alarms.

Keywords: warning signals, reversing alarms, noise

Introduction

Tonal or 'beeper' style audible alarms are commonly used as 'reversing alarms' or 'backup alarms' on vehicles and mobile plant across Australia, and around the world, to provide warnings of moving plant on work sites. Similar audible alarms are used as 'travel alarms' on plant such as hoists, cranes etc. The 'beeper' alarm comprises a pulsed sound comprising one or two alternating frequency tones, usually high pitched. The 'beeper' is intended to be louder than the background noise in the area and to draw attention to those in the area of the impending hazard.

Factors that may be desirable for an audible warning signal for those in danger can at the same time lead to the sound being an annoyance for those within and outside the site. Concerns within the site include:

- the alarm sound can be a loud annoyance for the operator – especially if it is fitted near the driver seat
- the noise of the alarm, typically in the range from 95 to 105 dB(A), can itself can present a potential risk of hearing damage for the driver if it is located close to the ear of the driver.
- the alarm sound can be heard outside the hazard risk area and leads to annoyance for other on-site workers
- the alarm sound occurs even when there is no person at risk
- the alarms from a number of moving plant on site can be confusing.

Factors that can lead to the 'beeper' being an annoyance for those outside the site include:

- the pulsing signal draws attention to the sound.
- the characteristic of the sound is such that it can be perceived at some distance from the site.

- the sound is clearly an unnecessary alert for those outside the site
- the sound can be seen to occur even when there is no person within the site at risk.

In this paper the options for alternatives to 'beeper' type reversing alarms will be discussed along with the challenges for the site manager faced with the need to approve the use of such alternative alarms. This paper draws upon the work undertaken for the NSW Department of Environment and Climate Change [Burgess & McCarty, 2009a].

Requirements for warning alarms

The aim of a motion alarm is to provide a warning for anyone in the area to take the necessary safety action. Such an alarm signal should provide three pieces of information about the hazard [Catchpole et al 2004]; namely:

- 'what' is the hazard;
- 'where' is the hazard; and
- 'when' is it a hazard?

Two different international standards could apply for reversing alarms on construction sites. If the alarm is considered as 'auditory warning signals' then ISO 7731 [2003] would likely apply, requiring the level of the signal to be 15 dB above the background noise level in the area, not to exceed 112 dB and recommending the alarm to have dominant tones. ISO 7731 requires a very loud signal and could be considered applicable to serious hazards, such as fires, when 100% reliability is required for all those in threat, including untrained personnel and those who may need some time to move from the area of potential risk. For movement alarms on earth moving equipment, then ISO 9533 [1989] would more likely apply, requiring the alarm to be at least as loud as the engine under full power. It is likely that the lower noise levels are considered appropriate as on-site personnel should have received a safety induction and so be alerted to the audible warnings used for the potential hazard.

A review of national Occupation Health and Safety regulations [Burgess and McCarthy, 2009a] showed that while a warning of the hazard of a reversing vehicle is required, it is not mandatory that the warning be an audible alarm. If an audible reversing alarm is fitted then it should not be modified without consultation with the manufacturer or without a risk assessment to demonstrate that the change will not reduce safety to those likely to be affected. National Codes of Practice similarly require a warning device and if it is an acoustic alarm then the only guidance is that it should be 'audible'. Industry guides for safe work require compliance with the Regulations and Codes of Practice and do not include anything specific about reversing alarms. Similarly guidance from industry and union groups does not specifically refer to any one type of alarm. However the perception is that the warning of a reversing or moving vehicle should be an audible alarm and the 'beeper' type alarm is widely accepted and recognised as providing a warning of an impending hazard.

Alternatives to audible warning alarms

The main alternatives to audible motion hazard warnings for plant on construction sites include:

- "Spotters" which may be required for specific types of construction work and can be used to clear the path behind reversing vehicles. However 'spotters' are generally not the preferred option on construction sites due to the need for additional personnel and to the degree of vigilance required.
- Visual alarms may be suited to some work areas but are not widely accepted as sufficient and are normally used in conjunction with other warning signals.
- Proximity sensors coupled with in-cabin alarms and even with in-cabin rear cameras can be used to alert the driver of potential for people or objects behind the reversing vehicle.

Proximity sensors with in-cabin audible and/or visual warnings for the driver are available for large plant and are becoming common for domestic vehicles. A study for NSW Motor Accident Authority on reducing the risks to young pedestrians from reversing domestic vehicles [Paine and Henderson, 2001] found that:

> *"Individually, none of the evaluated proximity sensors and visual aids provided complete coverage of the critical blind spots. .... With such a system in place it is important that drivers realise that they must still reverse very carefully."*

The effectiveness of the warning system relies on correct installation of the sensors and optimisation of the beam width so they respond to the presence of persons or objects in the hazard risk area behind the vehicle. If the beam is too wide, unnecessary warnings can lead to desensitisation of the driver to the real warnings. Additional concerns about the use of such alarms for plant on construction sites include:

- while the sensors may be adjusted properly for substantially level surfaces when a vehicle travels over sloped terrain the beam may not detect an object or person until it is too late for the evasive action by the driver
- greater risk that the sensors and/or the alignment of the sensors will be damaged during the course of site work
- functions of the vehicle – such as unloading or spreading material – could interfere with the operation of the sensor
- responsibility for evasive action remains wholly with the driver if there is only an in-cabin alarm.

Audible warning alarms with reduced annoyance

Recent advances in technology have resulted in a range of audible alarms which may indicate the hazard to those at risk while reducing the annoyance for others within and outside the site:

- 'Self adjusting' or 'smart' alarms. These include a mechanism to detect the local noise level and automatically adjust the output of the alarm is so that it is 5 to 10 dB above the noise level in the vicinity of the moving plant. While this does help to limit the noise level on sites which are generally 'low noise' the resultant pulsed tone can still be clearly heard outside the site.

- Proximity sensor coupled with a "smart" alarm. The reversing alarm is either not active or normally only 5 dB above background noise but then increases greatly when an object is detected in hazard risk area. This sudden increase in noise level may well be effective as a warning for those on site but it can also increase the annoyance for those outside the site.
- Focussed 'beeper' alarms. These incorporate multiple transducers in an attempt to cancel the sound around the side and so focus the sound to the rear of the vehicle. The multiple transducers need to be carefully installed to achieve the required focussing of the sound.
- Non 'beeper' alarm signals. Advances in electronics have made alternative signals more feasible and these can have different frequency sounds or be designed to contain more audible information than simply a simple pulsed warning tone.

Of these alternatives, a non 'beeper' alarm signal, namely a broadband sound, is being promoted for use as a reversing alarm for plant on construction sites. The supplier claims that the broadband signal provides an effective warning of the hazard while being more directional on site and less annoying to the surrounding community than the conventional pulsed tonal alarms [eg Brigade Electronics, 2009]. They are also available with the 'smart' or self adjusting level option to further reduce the off-site annoyance. Currently Brigade Electronics PLC is the sole manufacturer of these alarms, holding the patent rights [Brigade, Yamaguchi, 2001].

A comparison of the frequency spectrum for a typical pulsed tonal alarm and a pulsed broadband alarm is provided in Figure 1 and it can be seen that the broadband alarm signal extends from around 1,000 Hz to around 5,000 Hz with none of the peaks that are present in the spectrum for the tonal alarm. A comparison of the time signals is shown in Figure 2. This shows that the repetition or pulsing rate of the two types of alarm signal are similar.

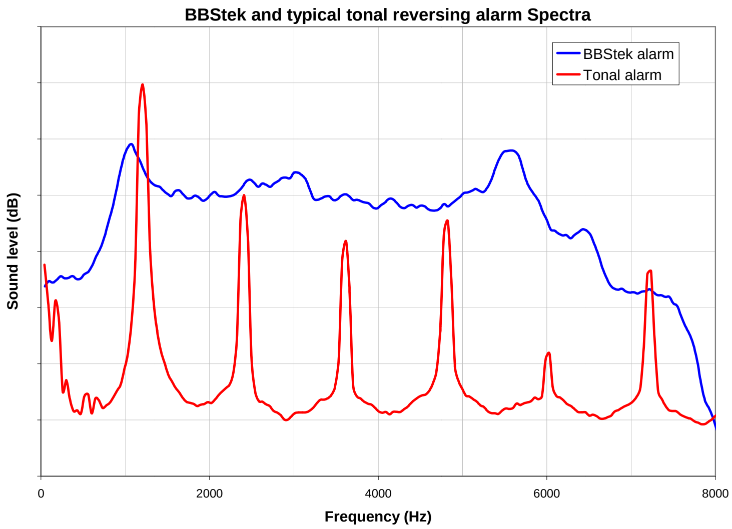

Figure 1. Frequency spectrum for a typical pulsed tonal alarm (wav file from www.federalsignal-indust.com) and a pulsed broadband alarm (wav file from www.brigade-inc.com/What%20is%20White%20Sound)

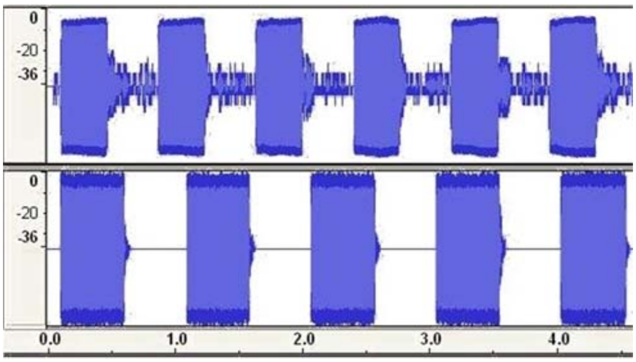

Figure 2. Time signal for a typical pulsed tonal alarm (wav file from www.federalsignal-indust.com) and a pulsed broadband alarm (wav file from www.brigade-inc.com/What%20is%20White%20Sound)

These broadband reversing alarms have been implemented on many mining sites around Australia and they are being used on construction sites. Agencies involved with major construction projects consider that there are fewer complaints when the broadband alarms are used, especially for those sites that need to operate near residential areas during the night time [Burgess and McCarty, 2009,a].

On-site safety considerations for broadband alarm signals

The 'beeper' alarm is been the universally recognised warning signal and is widely considered to provide the 'what', 'where' and 'when' of a hazard. This implied acceptance means that a hazard risk assessment is not required for the use of such signals for reversing alarms on site and many items of plant come fitted with such an alarm. The OHS regulations [Occupational Health and Safety Regulation 2001] require that should a factory fitted alarm on an item of plant be replaced by an alternate alarm, a risk assessment should be undertaken that needs to consider if the pulsed broadband alarm provides the necessary safety requirements to warn of hazards.

Burgess and McCarty [2009a and 2009b] provided a review of the claims and reports provided by the manufacturer that pulsed broadband alarms provide a superior warning for moving plant, ie a superior indication of the 'what', 'where' and 'when' of a hazard. They found that the broadband alarm has become very popular for use on mining sites but noted that such work sites have a more stable workforce and greater control of plant and operations. Hence understanding and acceptance of a different type of warning signal may be easier to achieve on a mining site than on a construction site. They also found that industry experience to date has shown that with the appropriate selection of the loudness of the alarm and with suitable training/induction on the nature of the alarm, the broadband alarms have been used safely on construction projects. There is no comprehensive, independent verification of all of the features of broadband alarms as promoted by the suppliers - a study currently being undertaken in Canada may provide that information [private communication Laroche 2010].

The person responsible on site for undertaking the risk assessment currently has no clear guidelines and needs to use a variety of means to support their decision making. From discussions with those involved with trials of the broadband alarms and observations of their use [Burgess & McCarty 2009a] and consideration of the check list in "Learning Lessons from Incidents" [Health and Safety Laboratory, 2008] some key features for effective implementation of the alternative alarms on a construction site could include:

- Use of the same type of alarm sound for most vehicles on site - to ensure association of the sound with the warning and to avoid confusion caused by a mix of warning signals
- Selection of appropriate sound level – trials of different models may be necessary to optimise the level of the alarm
- On site listening checks – may indicate problems for those wearing hearing protection and/or for those with a hearing impairment
- Correct location of the alarm on the item of plant – so that the sound is heard clearly in the hazard risk area
- Appropriate training and signage to ensure association of the sound with a hazard for all site personnel and visitors

Conclusion

Warning of a hazard is a necessary requirement for safety on a worksite. The most common warning signal for a reversing vehicle on a construction site is an audible pulsed tonal alarm. Such 'beeper' type alarms have disadvantages both on-site and off-site where the sound becomes an environmental noise problem. In this paper the options for alternatives to 'beeper' type alarms have been discussed. In particular the broadband alarm which is being increasingly promoted for use on moving plant on construction sites. The importance of undertaking a risk assessment prior to the use of this type of alarm has been highlighted and some key features for such an assessment summarised.

Acknowledgement

Much of the content of this paper was provided in a report commissioned by Department of Environment and Climate Change, NSW Government. The work of Matthew McCarty in the preparation of that report is acknowledged.

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Building hearing awareness via linkages & leverages: A Chevron health initiative

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Abstract

In 2009, and again in 2010, Chevron Australia has undertaken a series of measures to raise awareness of the potential for noise induced hearing loss within its Australian operations. This was intended to strengthen Chevron's planning and preparation in advance of the roll-out of its Major Capital Projects (MCPs). Project initiatives were designed to align with and support Hearing Awareness Week (HAW), a national health promotion effort that is usually run in August of each year. HAW was seen as representing an opportunity to develop a multi-faceted campaign to increase awareness of the effects of noise on hearing and the preventative measures that are available, and to bring these to the attention of a wide range of stakeholders. Chevron Australia's Health and Safety staff took a leadership role in engaging at both a State and National level with industry bodies, government agencies, professional institutions (such as the AIOH), major resource houses, tertiary institutions and charities to encourage their participation and to link Chevron's efforts with those being developed in the wider community.

This paper outlines how those linkages were planned and executed, and the high profile and leverage that was achieved for the project as a result.

Key Words

Hearing awareness, Noise Expo, Hearing Awareness Week, noise induced hearing loss.

Background

Noise induced hearing loss is an issue of considerable significance for Australia. According to Ear Science Institute Australia (www.earscience.org.au), four million Australians, or one in five people, are affected by significant hearing loss - with more than one-third of this due to excessive noise. Additionally, 1.5 million Australians suffer from severe tinnitus. This translates to social, economic and safety implications at the national level, at the work or community group level, and at the individual level. When hearing loss occurs, it is usually gradual in onset, insidious and permanent.

Hearing Awareness Week has been a national event in Australia since 1998. It is run by the Deafness Forum and related bodies – with an emphasis on how to measure and cope with hearing loss. A large number of organisations, both public and private, actively participate in the week and often register their activities on the HAW website. However, in the past, there has been little prominence given to noise-induced hearing loss (NIHL) or to preventative measures that might be applied in the workplace or at home.

Chevron has been active in Australia for almost 60 years and has significant experience in the exploration, development and production of hydrocarbon resources.

Until recently, Chevron's operations at Barrow and Thevenard Islands in Western Australia have been conducted by the WA Oil Asset and have involved a small field workforce of less than 100 employees. The Gorgon Project, which is currently under development, will have around 10,000 people working rotation on Barrow Island during its peak construction phase. This increase in numbers will create a significant Management of Change challenge to communicate Chevron's Occupational Health and Safety expectations, to implement world-class programs and to achieve its Incident and Injury Free (IIF) vision.

It can be reasonably expected that upcoming MCPs will need to address significant noise issues; therefore, a major campaign to promote hearing awareness and noise management approaches was launched in 2009. It sought to reach managers, planners, engineers, procurement specialists, Health, Environment and Safety professionals, safety representatives, crews and many other groups within the industrial community.

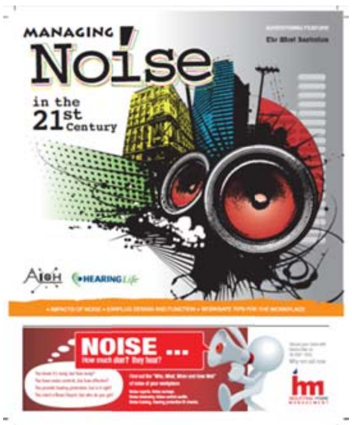
Chevron's planning tools and processes were applied during the early stages of the exercise. A Project Implementation Plan was used to guide project initiation, stakeholder engagement (internal and external), preparation, implementation and follow-up. Additionally, a formal communications plan was established to ensure that messages, objectives, responsibilities, delivery and issues were considered in detail. A team was assembled to support the project, including representatives from the company's Occupational Hygiene, Health Promotion and Public Affairs divisions, as well as representatives of the Major Capital Projects.

Chevron's Health and Safety staff took a leadership role in engaging at both a State and National level with industry bodies, government agencies, professional institutions and charities to encourage their participation and to link Chevron's efforts with those being developed in the wider community. Australia's Occupational Hygiene community was approached via the AIOH. Attachment 1 is a copy of an item published in the Institute's June 2010 newsletter – canvassing support for HAW. An example of an engagement exercise is that which took place during preparation for a special lift-out in the daily newspaper in Western Australia.

Project Elements

- **Lift-out in *The West Australian***

Chevron's Health Group approached *The West Australian's* Special Lift-out Section in February 2009 with a view to producing a colour supplement to be published in *The West Australian* just in advance of Hearing Awareness Week. The goals were to raise awareness about the sources, types, measures, impacts and solutions for noise-induced hearing loss, and promote the principles and practice of noise management to the public (and to sub-sets such as managers, engineers, safety representatives, law-makers, inspectors, health professionals, educators, journalists, unions and employees).



Chevron's vision was for an eye-catching and engaging feature that would include a detailed account of the familiar recognition, evaluation and control elements, along with case studies that dealt with the personal impact of hearing loss. Although the material was to cover both occupational and community noise issues, the emphasis was on Occupational Noise Induced Hearing Loss. The initiative was carried out under the auspices of the Australian Institute of Occupational Hygienists and with the active support of the Institute's Communications Committee.

It was necessary to secure enough advertisers to make the production viable and this was achieved largely by approaching professional contacts within the AIOH. Secondly, it was necessary to draw up a list of topics and approach suitable individuals to write articles. Again, this was done via professional colleagues. Contributions were received in this way from local, interstate and international (US) contacts. Several of the organisations that took out advertising space were also involved in other Hearing Awareness Week activities – those organised by Chevron staff (Lunch and Learns, Expos and training for engineers) and those put on by other major resource houses.

The Lift-out was published on Friday 21st August 2009 in *The West Australian* newspaper. It was a 20-page square format, colour feature entitled "Managing Noise in the 21st Century". An electronic version was subsequently posted on the front page of the AIOH website, and hard copies were sent to relevant schools within the Edith Cowan and Curtin Universities, the AIOH, other companies (project participants such as Shell, Rio Tinto and Woodside Energy), advertisers and suppliers.

- **Training for engineers**

Another element in the project in 2009, and repeated in 2010, was the provision of two half-day pilot training courses on noise control engineering. These were presented by SVT Engineering Ltd. The purpose was to provide an opportunity for designers, engineers and HES professionals from the Major Capital Projects to learn more about noise control principles and techniques for potential application in the design, construction and operational phases of the Gorgon and Wheatstone Projects.

- **Lunch and Learn Sessions**

"Lunch and Learn" sessions represent a useful way to reach a wide cross section of Company employees and contractors. Two sessions, entitled *"Noise Management in the 21st Century – Perspectives of a Scientist, an Engineer and an Entrepreneur"* were held in Perth during Hearing Awareness Week 2009 and these reached more than 250 people. A similar arrangement in 2010, entitled *"Noise – Impacts and Solutions"* attracted more than 350 people. The purpose was to outline Chevron's initiatives in relation to Hearing Awareness Week, to explain mechanisms of noise injury, key principles used in engineering noise control and preventive approaches that may be applied at work and at home.

- **Noise Expos**

Noise Expos were held in the Perth CBD during Hearing Awareness Week. The purpose of the Expos was to convey the main elements of a noise management program in industry and to demonstrate the latest developments and thinking with respect to these. The initiative was supported by leading equipment and service providers, and, in 2009, covered aspects such as noise level measurement, noise dosimetry, engineering noise control, administrative controls, iPod noise evaluation, hearing checks (audiometry), fit checking of ear plugs and communication devices for high noise environments. In 2010, further elements were added. These included stands dealing with tissue engineering, clinical research and the role of government agencies (workplace safety and workers' compensation). In addition, a noise-themed children's competition was conducted – with judging carried out by a sub-set of the tripartite WorkSafe WA Commission. The Expos were well attended by a cross section of Chevron Australia employees and contractors, as well as personnel from major resource houses, Industry representative bodies, government agencies, local universities (staff and students) and the general public.

- **Field activities**

There were three activities conducted in the field in support of Hearing Awareness Week.

Firstly, toolbox sessions on noise awareness were presented to Chevron and contractor crews on Barrow and Thevenard Islands. The purpose was to convey some basic messages on noise management, to raise awareness and to engage crews in the broader effort.

Secondly, there was preliminary use of newly acquired quantitative fit check apparatus. This was used in one-on-one sessions with crew members at Barrow and Thevenard Islands to establish the degree of fit of the hearing protective equipment that is being used and as the means of reinforcing important messages about wear time, correct fitting of earplugs and other hearing awareness issues.

Thirdly, a competition was held to seek the best idea for noise control at the local (crew) level on Barrow and Thevenard Islands.

Conclusion

Noise is the most widespread occupational health issue in Australian industry and noise induced hearing loss carries social, economic and safety implications at the national level, at the work or community group level, and at the individual level. Accordingly, it has broad relevance across industry. Traditional approaches to awareness building about the effects of noise have had only limited penetration and success.

The project was designed to have a wide impact across the operations of Chevron Australia – with staff, contractors and suppliers. It involved a major campaign to promote hearing awareness and noise management approaches with managers, planners, engineers, procurement specialists, Health, Environment and Safety professionals, safety representatives, crews and many other groups within the Company's Perth-based and North-West field operations. It also had wider objectives – to promote hearing awareness within the general community, at both a state and national level, and with individuals and groups that are in a position to influence future direction with this issue. As such, the approach of linking and leveraging internal efforts with those in the external world is an attractive template to use in dealing with common health-related topics in the future.

Finally, the project had a sustainability element. The emphasis was as much to do with embedding the principles of noise management with planners and decision-makers as it was to do with conveying the main messages to those who work regularly in noisy work environments. The wider project sought to reach educators, regulators and members of the public who may be able to influence the direction of noise management for future generations.

Attachment: AIOH Newsletter item – June 2010

Attachment

HEARING AWARENESS WEEK - IT'S ON AGAIN!

Hearing Awareness Week (22-28 August 2010), a national event, presents an exciting opportunity for Australia's Occupational Hygienists to raise the profile of the profession, while at the same time doing something worthwhile to address the massive hearing loss problem that resides in the workforce and the general community. It is estimated that 22% of Australians over the age of 15 have hearing impairment and it is rare to find a Hygienist who doesn't have noise management near the top of their priority list.

Traditionally, HAW in Australia has been run by the Deafness Forum and related bodies – with an emphasis on how to measure and cope with hearing loss. There has been little prominence given to noise-induced hearing loss or to the preventive measures that might be applied in the workplace or at home. This then presents an opportunity for AIOH members to bring their knowledge and experience to bear in raising awareness of this important health issue.

Readers will recall that 2009 saw a first attempt by Institute members to link up in supporting HAW and there were initiatives taking place across the country – from Kununurra to Geelong. One highlight was a 20-page colour lift-out in *The West Australian*, a copy of which now resides on the front page of the Institute's website. HAW provides an opportunity for members from Industry, government agencies, including H&S inspectorates, umbrella organisations, equipment and service providers, and tertiary institutions to collaborate on a common issue.

Activities could be directed at stakeholders, such as managers, supervisors, engineers, designers, procurement specialists, OHS professionals, Safety Representatives and shop floor personnel via events such as toolbox presentations, competitions, Expos, "Lunch n Learns", awareness raising or other forms of training and promotion. The challenge is to be creative and do something different in an area where traditional approaches often fail to gain traction.

The Institute urges its members around Australia to initiate, or participate in, hearing conservation activities in the lead-up to, and during, Hearing Awareness Week. A large number of organisations, both private and public, actively participate in the week and many register their activities on the Hearing Awareness Week website at www.hearingawarenessweek.org.au. Institute members are encouraged to do likewise.

The Communications Committee will attempt to compile a list of the NIHL-related activities that are registered on that website and communicate this to members at some later point.

Barry Chesson

Chair, Communications Committee, Australian Institute of Occupational Hygienists

25 May 2010

Hearing Conservation Principles: Why aren't workers hearing our message?

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Abstract

The warning statement, 'the ear can be damaged by noise' has been repeated ad nauseam. We possess the knowledge regarding decibels and how long we can be exposed to them. In addition, we are aware of what can be done with engineering controls, work rotations and personal protective equipment. So why is the incidence of hearing loss approaching epidemic proportions? Why are compensation payouts at $41 million per year and on the rise? Why is the current economic cost of hearing loss to Australia reported to be $11.75 billion per year?

This paper examines what the true cost of noise-injury is, and more importantly, why the message is not resonating within the workforce.

Is the message too complicated? How can we simplify it?

What are some creative but simple ways of explaining complex concepts like noise dose and the accumulative effect of hearing loss on quality of life? How can visual effects to aid learning be effectively implemented into hearing conservation training in the workplace?

How do we invoke a change in culture when it comes to hearing conservation?

This paper will provide a brief yet comprehensive insight into the present climate concerning hearing loss and noise exposure, as well as, engaging preventive strategies to educate individuals at the workplace so as to bring about effective change.

Background

In 1873, the 15 year old Chester Greenwood was testing new ice skates when his ears became cold. Realising that his scarf was too bulky to be wrapped around his head, he proceeded to cut it up and had his grandmother sew the material between two loops of wire. In 1877, he had his invention patented, and the earmuff was born (O'Donnell 2001).

At the National Research Corporation in 1967, Ross Garner devised expanding memory foam as part of a project for sealing joints. The properties of this material were so amazing that further applications for it were considered. Five years on, the foam earplug came into existence (Garner Jr. & Berger 1994).

Given that we have been toiling away to engineer out the noise, and we have invested in the field of hearing protection for thirty eight years or more, why is hearing loss from noise exposure still an eminent problem?

When it comes to how much a human ear can be exposed to, the verdict is in. The Hearing Standard, shows that, statistically, to limit the hearing loss inflicted on (95% of) the workforce to no more than 10dB over their lifetime, exposure has to be curbed to no more than the equivalent of a continuous A-weighted sound pressure level of 85 dB(A).over an 8-hour working day (AS/NZS 1269:2005).

The most frustrating aspect about hearing loss from noise exposure is not that we don't possess the knowledge on how to prevent it, but the fact that we do. We are well-informed of all the facts necessary to how Occupational Noise Induced Hearing Loss (ONIHL) occurs and how it can be prevented, yet hearing loss continues to thrive in almost pandemic proportions.

So, if knowledge is power, and we have the power, then why do we not seem to possess the ability to curb the progression of noise induced hearing loss? Why is hearing loss costing Australia $11.75 billion per annum (Access Economics, 2006). Why was there a staggering 16,500 hearing loss compensation claims for permanent injury due to noise approved between July 2002 and June 2007? (Safe Work Australia 2010). Therefore the need for understanding the barriers obscuring the message from getting through to the workforce, is essential.

In August of this year, a paper was published discussing the barriers and enablers that play a role in effective noise control and hearing loss prevention.(Safe Work Australia 2010).

The report describes a variety of concepts such as: fatalism; the belief that no matter what we do, hearing loss is inevitable. Optimism; the belief that it 'will not happen to me'. Low self-efficacy; a lack of confidence to be able to do anything about noise. Nevertheless, it is important to note that none of the barriers uncovered were described as 'impossible' to overcome.

The report's highly favoured recommendation is education. This entails, promoting awareness about the dangers of exposure to loud noise, the roll hearing loss plays in reduced quality of life, and the real options that are available to prevent hearing loss.

In conclusion, the report highlights that, "employers, managers and workers need to be made aware of the real risks and available solutions – and they need clear, concise, and

readily available guidance on how to achieve these solutions".

Discussion

A pattern had now emerged. The theory of how ONIHL occurs is known, genuine solutions are available, but the vehicle of how to get this information to employers and their workers has proven to be difficult.

In the professional arena, concepts involving neural conduction, cell attrition, sound pressure levels, Pascal squared hours, and decibels, are commonplace. However, medical and technical jargon which relay how damage to hearing can occur, scientific methods which depict how noise and hearing loss are measured, as well as, precautionary measures, have rendered the information inaccessible to the layman.

In turn, a lack of understanding about the subject matter will not induce any action to be taken at the workplace. The greater challenge faced is to represent these concepts in an accurate, yet uncomplicated manner.

In human communication science, it is considered the fault of the speaker if the listener has not understood the intended message. As communicators of these hearing conservation principles, the focus should be placed on the finesse of the education we provide. In other words, the aim would be to channel this information across effectively so as to strike at the core of the listener; the employer and the employees who are exposed to hazardous noise.

To do this effectively, we can extrapolate from previous proven models of behavioural modification for adult learners. This is even used in effecting change in addiction; for example the Australian National Tobacco Campaign (NTC), or as it is more commonly known, the quit-smoking campaign. Launched in 1997 with the infamous advertising slogan, " every cigarette is doing you damage" (Wakefield, Freeman & Donovan 2003). The approach taken by the NTC was to abandon the cognitive appreciate of scientific facts by translating the risks of smoking into an experience which could be "felt" by viewers (Wakefield, Freeman & Donovan 2003). Each advertisement brought a fresh take on the harms of smoking so as to optimise the effect on behaviour by employing several devices:

(a). Shifting the focus away from long-term clinical damage onto the ongoing effects of smoking

(b). Highlighting smoker moments which are definitively awkward yet familiar, so as to appeal to the smoker and convey sympathy for their circumstance

(c). Exposing smokers to graphic images so as to obtain a strong visceral response (Wakefield, Freeman & Donovan 2003)

In addition, a free smoking cessation hotline number was displayed at the end of every advertisement to encourage smokers to take an easy step towards quitting (Wakefield, Freeman & Donovan 2003).

Results from the NTC 's review study found that an estimated half of smokers who had seen the advertisements reported that it was effective in making them more likely to quit and 60% of recent quitters reported that the advertisements made them more inclined to 'stay off cigarettes' (Wakefield, Freeman & Donovan 2003).

Explain the effect

Similarly, if time is invested to explain to workers how their ears actually work, a smooth transition into the topic of how damage from noise occurs and why, can take place. The process of explaining the effect of noise on hearing is not necessarily time consuming. Many excellent yet concise video clips exist that can be shown to provide this education.

As the majority of people are visual learners, demonstrating that some processes can occur in the absence of visual awareness, will deliver shock value to the audience viscerally. In this case, seeing is not believing.

Most importantly, when workers understand that they hear not with their ear, but rather with their brain, they begin to understand why defective messages being sent from the ear can be so debilitating. This provides an easy transition into talking about quality of life issues.

Show the consequences

A stylised video clip showing how and why the hearing instrument is damaged by noise is only a starting point. It is only 'interesting' for the viewer if it is not converted into an experience for them.

The worker has to know what it will sound like to have an ONIHL before they can start to appreciate what will be the impact of this type of hearing loss on their quality of life. This can be accomplished by conducting an auditory demonstration. This can be done either live, or by playing an MP3 file through speakers. The more of the workers senses we can appeal to in order to get this message across the better. Another effective tool is to present a personal impact story. This is best done if a speaker with an ONIHL can be found to speak to the workers. The more relevant, the more powerful the impact will be. A retired worker from the same workplace makes an ideal choice.

The true cost of ONIHL is not the dollars paid out in a worker's compensation claim nor the economic strain it puts on Australia, it's the isolation that an individual feels from their friends and family when they can no longer hear what is being said.

Provide solutions

In order for the workers and their employers to truly 'take-on' this message, it needs to be taken one step further. It is necessary for them to understand the concepts of exposure and dose. These are well understood concepts, but just need to be applied to noise. Workers understand that if they expose their skin to long periods of sunlight and hence ultraviolet rays, they will sustain sunburn. Although the skin will repair itself over time, repeated exposures have the propensity to produce skin cancers. Describing the ear with this analogy may assist the worker to make the link that although there is an acute symptom; such as temporary threshold shift or tinnitus, with repeated exposures, permanent hearing loss and tinnitus will ensue. Alternatively, making the education a demonstration, will appeal to the visual learners. Dose and exposure can be well represented by pouring water into a number of glasses. By taking a concept that is 'invisible' like noise, and representing is as something visual like water filling a glass, makes the concept of exposure over time and dose easy to understand. This can be used to represent the three different key concepts of hearing protection. 1. By working a longer shift, a slower pour rate has to be adopted so as not to overflow the glass. 2. If a worker has to be exposed to higher than 85dB (simulated by pouring faster), the glass fills much more quickly and so the activity can only be done for a much shorter time. 3. If the worker is wearing hearing protection, but they compromise it in some way; such as lifting up of an earmuff when communicating with other workers, this can be simulated by a steady controlled pouring of the water with sporadic 'glugs' to represent times when the earmuff has been lifted shows very visually how the glass will overflow before the workday ends.

Conclusion

For an educational campaign for adult learners to be effective, it must contain a number of fundamental elements. Firstly, the workers must be exposed to the campaign and remember it. Secondly, they must appraise that the information they have received is both believable and relevant to them. Thirdly, it must stimulate their thinking about their own behaviour, and finally, it must effect a durable change in any undesirable behaviours.

It is vital that the message of hearing conservation be pitched in such a way as to have maximum impact on workers. To do this, it is essential to present high quality, informative content in an easy to understand format. Furthermore, the format should not only be clear, but novel, interesting and engaging and even fun, so that it is easy for the worker to commit this information to memory, to be recalled when they are back on the job and analysing their behaviours with 'fresh eyes'; and hopefully fresh ears.

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Adequate Indoor Ventilation

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Abstract

The concentration of carbon dioxide (CO2) inside air-conditioned buildings is related to the ventilation rate, so it can be used to assess the indoor environment. Other uses include the control of air-handling systems, the calculation of air exchange rates, and the calculation of the outdoor air percentage and estimates of the indoor population. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) recommends a ventilation guideline of outdoors+700 ppm (updated from a 1989 recommendation of 1000 ppm). This is a useful guideline for occupational hygienists (as it avoids the measurement of air supply volumes). It is suggested as a routine test when air monitoring indoors. This paper presents data indicating that most spaces are well-ventilated, but some types of occupancy are more likely to not comply with the guideline.

Introduction

Carbon Dioxide as a Ventilation Indicator

Carbon dioxide is a colourless and odourless gas that is a constituent of the atmosphere at up to 400 ppm, but is also generated indoors by human metabolism. People performing light duties exhale carbon dioxide at a rate of about 300 mL/min, so the concentration inside air-conditioned buildings can provide a good indication of the ventilation rate.

Guidelines

ASHRAE Standard 62-1989 *(Ventilation for Acceptable Indoor Air Quality)* recommended a minimum ventilation rate of 10 L/s per person to ensure good air quality in offices, using the ventilation rate procedure. For normal occupancy and activities, this rate would result in a carbon dioxide concentration of 850 ppm at steady state conditions. The standard also provided an alternative performance method, the indoor air quality (IAQ) procedure, based on acceptable concentrations of certain contaminants, including 1000 ppm of carbon dioxide. ASHRAE 62-1991 updated the recommendation to an indoor carbon dioxide level of background+700 ppm. I take background to mean the outdoor level. Health Canada recommends a health-based acceptable long-term exposure range (ALTER) for carbon dioxide in residential indoor air of 3500 ppm or less.

Other Techniques

Carbon dioxide measurements can be used to calculate air exchange rates (in air changes per hour) at the point of measurement (Olcerst, 1994a), the outdoor air percentage (Olcerst, 1994b), the recirculated air percentage (Olcerst, 1994b), and to estimate the indoor population (Olcerst, 1994c).

Methods of Measurement

Carbon dioxide grab samples can be collected with direct-reading colorimetric tubes or chips. Non-dispersive infrared (NDIR) analysers can be used for instantaneous or continuous monitoring. Measurements can be taken at the outdoor air intake, the mixed air supply, the exhaust air plenum, places with high occupancy levels, and locations that are the subject of complaints. The investigator should ensure that the results are not influenced by his or her exhaled breath or other sources (such as combustion or the release of process gas).

Carbon Dioxide as a Contaminant

Carbon dioxide gas increases the rate of breathing. At elevated concentrations it can cause headaches, tiredness, intoxication, impairment (hearing, vision, judgement) and laboured breathing. Very high levels can cause unconsciousness or death by asphyxiation. The Australian exposure standards for carbon dioxide are 5000 ppm (TWA) and 30 000 ppm (STEL).

Methods

In most cases, spot-check measurements of indoor carbon dioxide concentrations were conducted using Q-Trak Model 8551 indoor air quality monitors (TSI Incorporated, Shoreview, Minnesota). Long-term data recording with the same instrument was conducted in other cases.

Results

Occupancy Type	Samples	Exceedances	Range
Administration Offices	7	0	450-860 ppm
Libraries	3	0	660-760 ppm
Canteen	1	0	700 ppm
Meeting Rooms/Training Rooms	1	1	1210 ppm
Hospital/Medical	31	3	480-1400 ppm
Industrial-Central Air Conditioning	14	0	480-780 ppm
Industrial-Room Air Conditioner	3	2	650-1100 ppm
Industrial-Factories/Warehouses	5	0	490-600 ppm
Laboratories	4	0	650-910 ppm
Residential	1	0	415 ppm
Security Booths	2	0	490-850 ppm
School Classroom	2	1	970-1570 ppm
School Staffroom	1	1	1100 ppm
Household Waste Processing (Indoor)	2	1	650-1100 ppm

Discussion

Use and Abuse of the Guideline

Some investigators use a guideline value of 800 ppm, many still use 1000 ppm. Some investigators has been criticised for inappropriate use of the 1000 ppm ASHRAE guideline because they quote the value as a mandatory standard (not as a recommendation), because they incorrectly believe that levels above 1000 ppm are a risk to health, because they don't use the updated outdoors+700 ppm guideline, or because they ignore problem buildings if the carbon dioxide levels are less than the guideline.

Typical Levels

Most buildings meet the ASHRAE guideline and typical carbon dioxide levels in air-conditioned offices range from 600 800 ppm. Based on the presented data (and trends from other data collected prior to that), occupancies that fail to meet the guideline more often include occupied meeting rooms and locations with room-air conditioners (window mounted or split systems). Most schools and medical occupancies are satisfactory, but they have been found out of compliance a greater percentage of the time.

Diurnal Variations

In general, carbon dioxide levels are highest in the late morning. If data recording is not possible, the hour before lunch is the best time for a spot check.

Use in Adequate Ventilation

A typical warning on a material safety data sheet is *use in adequate ventilation*, so we conduct carbon dioxide measurements as a standard test in all occupancies (in addition to air monitoring for compliance with exposure standards).

Conclusions

The ASHRAE ventilation guideline of outdoors+700 ppm is useful when assessing the indoor environment. Most air-conditioned spaces meet the guideline, but it is common for some types of occupancy to exceed the recommended value.

Acknowledgments

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Split Systems, Green Buildings and Indoor Air Quality

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Abstract

Related to the "*Green but Clean*" theme of AIOH 2010 is the widening acceptance of human effects on the global environment. This awareness has increased efforts for conserving energy, reducing carbon footprints, ensuring sustainability, and - across a number of OECD countries - mandating Green Construction for public and commercial buildings, and for private dwellings. A number of corporations, property managers, governmental agencies, councils, and authorities are also "Going Green". While the author is supportive of competent Green Construction, as so often occurs in the course of human events, it appears that there is "*no solution without its problems*", especially when lofty concepts run up against real world performance and commercial interests.

In practice, Green Construction commonly results in greater use of insulation materials and engineered wood products. When less expensive materials are selected, a result is large amounts of fibreglass insulation and urea–formaldehyde resin chip-board. Combined with tightening building envelopes and reducing or interrupting fresh air flowrates, the stage is set for Indoor Air Quality (IAQ) problems, especially when construction QA/QC is not well-managed. For example, recent studies in California (USA) showed significant problems with formaldehyde exposures in new "Green" houses. Although achieving healthy indoor environments is a stated goal of Green Buildings, actually ensuring indoor comfort and health appears to rank low in Green Building design evaluation schemes.

The author has been involved in many indoor air quality (IAQ) investigations in Australia, and a number had root causes relating to energy conservation and/or Green Construction. A few examples include:

- Widespread installation of "Split" (and similar) HVAC Systems because of their "ease of installation and energy efficiency". These systems typically supply no fresh air, have minimal air filtration and provide insufficient dehumidification, which can lead to a range of IAQ problems, including: insufficient fresh air, build-up of uncontrolled air contaminants, and extensive mould growth. Eg, a mine-site training facility where staff had to take regular "breathing breaks to clear the head" because the building had Split Unit air-conditioning with no fresh air supply.
- A highly touted new "Green 5 Star Rated Building" for an Australian SOE that had significant IAQ problems and uncomfortable and ill staff from uncontrolled draughts, fibreglass dust and other airborne contaminants.
- Staff in a new University Call Centre affected by night-time "energy saving" HVAC shut down, inadequate IAQ construction management and formaldehyde out-gassing from new particle-board furniture.

Incomplete, outdated and/or poorly enforced State and Federal requirements related to: chip-board and other sources of formaldehyde emissions, indoor ventilation systems, fresh air flowrates and HVAC air filtration also appear to affect this situation.

This presentation will also propose roles for Occupational Hygienists in addressing these issues.

Natural Radon and Gamma Radiation Levels in University Buildings, 1991 – 2009

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Abstract

Since the early 1990's the Occupational Health and Safety Branch at the Australian National University has regularly undertaken radon monitoring of numerous University buildings. The monitoring consisted of passive samplers monitoring over several months to a year. These passive samplers also allowed gamma exposure levels to be measured. In recent times one building was monitored using a real-time active monitor. These results are discussed in relation to the significance of radon on occupant health, building design and ventilation systems. As society pushes for greater energy efficiency and greener buildings, an occupational hygienist should consider radon exposure especially if a reduction in the building's ventilation is 'on the cards'.

Introduction

Radon is a naturally occurring radioactive gas, which results from the decay of uranium in the soil and surrounding rocks. Radon being chemically inert gas, works its way through tiny cracks and voids in the ground and into the atmosphere, where it can be inhaled with the air breathe. Radon is also heavier than air, accumulating in lower areas, like basements, and when ventilation is poor. Radon eventually decays to solid radioactive particulates that often adhere to dust particles. Radon is a natural part of life.

It has been estimated that half of the natural radiation we receive can be attributed to radon. In Australia, a national survey of homes, found the average annual ionizing radiation dose from radon to be 600 μSv and from gamma radiation to be 900 μSv [1]. Significant variations were found between sites. The Australian Capital Territory, for example, showed the highest state average for radon (900 μSv) and next to highest for gamma radiation (1100 μSv). A more recent article has reassessed the average effective background dose♣ received by the Australian population to be approximately 1500 μSv per year [2]. Over half of the exposure arises from exposure from terrestrial radiation (600 μSv) and cosmic rays (300 μSv), with the remainder from radionuclides within the body and from inhalation of radon progeny.

Australian radon results are at the low end of the range of figures collected worldwide (world average 40 Bq/m^3). Variables include geology, building materials, building design, ventilation, and lifestyle. The main variables with gamma exposures are the geology and building materials (e.g. concrete).

Health Effects

The health risk from exposure to radon is associated with the inhalation of radon and the short-lived radon decay products (radon progeny). The inhalation of radon and progeny (emitting alpha particles) has been linked to lung cancer. The more radon and progeny there are in the air, the bigger the risk. Similarly, the longer we spend breathing in radon, the greater the risk. The radon

♣ The Australian average effective dose has been revised down from 1.8 mSv to near 1.5 mSv/yr through the use of an updated conversion factor for radon exposure. The radon exposure is now estimated to be about 0.2 mSv per year.

lung cancer risks are generally consistent with a range of about one to two fatalities in a million per Bq.m^{-3} [3, 5].

Exposure Benchmarks

The Australian Radiation Protection and Nuclear Safety Agency and National Occupational Health and Safety Commission [4], recommend a radon action level for concentrations exceeding 200 Bq/m^3 in dwellings (based on an occupancy of 8000 hours/year) and 1000 Bq/m^3 in workplaces (based on an occupancy of 2000 hours/year). In the United Kingdom, the recommendations are an action level of 200 Bq/m^3 for simple remedial action in homes and 400 Bq/m^3 in workplaces [5]. While the United States Environmental Protection Agency recommends an action Level of (4 pCi/L) 148 Bq/m^3 [6]. The World Health Organisation proposed a reference level of 100 Bq/m^3 (2.7 pCi/L) to minimise the health hazards due to indoor radon exposure [7].

Building Radiation Monitoring

The radon monitors were supplied and analysed by the Australian Radiation Protection and Nuclear Safety Agency laboratory, Melbourne [8]. The monitor consists of a radon track detector and a gamma radiation thermoluminescent dosimeter, contained within a small plastic jar. The jar acts as a diffusion monitor allowing the radon to enter and decay. The alpha emissions damage the (CR-39) plastic, which is etched and the number of alpha tracks counted with the aid of a microscope. The number of alpha tracks is related to the radon concentration. Each monitor also contained a thermo luminescent dosimeter (TLD, $CaSO_4$(Dy)) for the measurement of the external gamma-ray radiation. The TLD results are reported as effective dose.

Radon and gamma radiation monitoring across the University occurred on 6 occasions between 1991 and 2008. A total of 138 monitors were used, in approximately 65 buildings. A summary of results are outlined in Table 1 [9]. The radon monitors were located in areas that people would access regularly, especially basements, rooms/offices cut into or below natural ground level, or the lowest level in the building. The range of buildings provided variations in building design and type of ventilation system – from simple offices to workshops and laboratories, single to multi-storey, operable windows to fully air-conditioned.

Although building renovations over the years prevents an in-depth analysis of building type and ventilation system, some generalities are provided in Table 2.

Of particular interest to our survey, was a library basement (containing books) that is regularly accessed by staff, students and visitors. This location was chosen for real-time radon monitoring during a 10 day period in November and December 2009. The equipment used was a SARAD radon-222/radon-220 (radon/thoron) monitor, (model number RTM 1688-2, serial number 078/05/08, calibrated September 2009), on loan from the Australian Radiation Protection and Nuclear Safety Agency and operated with their assistance [10]. The monitor is an active radon monitor (operating in slow mode), drawing air into the chamber for several minutes then using a semiconductor detector to measure short-lived radon progeny produced inside the measurement chamber.

Radon concentrations in buildings can vary throughout the year and are often higher in winter. A long term (twelve month) measurement may give different average radon levels compared to active radon monitors.

Radon Monitoring results and discussion

The radon monitoring results are summarised in Table 1.

The major factors that influence the radon level at the ANU are location above or below ground level, building material (commonly concrete construction) and ventilation. The ventilation, in terms of the amount and duration of fresh air supply, is greatly influenced by the cyclic nature of a building's air-conditioning management system or occupant's use of windows. As expected, locations below ground, of concrete construction and minimal ventilation have higher levels of radon. A radon concentration higher than that found in typical ACT brick veneer homes (14 Bq/m^3 [1]) is therefore not unexpected.

Table 1: The survey results for radon

Year	**Number of monitors**	**Radon concentration (Bq/m^3)**
1991/92	45	15 - 255 Bq/m^3 of air, (average 51 Bq/m^3)
1993	17	8 - 297 Bq/m^3 of air, (average 76 Bq/m^3)
1994	20	9 - 179 Bq/m^3 of air, (average 50 Bq/m^3)
1997	14	14 - 178 Bq/m^3 of air, (average 52 Bq/m^3)
2003/2004	22	10 – 427 Bq/m^3 of air (average 92 Bq/m^3)
2007/2008	20	14 – 412 Bq/m^3 of air (average 80 Bq/m^3).

Note: The accuracy of the results is in excess of ± 20 %. Radon levels have been corrected to account for storage and transport time.

The effects of ventilation can be seen in table 2. In general terms, the laboratory buildings have higher ventilation rates compared to that of office buildings. In a Library, the density of people is typically lower than that of office buildings and this can be reflected in a reduced fresh air intake rate.

Table 2: Summary for building types

Building type #	Average Radon Concentration (Bq/m^3)	Average gamma radiation levels (μGy/year)
Library	68	1025
Office buildings	40	865
Laboratory buildings	36	830

This table provides results of normal or typical buildings, excluding basements or areas of concern due to high radon concentrations.

The annual monitoring results of the library basement are given in table 3. The ventilation system was designed to operate 24 hours a day, 7 days per week, with 200 L/s of outdoor air. The fresh air ventilation rate was based on an occupancy of 10-12 persons and 10 L/s per person (as suggested by Australian Standard AS 1668:1991). Current Australian Standard [12] ventilation rates would require around 480 L/s [1].

The latest results (2003/04 and 2007/08) highlight the difference that can be expected if the ventilation system is not operational or effective. The 2003/04 increased radon concentration was a result of a significant ventilation problem (closed fresh air dampers), leaving the basement with no fresh air supply for a long period. A continuation of elevated radon in the 2007/08 period required further investigation. Again a ventilation failure was suspected.

Table 3: Radon results in the library basement

Library Basement	Radon concentration, Bq/m^3
1991/92	164
1993	187
1994	179
1997	178
2003/04	427#
2007/08	393, 412

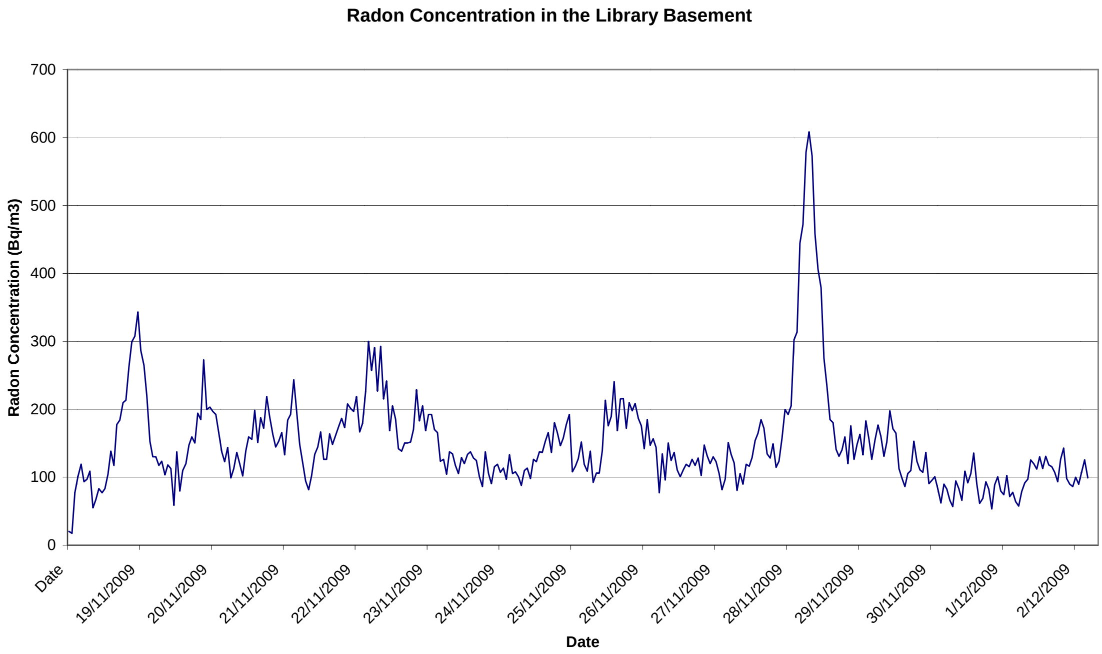
A ventilation problem occurred during the monitoring period, leaving the basement with almost non-existent fresh air supply for a long period.

The investigation of radon concentration over a 2 week period (shown in Figure 1) indicates the variation with radon permeation and radiation decay. The average radon concentration over the monitoring period was 150 Bq/m^3, consistent with the long term radon monitors.

There was one particular high radon peak of around 610 Bq/m^3 (@ 5 pm) which occurred on a weekend. On that Saturday, there had been a (planned) power outage to the building for most of the day. The power outage had caused the ventilation system to shut down, allowing radon levels to increase in the basement. The lack of ventilation and its impact can be seen in an almost tripling of the radon concentration and then its return to normal levels upon the resumption of the ventilation system and fresh air. This incident was useful to show the importance of good ventilation in the library basement area.

[1] According to Australian Standard 1668.2:2002 [12], Table A1: for libraries 5 m^2 per occupant, recommended dilution index for a grade 2 amenity = 5. Basement floor area = 482 m^2 (plus 194 m^2 plant rooms etc). Therefore by floor area = 96 people @ 5 L/s = 480 L/s

Figure 1 Radon concentration in Library basement Nov/Dec 2009



Each individual data point has a 14% error range which is calculated with a 95% confidence limit. The overall average radon concentration is 150 Bq/m^3 ± 74 Bq/m^3.

If the basement ventilation system was to be improved to current Australian Standard requirements, then achieving 400 L/s would impose an additional 2.8 kW load on the cooling system in summer and 5.6 kW load on the heating system in winter [13]. Hence doubling power consumption! This increase in energy concerns building owners, operators and those concerned with reducing energy costs. Reducing ventilation system airflows to reduce energy consumption would increase radon exposure and health concerns. As the ventilation system is the only means of reducing radon concentrations in large concrete buildings/basements, occupational hygiene principles need to be considered before a ventilation system is modified.

Gamma radiation results -

The survey results for Gamma radiation were in the range -

Year	**Gamma radiation levels per year**
1991/92	490 - 1390 µGy (average 900 µGy)
1993	600 - 1740 µGy (average 1105 µGy)
1994	810 - 1640 µGy (average 1140 µGy)
1997	523 - 1574 µGy (average 1025 µGy)
2003/04	52 – 481 µGy (average 262 µGy, range 53 - 482)
2007/08	561 – 1253 µGy (average 887 µGy)

Note: Gamma radiation levels have been adjusted to give the Absorbed Dose per year, taking into account the storage and transport time.

ACT median external radiation dose is 1.1 mSv/yr [1].

Variations in the readings and some of the high values can be accounted for by the proximity of the monitor to slightly higher activity materials, like concrete which contains minerals and uranium. The significantly lower results for the monitoring period 2003-2004 could not be adequately explained, but instrumental or human error have been ruled out.

Conclusion

The radon concentrations measured for the majority of University buildings are below the recommended Australian action level for radon within residences, and no University building exceeds the Australian action level for radon in workplaces. Although some buildings exceed the World Health Organisation reference level for radon of 100 Bq/m^3 [7], they should not be considered a health risk, allowing for the reduced exposure related to the portion of time spent in these areas (8 hours out of 24, or 24 % of the total week, or less).

Gamma radiation exposures are typical of the ACT environs.

Of the buildings/areas of interest (including the library basement) that recorded higher (than typical) levels of radon, changes were considered. Recommendations/suggestions included:

a) Ventilation system converted to manual operation – removing the ability to remotely vary system parameters.

b) Outdoor fresh air dampers interlocked with the fan ensuring that fresh air is supplied when then fan is on.

c) Ventilation system fans to run 24 hours a day, 7 days per week.

d) Disabling the ventilation system's economy cycle.

e) When (if) the area is renovated, the ventilation system is to be improved.

Monitoring is expected to continue in future, particularly in new buildings and those of interest.

Over the years, many of those areas have been renovated, closed or their function altered. Of the factors that influence radon concentration, ventilation is the easiest to influence in older buildings. Obtaining important information about the radon concentration can be useful in influencing changes to a ventilation system's performance or preventing a system being detrimentally modified in order to save energy/money. In that way, a ventilation system will not only provide occupant comfort but sustain a healthy workforce.

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Mobile Phones and Cancer: An Update

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Abstract

With the Publication of the Interphone study and other recent studies it is now an opportune time to take stock and review the evidence for radiofrequency radiation (RFR) exposure from Mobile phones and cancer. Exposure to RFR from Mobile phones is now common in the global population with an estimated 4.3 billion people exposed.

The Interphone study did not provide the definitive answers originally sought when first proposed in the late 1990s and as a result has still left the question unanswered as to the causation of brain tumours and RFR exposure. Some other studies have found questionable results with regard to cancer and exposure to handsets. Furthermore, recently there have been studies that have investigated cancer in children and exposure to mobile base stations, which have also had findings that have been contradictory.

The most disappointing aspect of research with regard to cancer and RFR exposure from mobile phones is the lack of occupational studies. The usual practice of our traditional approach in occupational and environmental epidemiology was for researchers to seek out and study highly-exposed occupational groups. This has not been undertaken in the Mobile phones and health context probably due to methodological difficulties.

Benefits Realisation through Health Risks Management

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Abstract

Work being an economic activity, businesses will want to ensure an "acceptable" financial return on their investment. In order to maximise the financial return, every business will want to deliver their "work" in the most efficient way and expect the payback period to be as short as is practical. Hopkins points out that "any attempt to argue that safety pays must specify for whom. Unless we can identify a relevant decision maker for whom (health and) safety pays, the argument has no capacity to motivate action to reduce injury and illness." A report of the AIHA has proposed a model to demonstrate business benefits of industrial hygiene intervention. It is termed as the Industrial Hygiene (IH) value. This paper summarises the IH value and then describes frameworks, signposts and practices that are helpful for demonstrating the IH value of a proposed IH intervention. In addition it will use a case study to provide a practical demonstration of the issues discussed.

Introduction

Work being an economic activity, businesses will want to ensure an "acceptable" financial return on their investment. In order to maximise the financial return on investment (ROI), every business will want to deliver their "work" in the most efficient way and expect the payback period to be as short as is practical. Many companies use 3 times or 300% as an acceptable ROI.

ROI = (Amount earned from the investment/cost of the investment) x 100

Payback period - refers to the time required for the return on an investment to "repay" the sum of the original investment. It could be 1, 2 or many years.

Hopkins (1999) points out that "any attempt to argue that (health and) 'safety pays' must specify for whom. Unless we can identify a relevant decision maker for whom (health and) safety pays, the argument has no capacity to motivate action to reduce injury and illness."

The American Industrial Hygiene Association (AIHA) report - Demonstrating the Business Value of Industrial Hygiene" - puts forward the argument in another way. "A financially-oriented value proposition that speaks to critical business issues and that includes specific numbers or percentages is now almost a requirement for obtaining funding for many projects and programs. Those who lack such a business case will quickly lose ground to those who have one. Making the value proposition for IH strengthens the moral argument for protecting workers."

The IH value model and many of us (Hopkins, Veltri et al, European Agency for Safety and Health at Work) argue that benefits realisation goes beyond the financial ROI. Benefits realisation means to me: demonstrating (to the "purse holders") the value, results or benefits of an investment on a given product, service, project or an intervention. To demonstrate the IH value, one should take account of economic and financial ROIs and other business desirable values or benefits.

In other words, an IH intervention should aim to deliver the company's acceptable level of ROI and (or) it should clearly demonstrate other benefits that would meet or help to deliver the business objectives of the company.

Let me relate benefits realisation by using "Industrial Hygiene (IH)" as an acronym.

3i's 4 H.

- ✓ Indentifying hazards, assessing risks and opportunities
- ✓ Innovating for sensible risk management
- ✓ Initiating the implementation of practical solutions

4 (for)

Harvesting the benefits

Therefore, our job is about: preventing or minimising health risks to workers arising from work activities as well as making contributions to the business objectives to bring positive benefits to the organisation.

It means our work should include the assessing, devising and delivering the business case for risk management. Therefore, our job goes beyond making the moral case and enabling compliance with legal requirements.

IH Value

AIHA report has proposed a model to summarise the business benefits occupational hygienists can bring to a business. It is termed as the "IH value".

The elements and their relationship leading to the IH value can be summarised as:

"Pre IH intervention costs" (A) – "Post IH intervention costs" (B) = "Reduced costs" (C)

Reduced costs (C) – IH costs (D) = Net Savings (E)

Net Savings (E) + New Revenue (N) + Other benefits (O) = IH Value

Pre-industrial hygiene intervention costs (A): These relate to costs of producing the goods or services whilst the risk is not prevented or adequately controlled. It can include costs associated with materials, product rejection, product rework, maintenance, equipment, wastes, energy such as gas and electricity, labour, injury, sickness absences, recruitment, training, compensation, insurance, incident investigation and enforcement related costs.

The post IH intervention costs (B) will reflects the costs of producing the goods or services after the IH interventions. A-B delivers reduced costs (C). The cost associated with B can be from reduced unit cost such as increased production rate with new machines, technology and product design; from longer life span for machines and equipment; energy savings, less waste and disposal costs; cost reduction through less absenteeism, operator efficiency through training; reduced compensation claims; reduced staff turnover and associated training/induction costs, reduced numbers of incidents and investigations; decrease in insurance premiums; less health surveillance costs etc.

Reduced costs (C) – IH costs (D) = Net Savings (E)

In order to establish the net savings (E) we need to deduct the cost of IH costs (D) that helped to implement the IH intervention for sensible risk management. IH costs will include salaries, monitoring costs, design costs and other IH related overheads.

So, we should know and manage efficiently our IH costs associated with a proposed IH intervention. Here, I would like to make a remark. Do not consider IH as an overhead or a service unit, but as a benefit delivery unit.

Net Savings (E) + New Revenue (N) + Other benefits (O) = IH Value

New revenues include increased sales (new customers, winning back lost customers through improved reliability and quality), revenue through reduced interest rate payment; appreciation in asset value such as shares.

Other Benefits (Business Value)

Some of these are difficult to quantify but estimates could be made for some aspects. Reduced potential for enforcement actions based on previous experience or existing case studies; product quality improvements, improved industrial relations; retention of key people, employees' positive perception of exposure control; improved customer relations; positive customer satisfaction surveys; improved public relations; increased respect from trade bodies and competitors; improved investor confidence, innovation leading to other opportunities, increased potential for leverage; reduced environmental impacts; reduced carbon imprint; reduced bad publicity; considered as a good neighbourhood employer; ability to link exposure monitoring data to ill-health or health monitoring data (e.g. total dose, no deterioration on a health monitoring marker); recognition through industry awards; competitors emulating your approaches.

To put it simply, financial ROI from IH intervention + Other benefits deliver the IH Value. In summary, when we are proposing an IH intervention, we should be clear about the costs and business benefits associated with it.

Suggestions for Demonstrating IH value and Winning arguments

Having provided an introduction to IH value, let me describe a framework, "signposts" and practices for helping us to demonstrate the IH value and win arguments. The framework, signposting and practice propositions I am going to list may not be comprehensive and may not be applicable in every situation. However, they provide a foundation for developing and demonstrating the IH value in a given situation.

IH value and Framework

Framework 1: Be familiar with company business processes, business/operational objectives and key drivers. Having these knowledge will help in making the case.

Framework 2: Know and document the cost of occupational hygiene interventions. Establishing a database on cost is useful for making value cases in the future.

Frame work 3: Be familiar with a number of economic and accounting terms and the company accounting processes and models. For example: what data are required, how to calculate ROI and the company guidance for calculating ROI, payback period, net present value, net cash flow, cost-effect analysis and cost-benefit analysis.

Be familiar with internal and external guidance in this area. (e.g. HSE's guidance on cost-benefit analysis). These are needed for the quantitative assessment which forms part of the value demonstration.

Framework 4: Find out about the new revenues arising from exiting IH interventions. Collect data, quantify and maintain the information.

Framework 5: Establish/estimate what other business benefits are arising from IH interventions already in place. These can be semi-quantitative or qualitative in nature and are helpful for future IH value demonstration.

Framework 6: Know how business value is demonstrated by other parts of the organisation to win investment and business cases. Work with others to integrate the IH intervention case as part of an operational requirement.

Framework 7: Know how to pitch the value case. For example: at a project, department, site or co-operate level. This will be influenced by things such as organisation structure, culture, reporting and financing arrangements such as funding limits, monitoring regime, authority etc.

Framework 8: Maximise the application of IH hierarchy of controls and make a relationship to the value case. It means that you will need to innovate sustainable, practical and cost effective solutions, not just LEV and PPE.

Framework 9: Work with other departments to collect and access relevant data. Develop the value case with the cooperation of the operational and finance departments. This approach helps to lessen the chances of rejection where a justifiable case exits.

IH Value and Signposts

Examples of signposts proposed here will help you to make the values case for IH interventions.

Sign post 1: Are occupational hygiene/health considerations included as part of the company policy, vision, or key objectives and in the training and development of management and people at risks as well as for the development of new products or service provision?

Signpost 2: When proposing occupational hygiene interventions, consider business factors beyond regulatory and moral compasses? If not, consider the reasons.

Signpost 3: Consider whether there is a close relationship between the proposed IH intervention and the key objectives, key performance indicators and/or leading performance indicators of the business? If not, ask the question why?

Signpost 4: Does your bidding process or the intervention plans and proposals should take account of key factors that can be associated with business objectives?

Signpost 5: Do you have a good reputation, credibility and visibility within the organisation? Think about this in terms of pan organisation, among board members or where you will get acceptance of the value case.

Signpost 6: Do you get support from other departments to develop the value cases? A Team approach is necessary for developing the value case.

Signpost 7: Understand what motivates operational managers, who are responsible for managing the risks for which you are proposing interventions. Then present the case in those terms - but briefly.

Signpost 8: Know who are the people in the board has responsibilities, keen ears and understanding for your case.

Signpost 9: Know what things will/can excite the board into actions. For example: citing the lessons learnt from a big case that is relevant to the company; potentials for avoiding court fines; prosecutions costs; revenue opportunities or cost reduction.

Making Connections and Practices

Practice 1: Help operational managers to see that the occupational hygienist can take the problem off their back and deliver the solutions. It helps to establish credibility, visibility and networking. You can be seen as an enabler and not as an overhead.

Practice 2: Do some research on cases of occupational disease, compensation costs, litigation costs (internal and external) and so on. Aggregate the data for making the value case and to avoid confidentiality and other sensitivity issues.

Collect relevant information, such as case studies on internal and external enforcement statistics; costs associated with various types of risks, adverse publicity, science behind hazard and risks. These will help to develop and support your IH value case.

Practice 3: Deliver boundary busting IH interventions. When developing risk management solutions you need to consider, (as appropriate), chemical, physical, biological, physiological and psychological issues. Avoid piece meal approaches. Demonstrate cost implications of piecemeal approaches. Engage and consult experts and develop teams that are fit-for-purpose to deliver the value case.

Practice 4: Utilise modern communication channels effectively. For example using short DVDs in canteens and for contactor induction; using models and mock-ups for behavioural changes (e.g. LEV model, RPE fit test model, gas or dust dispersion systems; skin/surface contamination and the potential for secondary and third party exposures.)

Practice 5: When designing controls, training and behavioural change solutions engage workers and users. Get involved in the planning and design stages of a project to avoid add-on control solutions. Develop and inform the cost of add-on control approaches for production, quality, and other relevant issues.

Practice 6: Use case histories to make or promote and justify the value case. Examples include where senior managers have had to devote time on H&S issues unnecessarily, money spent on managing and investigating an incident; people suffering from ill-health or injury and the consequences.)

Practice 7: Time it right to present the value case. For example not when the share value is falling or production department has lost a major order. Understand what are the hot topics and priorities of the Board.

Practice 8: The best way to engage the Board is not by hoping they see what you're doing and think it's great. You have to get in front of them and tell them why it's essential. The approach and tactics should be matched to the company culture and procedures. You need to make sure that they understand that you add value to the business.

Practice 9: Find a supporter in Board or where decisions are made on IH interventions.

Practice 10: Develop informal networks.

Practice 11: Raise awareness within the business: get coverage for the issues you want to be on the agenda across the business. Use existing channels and develop innovative brands and methods. Publicise success stories widely. Others should know that IH interventions add value to the business.

Practice 12: Maximise the use of the “AIDAR” approach in IH intervention. (AIDAR – awareness, interest, desire, action and review)

Conclusion

There are numerous approaches to getting the message and the value case across the intended audience. There is no magic bullet. The trick is to use approaches that work best at different times, situations and in different companies.

In big companies occupational hygiene and the intervention costs can appear insignificant when compared to other business costs. In these situations ethical, moral, case studies and legal arguments can work. Otherwise break it down to cost centre levels where the intervention is necessary.

In summary, we are passionate about health and safety. But, always remember: Science is important. Marketing is critical for delivering the business case.

Case study

A case study from a brick making facility will be presented to demonstrate the relationship in a practical way.

Acknowledgements

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A Consultative Process to Manage Hazardous Manual Tasks - Practicing what we preach!

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Abstract

Musculoskeletal disorders arising from performing hazardous manual tasks continue to represent the majority of lost-time injuries and compensation claims in all industries, including mining. Until recently, mining specific guidance material on managing this hazard was not easily accessible, nor widely adopted. During 2007, several investigations into the extent of this issue were undertaken around Australia. In WA, Resources Safety initiated a review of accident and incident data to identify major causes of musculoskeletal disorders. The aim was to identify and develop of an effective approach to assist the industry to reduce the incidence of musculoskeletal disorders in the future. This paper will describe the consultative process with other Australian jurisdictions and the WA mining industry, as well present the recommendations made from the initial review and explain how the consultative process that followed focused implementation of these recommendations.

Keywords: *manual handling, manual tasks, musculoskeletal disorders, strains and sprains, occupational overuse syndrome, risk management*

Introduction

Musculoskeletal disorders arising from performing hazardous manual tasks continue to represent the majority of lost-time injuries and compensation claims in all Australian industries, including mining. During the 2006 Mine Safe Roadshow WA's Resources Safety highlighted the need for improved risk management of this hazard because it continued to be the most frequent and significant injury reported (Resources Safety, 2006). Its significance was measured in terms of total numbers of people injured; incidence and frequency rates; as well as length of time employees were unable to return to work. In addition to the impact of the injury on the employee, there are also a number of detrimental impositions to industry; productivity losses, medical and compensation costs and diversion of administrative resources from other tasks.

In spite of the recognition of the problem by industry, unions and the regulator, there was a distinct scarcity of relevant and current guidance on how to identify, assess and effectively control this hazard in mining. Indeed there is no specific reference to manual handling or management of hazardous manual tasks in the WA legislation (Mines Safety and Inspection Regulations, 1995).

In August 2007, The National Standard for Manual Tasks (2007) and the National Code of Practice for the Prevention of Musculoskeletal Disorders from Performing Manual Tasks at Work (2007) were declared by the Australian Safety and Compensation Council (ASCC). The aim of the revised standard and code of practice was to prevent injuries that may be caused by performing manual tasks at work by setting out ways to identify and manage risks for all industries across Australia. The Code of Practice is a voluminous document describing generic activities for the majority of industry groups in Australia, and there was a perception by several occupational health specialists that it lacked relevance to the WA mining industry.

At the outset of this project, it was obvious that manual tasks represented a significant problem and that existing industry support and guidance had not been effective in reducing the extent of the problem in WA's mining industry. As Resources Safety did not employ any ergonomists, we decided to contract an ergonomist to undertake a scoping study to identify the highest priority tasks for which efficient management practices could be devised with aim of significantly reducing the incidence of musculoskeletal disorders in mining.

We anticipated the project would run through four distinct stages, outlined below. Even though stakeholder consultation was an intrinsic component of each stage of the project, steps 2 and 3 are discussed separately purely to demarcate a description of the process from the products.

Step1. The Independent Expert Review of the Issue (Scoping Study)

- Analysis of Injury/Accident Data
- Review of Information
- Consultation
- Conclusions and
- Recommendations

Step 2. Implementing Recommendations (The Process)

- Stakeholder Consultation

Step 3. Implementing Recommendations (The Products)

- Simple Basic Guidance
  - Fact Sheets
- Useful Tools
  - Risk Assessment Tools
  - Risk Management Tools
  - Training Package
  - Regulatory Audit Tool for Self-Audit
- Stakeholder Review and Endorsement

Step 4. Engaging ALL Stakeholders to Adopt a Participative Ergonomic Approach (the Future)

STAGE 1: THE SCOPING STUDY

The scoping study entitled "Manual Handling Review of WA Mining industry Project" is summarised below and is available from the Resources Safety homepage at http://www.dmp.wa.gov.au/documents/Reports/MSH_FS_ManualHandling_ScopingStudy.pdf

Analysis of Injury/Accident Data

The major findings of the review of accident and injury data reported to Resources Safety and stored in the AXTAT database, and compensation figures provided by WorkCover WA, confirmed the extent and severity of the problem in the WA Mining industry. It found that:

- Injuries from performing manual tasks consistently account for approximately 1/3 of all new LTIs and DIs and over 50% of all injury recurrences.
- About 2/3 of these LTIs and DIs and 90% of these recurrences are serious (14 or more days/shifts lost).
- These injuries account for nearly 40% of all LT injury compensation costs and for approximately 45% of the total days lost from workplace injuries.

LTI - Lost Time Injury, requiring absence from work for a full shift
DI - Disabling Injury, unable to work usual job any time of shift/alternate duties

Review of Information

A review of existing literature and information sources indicated that:

- Musculoskeletal disorders from performing manual tasks in mining workplaces are a significant occupational safety and health (OSH) issue worldwide.
- Known manual task risk factors in the mining industry include:
  - handling heavy/awkward loads;
  - working in awkward/constrained and/or sustained postures;
  - extreme workplace environments, for example hot, confined workplaces
  - exposure to vibration; and
  - the duration and frequency of tasks.
- A number of solutions for hazardous manual tasks in mining are recorded in the literature. For example; Innovative Solutions awarded by industry bodies.
- A proactive systematic risk management process of hazard identification, risk assessment and risk control is the most effective way for workplaces to manage manual task risk.
- Management commitment and worker participation in the process are essential to effectively implement the risk management process.
- A participative ergonomics approach to manual task risk management is current best practice.

Consultation during the Scoping Study

Consultation was sought with WA mining industry stakeholders through the following processes:

- A workshop with Chamber of Mineral and Energy OSH Committee representatives;
- A workshop with Resource Safety Division (RSD) Inspectors;
- A meeting with the union representative on Mining Industry Advisory Council (MIAC); and
- An article in *MineSafe* magazine inviting input to the project.

The main findings from this consultation were:

- Injuries from performing manual tasks are a major concern.
- State of knowledge of manual task risk & risk management varied widely.
- Guidance on effectively managing manual task risk required.
- Desire for more information sharing, for example a Shared Solutions Base.
- Support for an ongoing Manual Task Working Group to meet to discuss preparation, progress and site-based testing of products produced.

Other Australian mining industry jurisdictions, had also been in communication with us about projects being undertaken elsewhere. These included:

- Queensland & New South Wales joint project: Preventing Musculoskeletal Disorders in Mining;
- Earth Moving Equipment Safety Round Table (EMESRT) project; and
- South Australia's AWU project: Critical OHS Vulnerabilities: Manual Handling.

Scoping Study Conclusions

A systematic risk management process with a consultative, participative ergonomics approach is the most effective way to manage manual task risk. Although there are some existing guidance materials and tools to assist mining workplaces to implement manual task risk management systems it is indicated that there is a need for RSD to develop products for the WA mining industry. The development of guidance material and tools will be enhanced by:

- Basing products on the existing resources identified in the literature review;
- Ongoing collaboration with other jurisdictions, in particular NSW and Queensland;
- Ongoing industry consultation; and
- Including information from AXTAT and WorkCover WA on the extent and cost of manual task injuries.

Scoping Study Recommendations

Based on the findings of the scoping study a number of directions and activities aimed at reducing the extent and severity of injuries from performing manual tasks were recommended.

1. Resources Safety take a leadership role in undertaking:
   - Education and information activities; followed by
   - Compliance activities; developed in
   - Consultation with industry stakeholders.
2. Engage all stakeholders in the process facilitated by way of the establishment of a tripartite Manual Task Working Group.
3. Resources Safety to develop or modify existing information products, publishing them in a Manual Task section of the homepage. It is recommended the following information products are given priority:
   - A summary of useful references to facilitate access to existing information products
   - One to two page Fact Sheets on:
     I. Manual task terminology
     II. Extent and cost of manual task injuries in the WA mining industry
     III. Causation of MSD from performing manual tasks at work

IV. The manual task risk management process
V. The participative ergonomics approach
VI. Whole body vibration
VII. Hand-arm vibration
VIII. Reducing injury risks associated with mining equipment
IX. Safe design
X. Manual task legislation

4. Undertake manual task education activities at established forums such as the MineSafety Roadshow, annual CFMEU forums for employee representatives and other mining expositions.
5. RSD facilitate mining workplaces to implement systematic manual task risk management processes, recommending a participative ergonomics approach. There would need to be an initial period of education/information followed by compliance activities.
6. Develop or modify manual task risk management guidance material and risk assessment tools that RSD could badge and publish. It is recommended that any tools/processes developed be trialled in all Mining industry sectors.
7. Develop and administer a shared Hazardous Manual Task Solution Base.
8. Establish a formal collaborative arrangement between RSD and the Queensland Department of Mines and Energy and the NSW Department of Primary Industries on the joint project they are currently undertaking Preventing Musculoskeletal Disorders in Mining to co-develop guidance material that may be used uniformly throughout Australia, in line with the objectives of the National Mine Safety Framework.
9. Maintain an up to date knowledge of manual task literature, projects and activities within the Mining industry to ensure RSD is aware of current best practice. To achieve this it is recommended that there is ongoing collaboration and consultation with all industry stakeholders nationally and internationally.
10. RSD undertake compliance activities on manual tasks following a period of education/information. Targeted audits on poor performing companies are recommended. To assist in the audit process it is suggested a Manual Task High Impact Function Audit tool be developed and published on the RSD homepage for Industry and Inspectors to utilise. Inspectors will need education/training in order to undertake manual task compliance activities.
11. Consider the development and implementation of specific manual task legislation by way of a manual task regulation, (perhaps requiring duty holders to identify hazardous manual tasks, assess the risk and control the risk).
12. Use AXTAT information on manual task accident and injury statistics to focus regulatory activities.

STAGE 2: IMPLEMENTING RECOMMENDATIONS (THE PROCESS)

To purchase buy-in, we consulted with all of our major stakeholders to gauge and engender their support for the project. We met with them before we started, at regular intervals during the project and after each milestone that was usually defined by completion of a task or new product. From the beginning we realised that we needed to identify our stakeholders' priorities and drivers so they would engage in the project and hopefully adopt and implement it at their workplace.

It was important that we understood how to communicate effectively in a language that was meaningful for everyone in our audience. Hence whenever we met with our stakeholders we checked who the audience was for each of the products and requested that they be "tested" and all feedback be conveyed back to the group. It was acknowledged that underground bogger drivers and tradespeople have a different view on risk management compared with OSH professionals. For the message to be meaningful, the language had to mean something to our audience.

Following endorsement by MIAC for RSD to implement the first ten recommendations, a Tripartite Manual Tasks Working Group (the working group) was established. Everyone who had been involved at the initial workshops was invited to be involved in this group. By further advertising through the MineSafe magazine we invited new recruits and sought expressions of interest.

The working group comprised ten core highly motivated OSH professionals with responsibilities for managing the risk or for reducing the impact of musculoskeletal disorders on their employees. The group often comprised as many as 25 representatives attending several meetings, while another 10 to15 people followed the project's progress through meetings' minutes. Several people kindly reviewed material and gave feedback even when they were unable to attend the meetings.

In acknowledgment that members of this group were taking on additional tasks to already full workloads, the working group defined acceptable rules of engagement to establish expectations and impose appropriate limitations as necessary. They included:

- Participation in the group implied a willingness and preparedness to be involved in contributing to developing ideas and trialling products at their workplace.
- The group would meet at regular scheduled meetings, around six weekly, as long as sufficient progress had been achieved towards completing the task in focus, however delays were rarely extended beyond four weeks.
- Implementation of a sunset clause, as required and in agreement with working group members, to establish the end of the Working Group.

The working group was highly functional with an over-riding desire to keep everything as simple and brief as possible to ensure guidance produced by RSD complemented the National Standards and Code of Practice, and the materials that were being drafted for New South Wales and Queensland.

As each resource was at final draft stage, they were distributed to the working group participants for review. Several of the resources were also trialled at the representing mines seeking feedback from our real audience. This process often produced insight that the group participants were unable to predict and we believe the final products are better for it. At each stage of the project we set finite, but flexible time periods to complete tasks and would only move on with consensus.

STAGE 3: IMPLEMENTING RECOMMENDATIONS (THE PRODUCTS)

The final product is a homepage from which a number of resources are available for download. The products set out to define the issues, assist professionals to undertake training on managing the risks, as well as providing guidance on how to identify, assess and control hazardous manual tasks experienced by mining employees. The Hazardous Manual Tasks homepage is available from the Occupational Health page and is located at: http://www.dmp.wa.gov.au/7221.aspx . It contains the following resources:

- **The training package**: Prevention of musculoskeletal disorders from performing manual tasks in mining workplaces comprises

  - Presenter's guide
  - Principles of adult learning
  - Tips for workshop presenters
  - Workshop Plan
  - PowerPoint presentation
  - Workshop resources
  - References and sources of further information
- **Guidance for managing risks**
  - Implementing an effective program to manage the risks associated with manual tasks: Guidance for mining workplaces
  - An audit guideline and template.
- **Fact sheets**
  - Manual tasks in mining fact sheet No 1: Terminology
  - Manual tasks in mining fact sheet No 2: Extent and cost of injuries
  - Manual tasks in mining fact sheet No 3: How injuries can happen at work
  - Manual tasks in mining fact sheet No 4: Manual tasks and the risk management process
  - Manual tasks in mining fact sheet No 5: Participative ergonomics
  - Manual tasks in mining fact sheet No 6: Whole-body vibration
  - Manual tasks in mining fact sheet No 7: Hand-arm vibration
  - Manual tasks in mining fact sheet No 8: Machinery and vehicle cab design
  - Manual tasks in mining fact sheet No 9: Safe design
  - Manual tasks in mining fact sheet No 10: Occupational safety and health legislation
- **Toolbox presentations**

During the project a number of opportunities to promote these materials was provided through invitations to speak at the MineSafety Roadshows and the Chamber of Mineral and Energy's annual conference. These forums also provided an occasion to release final publications of the Fact Sheets to industry employees. During this period, we received regular highly complimentary feedback from mining employees around the state and from people working in other states who requested access to use the materials.

STAGE 4. ENGAGING ALL STAKEHOLDERS TO ADOPT A PARTICIPATIVE ERGONOMIC APPROACH (THE FUTURE)

The final stage of the project has yet to be initiated. However, it is recommended that this final stage will involve:

- Training RSD inspectors in management of hazardous manual tasks in mining
- Implementation of an industry-wide education campaign on managing hazardous manual tasks
- Establishment of a compliance policy focusing on hazardous manual tasks, for use as a driver of behaviour change within the industry
- RSD inspectors to audit mines using the Hazardous Manual Task audit tool and
- Use of AXTAT data to focus inspection campaigns for poorer performing mines
- Measure the efficacy of these efforts within five years of their implementation by comparing trends in musculoskeletal injuries with the information reported in the Scoping Study.

Discussion

The basics for a successful education program for the management of hazardous manual tasks are now completed. However, the most important part of the project, delivering the message across the industry, has yet to be implemented. The authors hope that enthusiastic and energetic champions will pick up these resources and promote them widely at their workplaces so that employees will assess their risk of exposures to hazardous manual tasks so that they change their behaviour to minimise this risk.

The project demonstrated a participative ergonomic approach, in that stakeholders were engaged at every stage. Their feedback was often unexpected but always invaluable and insightful. This approach is highly recommended.

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The Power of Healthy Community Engagement

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Abstract

Port Pirie in regional South Australia is a city and surrounding communities based on 120 years' operation of the Lead Smelter. When current company owner, Nyrstar looked to meet a World Health Organisational goal for blood lead levels in Port Pirie's children, the fundamental community obstacle was dealing with - at best apathy and at worst - anger, that 'the lead mob were preaching again'. Green Team Australia are public education and community engagement specialists, and the strategies and communications they provided for the community have now been described by Director of Public Health, SA, Dr. Kevin Buckett, as the best results for an awareness campaign he has seen. Alongside Martyn Bradfield from IPM (Injury Prevention and Management), Rowan Smith, Executive Creative Director of Green Team Australia, will share both the strategies, and the messages, that have transformed the City of Port Pirie's future.

Respiratory Protective Equipment (RPE) Practical Tools for Risk Communication through the Supply Chain

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Abstract

The Health and Safety Executive in partnership with the British Safety Industry Federation and other stakeholders* have developed a series of awareness tools, through the "Clean Air? Take Care!" campaign to raise the profile of the risks from respiratory hazards in the workplace.

One of the most effective methods of getting a safety message to end users in the UK market is through the safety and industrial supply chains. The manufacturers and distributors of RPE are in contact with large, medium and small users of RPE on a daily basis, and have a huge influence on the types of helpful information the users receive and what they select for their RPE requirements.

Many end users are not fully aware of the respiratory risks in their place of work; this is particularly true of small and medium businesses (SMEs). Therefore the "Clean Air? Take Care!" campaign has been driven by the need to improve the health and well being of workers exposed to hazardous substances in the workplace, in particular though the use of RPE.

The "Clean Air? Take Care!" risk communication campaign tools include an awareness poster to assist users when using respirators; a computerised RPE selector tool; an RPE selection leaflet - designed to be used in conjunction with manufacturers current information and future on-line tools; a toolbox presentation for safety managers and responsible persons in the workplace; and a three minute DVD for raising awareness of the workers and employers though a variety of mediums. This presentation will introduce these tools and invite the audience to be part of the solution by promoting the positive messages from the Clean Air? Take Care! campaign.

Stake holder partners:

British Occupational Hygiene Society (BOHS)

International Institute for Risk and Safety Management (IIRSM)

Institute of Occupational Safety and Health (IOSH)

International Society for Respiratory Protection (ISRP)

Safety Groups (SGUK)

Benzene exposure levels: Wastewater treatment operators: 2001 – 2009

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Abstract

Over an 8 year period 2445 personal benzene samples were collected during works conducted by wastewater treatment operators. Benzene monitoring was conducted in a number of locations along a wastewater treatment pipeline from point source to kilometres from the source. The program was introduced as an organisational due diligence process to ensure a workplace that was safe and without risk to long term health.

Monitoring has revealed that 84% of sample results are below the LOD of the analytical methodology (<1µg/sample). The average 8 hour TWA concentration for samples above the level of detection is 0.4ppm. Benzene concentration sample results range from <0.02ppm to 9.9ppm (8 hour TWA). A decrease in average benzene exposure levels over the duration of the program has been achieved.

Increases in benzene exposure levels are considered to be associated with higher benzene concentration in wastewater and activities which disturb wastewater deposits in pipelines i.e. high pressure water cleaning.

In vitro studies of ammonia absorption into skin and the influence of street clothing and personal products

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Abstract

Ammonia releases represent one of the most common types of HAZMAT incident. Little has been published on dermal absorption equilibria and kinetics, and there appear to be no systematic studies of the influence of street clothing and personal products such as sunscreen. Skin decontamination should be risk-based and this research aims to assist in appropriate decision making for first responders.

Permegear jacketed static Franz cells, heat separated pig epidermis, and a dynamic atmosphere generator were used for *in vitro* experiments in accordance with the OECD (TG428-2004) guideline. Off-gassing rates were determined with a calibrated *ppbRAE* PID. Breakthrough and residual ammonia were monitored by pH change. A range of fabrics were used representative of street clothing.

Preliminary results show that heavier fabrics (e.g. denim) may initially protect the skin from exposure but once contaminated may represent a longer-lived reservoir of continuing exposure than lighter fabrics (e.g. polyester). This effect is magnified if clothing is wet. Ammonia applied to skin at concentrations equivalent to IDLH did not significantly corrode the epidermis by microscopic examination, but may decrease barrier integrity as determined by electrical impedance.

Heavy Metal Contamination – Case Studies of Issues Encountered, Strategies for Remediation and Exposure Controls

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Coffey Environments

Abstract

Heavy metals are common throughout the mining industry; either as the primary mineral being mined and processed, as a secondary by-product, or often as a lesser non-economic waste mineral. The effects of exposure to heavy metals such as Mercury, Arsenic and Lead are well documented. The controls for minimising exposure to heavy metals are also well documented. In practice though, how well do we control exposure of personnel that are directly exposed during the mining and processing of this material? Further, when the processing plant shuts down, either for programmed maintenance or prolonged/permanent periods, how much foresight is shown in planning that shutdown to try and ensure that exposures are minimised for future human interaction with the mine or plant? This paper discusses the challenges associated with managing exposure at an operational lead mine, and removing heavy metal contamination from a decommissioned processing plant, the controls utilised, and the lessons learnt that may assist others who face similar issues.

Introduction

The term heavy metals has come to include a wide number of metals that can cause adverse health effects. Mining by its nature targets areas of elevated metal concentrations. Whatever the target metal is, it is often associated with other metals at concentrations that whilst possibly not economic, may present a health risk during mining and processing operations. This paper does not seek to discuss the health effects of exposure to heavy metals; rather it endeavours to relay operational aspects of minimising and controlling exposure related to two projects where heavy metals management has been important.

Occupational Exposure

Where heavy metals are present in the working environment, occupational exposure may occur through a number of routes, predominantly through inhalation, but also through ingestion and absorption. As airborne exposure controls become more accepted in industry, anecdotally, the contribution of ingestion is becoming an increasingly important route of exposure.

Observational monitoring of the workforce is also becoming accepted for general safety risk assessments, but is likely to become increasingly important in the context of occupational exposure, as lack of personal hygiene and non-adherence to safe work methods is often a major contributing factor to individual exposure.

Environmental Contamination

Contamination of environments surrounding industrial facilities, particularly older facilities, is often hard to quantify as there is often a lack of sufficient baseline data to compare against.

In mining areas particularly, background heavy metals in soil levels are often elevated above Health Investigation Levels (HILs). Siting of accommodation, infrastructure and recreation facilities to service mining operations should take into account the concentration of metals in soil. Operations where workers reside with their families in proximity to the mine or processing plant such as Mt Isa remind us of this need. Companies should take a holistic view of their operations to identify the type and sources of emissions and potential impacts their operations may have on their workforce, contractors, visitors and the public.

Case Study 1 – Magellan Lead Mine

Background

The Magellan Mine is a lead carbonate mine, located in the northern part of the Eastern Goldfields region of Western Australia. It consists of an open pit mining operation, processing plant, concentrate bagging, containerising and truck washing facilities, as well as ancillary workshops, offices and accommodation facilities.

Originally commissioned in October 2005, the Magellan operations were suspended in early 2007 after it was discovered that lead concentrate dust had escaped from the Port of Esperance during ship-loading and re-handling activities, leading to contamination issues in and around the port.

Magellan operations were recommissioned in early 2010 following extensive changes to the process of handling and transport of the lead carbonate concentrate.

The Problem

Whilst lead dust issues were recognised at the mine prior to the Esperance Port contamination issue, there was a perception that once the concentrate was delivered to the port, Magellan had relinquished ownership of the product. The subsequent fallout from the lead concentrate contamination included:

- Children in Esperance recording elevated blood lead levels and the associated trauma of parents and general population
- Esperance Port Authority fined $525000
- Magellan agreeing to a $9 million cleanup of the town of Esperance, plus a $1 million fund for community projects
- Significant loss of public trust for Magellan and the Esperance Port Authority
- A Parliamentary Inquiry which found that the Esperance community had been let down by the actions of the Esperance Port Authority, Magellan Metals, and the WA DEC
- Suspension of Magellan mining activities for a period of 3 years

As can be seen, Magellan operations were majorly affected by the contamination of Esperance.

The Challenge

Mining, processing and exporting lead presents challenges, particularly when there is a negative public perception of the operations involved.

Magellan had to demonstrate that they were able to mine and export lead in a manner that would minimise risk of lead exposure to workers and the general public. In particular, significant changes were required to the methods of transportation of the lead concentrate.

Control Measures

Magellan conducted an extensive review of their operations, taking a holistic approach and looking at the entire life-cycle of the product. Whilst a significant range of control measures were previously utilised on site, further controls were identified and implemented. Controls include:

- *Training* – Site personnel are given specific training on the risks associated with lead, controls in place, and how they can help to ensure that those controls are adequate and are maintained.
- *Positively Pressurised Vehicles* **–** Site vehicles are fitted with pressurising systems to prevent dust ingress into the vehicle cabins.
- *Vehicle Washdown Bay* **–** The automated vehicle washdown bay has been installed so that vehicles that have been in the lead concentrate area of the processing plant, as well as trucks transporting the lead concentrate by sea container, are washed down prior to leaving the plant area.
- *Dust Suppression* **–** Dust suppression on site mainly involves the use of water trucks on traffic routes. Water sprays are also fitted at strategic points at the crusher and ore transfer points. Recently, water misting sprays have also been fitted inside the concentrate shed to prevent concentrate from drying out and becoming airborne.
- *Extraction Systems* **–** Dust extraction systems are fitted at the Sample Preparation Laboratory and the semi-automated lead concentrate bag-filler in the concentrate shed.
- *HEPA Vacuum Cleaners* **–** Sealed HEPA vacuum cleaners are utilised throughout the site, including heavy vehicles, for removal of dust residue.
- *Segregated Clean and Dirty Changerooms* **–** This ensures that personnel do not leave work wearing contaminated clothing and contaminate their living quarters.
- *Boot Washing Stations at Exit from Processing Plant and Concentate Shed* –Personal boot washing stations are located at the exit from the Concentrate Shed and Processing Plant so that personnel do not carry contaminated material into the 'clean zone'.
- *Cleaning of Equipment Prior to Works* – Equipment that requires work to be conducted on it within the Plant Workshop must be thoroughly cleaned prior to the work taking place. This minimises risk of releasing or coming into contact with lead dust, as well as potential release of toxic fumes.
- *Containment of Lead Concentrate* – Lead concentrate is pressed, dumped and subsequently bagged in double-lined bulka bags within the Concentrate Shed. It is then stored on the adjacent concrete storage pad, prior to being loaded into sea containers and transported off-site. This minimises exposure risk for personnel not involved in the handling of concentrate on site. The 'sealed shipment method' eliminates the requirement for any re-handling of concentrate until it arrives at the end-user and eliminates the risk of emissions of lead concentrate dust during transportation.
- *Biological Monitoring Programme* – Monthly biological monitoring is conducted for all site personnel to ensure that blood lead levels (BLL's) are within guidelines. This programme is supported by a Blood Lead Level Management Process.

- *Airborne Contaminant Monitoring* – Occupational and para-occupational monitoring is conducted to determine levels of exposure and ambient levels of various contaminants throughout the site.
- *Personal Protective Equipment (PPE)* – Operational areas in processing require the wearing of full length clothing, boots, gloves, safety glasses and half-face P2 respirators (eg half face respirator fitted with P3 particulate filter and pre-filter). Concentrate handling and welding activities require personnel to wear PAPR respiratory protection and disposable coveralls. Mining personnel are required to wear half-face P2 respirators at all times that they are outside of their vehicle in an active mining area.

Of these control measures, the major changes have been the installation of the Concentrate Shed, including the semi-automated bagging plant and water misting sprays, the automated vehicle washdown bay, and the introduction of the 'sealed shipment method'.

Lessons Learnt

There are a number of lessons that have been learnt from the challenges that Magellan has faced and continues to face. In no particular order, these include:

- Whilst they have instituted significant exposure controls, the BLL results recorded at Magellan have highlighted that personnel within a similar exposure group (SEG) can have vastly different BLL's dependent on their own work habits and personal hygiene.
- PPE requirements need to be appropriate and reviewed for applicability. Extended periods of wearing half face respirators in particular can lead to operator discomfort, rashes, extra heat burden and discontent.
- Installation of the Concentrate Shed resulted in far greater containment of the lead concentrate, however it also introduced other hazards such as carbon monoxide and diesel particulate exposure, and high lead concentrate dust levels that bagging personnel were exposed to.
- Failing to identify emissions at all stages of mining, production and transport has far-reaching consequences.
- Responsibility for the product does not finish at the mine gate. To this end Magellan have increased product governance, including visiting and liaising with customers on product handling.
- Open communication with regulators can result in greater awareness and appreciation of risks.
- Negative public perception can give rise to being a non-preferred employer. This is increasingly important in a tight labour market.

Case Study 2 – Nimbus Silver Mine

Background

The Nimbus Silver Mine is located east of Kalgoorlie. Mining was carried out utilising conventional open pit techniques. The first phase of mining took place in oxide material, and the second in the supergene mineralisation. The supergene material, as well as containing high silver concentrations, also hosted significant quantities of native mercury. This resulted in mercury vapour release during the mining and processing of this material. In addition to mercury, other heavy metals such as arsenic and lead were present at significant levels in the ore.

Processing was undertaken on a 24 hr per day continuous roster, processing at a rate up to 20 tonnes per hour through the mill, which consists of crushing, grinding, leaching and cementation circuits.

The processing plant was placed on care and maintenance in December 2006 at which point all ore had had been milled. The refining of cementate and amalgam ceased in May 2007.

The Problem

Whilst Nimbus had been decommissioned, mercury vapour levels in and around the processing plant remained elevated, with native mercury evident in certain areas of the plant, particularly around the refinery scrubbers and retort area. This represented a potential hazard to the on-site caretaker, as well as to site visitors.

The Challenge

The scope of the project was to initially identify and evaluate sources and levels of mercury vapour at the mine, and to subsequently undertake project supervision and mercury monitoring during site remediation. Site remediation was intended to render airborne mercury vapour levels as low as reasonably achievable.

The challenge was to conduct the remediation works in as safe a manner as possible, knowing that there was going to be a high level of risk associated with exposure of cleanup personnel to mercury, as well as to arsenic and lead; that the processing plant was in a moderate state of disrepair; and that temperatures were in the low 30's with personnel wearing TYCHEM suits.

Control Measures

To conduct the works safely, a number of control measures were utilised.

Elimination

The primary goal of the project was to remove the major sources of mercury vapour at the site.

Significant quantities of native mercury were removed from sumps, beneath and around refinery scrubbers, laboratory sink traps and the mercury retort spill trap. As well as visible native mercury, identified sources such as refractory lining of the smelting pot, residual material on the filter press and solidified flocculant were removed.

Collection of native mercury was either by syringe or dust pan and window wiper, or in the case of lab sink traps, direct removal and direct collection, whereupon the mercury would be placed in a bucket of water. The dust pan and window wiper proved to be the most effective method for flat areas such as concrete floors and sumps, while syringes were useful in hard to reach locations.

Removal of contaminated material was conducted using a combination of high and low pressure water spraying, followed by vacuum removal.

Isolation

Isolation controls used during the cleanup consisted of the following:

- Remotely controlled ultra-high pressure water blasting of the refinery smelting pot. This was done to remove the refractory lining of the pot, and had the secondary result of removing degraded roof sheeting
- Isolation of mercury sources. Examples included cementing the base of the flocculant storage vessel and containment of collected native mercury in the site mercury storage vessel under a layer of water.

Administrative

Personnel involved in the site works were given an induction followed by a tour of the site where they were shown visible native mercury, where it was expected that quantities of native mercury would be present and examples of other hazards such as loose piping and sheeting. The induction included the risks associated with mercury exposure, mercury exposure standards, safe work methods that were to be adhered to during the course of the works, mercury vapour monitoring that was to be conducted and decontamination procedures and facilities. It was reinforced during the induction that failure to adhere to safe handling procedures and incorrect wearing of PPE would likely result in high level mercury exposures due to the nature of the work. This was supported by ongoing supervision.

Daily pre-start meetings were held to discuss work to be conducted, address any concerns raised, controls to be implemented and areas/tasks where mercury levels were likely to be high.

Instantaneous mercury readings were taken throughout the cleanup using a Nippon Instruments EMP1A Mercury Analyser, a cold vapour atomic absorption (CVAA) method analyser which was highly portable and simple to operate.

Personal Protective Equipment (PPE)

PPE included Protector Airflow PAPR respirators fitted with P3 mercury cartridges (APF 20), Tychem suits for liquid and vapour resistance, rubber gloves and boots.

Lessons Learnt

The induction, site familiarisation and daily pre-start process were extremely important in addressing any concerns that the cleanup crew had with conducting the work. They had to be comfortable with doing the work, knowing the risks and knowing the controls.

Mercury has a strong affinity to steel. It will retreat into the steel during cold weather and come out as it heats up. Cleaning the steel can actually increase the mercury levels as it 'opens up the pores of the steel' as the agglomerated crust is removed. This also applies to other surfaces such as concrete.

Native mercury is not easily or readily absorbed or adsorbed; in fact it appears to be repelled by everything it comes in contact with. However, dusting cleaned areas with zinc powder was effective at reducing mercury vapour levels, likely forming a less volatile amalgam with residual native mercury.

If something isn't working, such as removing the solidified flocculant with water, the sooner that process is stopped the better. It wasn't recognised initially that the flocculant was contaminated with finely dispersed mercury. Moving to non-dispersive physical means such as shovelling or vacuum removal of this material reduced mercury levels significantly.

Focussing on one contaminant can increase the risk of ignoring others that may be just as important. In this particular case, the focus was heavily on mercury, whilst arsenic and lead also presented considerable risk.

Maintaining hot and cold running water is essential for personal hygiene. A pump failure during the cleanup for a short duration had the potential to increase the risk of heavy metal ingestion of the work crew. A hot water system also had to be replaced prior to the work being undertaken to service the shower facilities.

Industrial cleaning contractors can often be exposed to heavy metals and other contaminants during the conduct of their work. Companies need to provide information, instruction, training and supervision for this group of workers appropriate to the task that they have been hired for.

Planning of shutdown and remediation activities needs to address all hazards, including exposure to heavy metals, and the provision of adequate facilities and resources to make the safe conduct of the works possible.

Regulators are generally happy to assist. The methodology for this project was reviewed and partly amended through consultation with the Western Australian Department of Mines and Petroleum - Resources Safety Division. As a result, this particular processing plant is likely to be returned to service, representing the recycling of a valuable asset.

Blood Lead levels in Industry

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Abstract

In 2009 the National Health and Research Council (NHMRC) recommended that all Australians should have a Blood Lead Level (BLL) below 10 µg/dL. However, little has been published regarding historical occupational BLLs in the Australian Lead industry. The current national standard is 30 µg/dL and it is known that occupational BLLs were historically in excess of this limit. The reduction in BLLs over time in Australian children has been documented but not in Australian industries. Historical information regarding BLLs in the Australian industry would be useful for epidemiological studies investigating the association of Lead and cancer.

Methods

We conducted a retrospective cohort study of lead workers in NSW and Victoria. The cohort was assembled from government archives of regular blood lead level (BLL) monitoring required for those working in scheduled lead processes by government regulation during the periods 1980 to 1989 and from 1990 onwards. The information was scanned from the original hard copy records and entered into an electronic database. The industries in which each subject worked at the time of monitoring were coded according to the Australian Standard Industry Codes. For many subjects, more than one BLL was recorded.

Results

The cohort consisted of 7168 workers. Geometric mean (GM) BLLs for Battery Manufacturing (N=287 workers) fell from 41.5 µg/dL from 1980 to 1989 to 23.0 µg/dL after 1990. In Non-ferrous Metal Casting (N=111) BLLs fell from 40.0 µg/dL to 36.2 µg/dL and for Copper, silver, lead and zinc smelting and refining (N=104) BLLs remained virtually unchanged from 30.5 µg/dL compared to 30.6 µg/dL. GM BLLs were determined in 68 industrial classifications.

Discussion

We found in an historical cohort of workers in the lead industry that GM BLLs fell in most industrial categories for the years 1980-1989 compared to 1990 onwards. However, some industries continued to exceed the current national standard of 30 µg/dL. The introduction of Lead regulations in the late 1980s may have in part contributed to this decline in BLLs. These BLLs will be used to assess associations with cancer incidence and mortality in the cohort.

Biological Monitoring to Assess Exposure to Isocyanates

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Abstract

Isocyanates are extensively used in industry particularly in two-pack spray paints, polyurethane and glues. They are highly reactive chemicals and can cause respiratory sensitisation. The measurement of isocyanate-derived diamines has been widely used to assess occupational exposure to isocyanates and the Health & Safety Executive (HSE) proposed a biological monitoring guidance value for isocyanates of 1 µmol isocyanate-derived diamine mol^{-1} creatinine. In this study, a liquid chromatography tandem mass spectrometry (LC-MS/MS) method for determination of the diamines has been developed to enable the assessment of exposure to hexamethylene diisocyanate (HDI), toluene diisocyanate (TDI) and methylene-diphenyl diisocyanate (MDI).

Our analytical method is capable of detecting down to 0.50 µmol isocyanate-derived diamine mol^{-1} creatinine. The average recovery was 97-110% and the calibration graph was linear with very good correlation coefficient (r^2 > 0.999) in the concentration range of 0-20 µg/L urine. The method was applied to urine samples collected from workers who worked in car smash repair garages and were exposed to hexamethylene diisocyanate (HDI). Air monitoring was performed at the same locations to compare to the biological monitoring results. The results indicated that the biological monitoring method gave a more sensitive assessment than the established air monitoring method.

This is the first time that a test for urinary isocyanates has been offered on a routine basis by an Australian laboratory and illustrates the use of the latest technology of an LC-MS/MS.

Introduction

Isocyanates are extensively used in the automotive industry and in the manufacture and application of polyurethane. The most commonly used isocyanates are hexamethylene diisocyanate (HDI), toluene diisocyanate (TDI) and methylene diphenyl diisocyanate (MDI) and structures appear below in Figure 1.

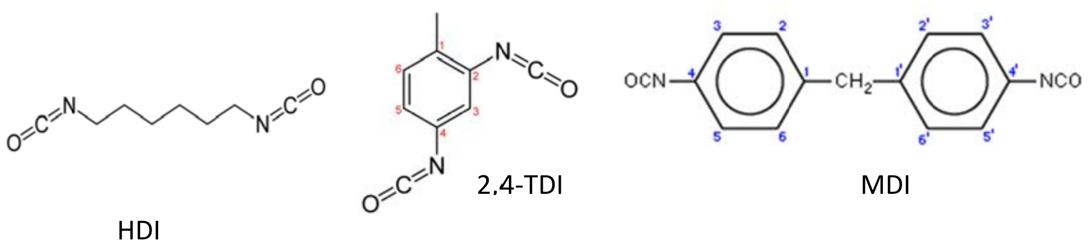

Figure 1. The chemical structures of hexamethylene diisocyanate (HDI), 2,4-toluene diisocyanate (TDI), and 4,4-methylene diphenyl diisocyanate (MDI).

HDI is used in two pack spray paints while TDI and MDI are used in the manufacture of polyurethane foams, floor coverings and adhesives. It is well known that these chemicals can cause respiratory sensitisation and asthma [1]. The measurements of these chemicals in air is problematic as there are no standard reference materials available of the oligomers (ie., isocyanurate, biuret, uretidone) of the isocyanates which make up a large proportion of the pre-polymer mix used. Studies have shown that skin absorption is a significant route of exposure to these chemicals particularly the less volatile isocyanates such as MDI [2-4]. However, the mechanisms are still unclear of to how the dermally absorbed isocyanates can lead to respiratory sensitisation and research is ongoing in this area [5-7]. Nevertheless, most isocyanates are skin sensitisers so skin exposure should be avoided in any case. Currently, health surveillance of respiratory symptoms is the only means of detecting excessive exposure of an individual. The development of this urine test is an effort to try and control exposure before symptoms arise and can be used to assess the efficacy of personal protective equipment and individual work practices. The method uses the latest technology (UPLC-MS/MS) to be able to detect very low levels of the metabolites of the isocyanates. The method was verified by collection of urine samples from car smash repair workers who were exposed to HDI. Air monitoring was also performed at the same location in conjunction to the biological monitoring for comparison purposes.

Experimental

Chemicals and reagents. 2,4-Toluene diamine (CAS 95-80-7) and 2,6-Toluene diamine (CAS 823-40-5) were obtained from Sigma-Aldrich (St Louis, Missouri, USA). Hexamethylene diamine (HDA) (CAS 124-09-4) was obtained from TCI (Tokyo Kasei Kogyo Co. Ltd., Tokyo, Japan). Methylene diphenyl diamine (MDA) (CAS 101-77-9) was obtained from ChemService (Pennsylvania, USA). The following deuterium labelled diamines were used as internal standards (IS): Tetradeuterium labeled HDA (d4-HDA) was from Synthelec (Lund, Sweden); tri-deuterium labeled 2,4-TDA and 2,6-TDA (d3-TDA) and di-deuterium labeled MDA (d2-MDA) from CDN Isotopes (Quebec, Canada). Pentafluoropropionic anhydride (PFPA) (CAS 356-42-3) was used as the derivatisation reagent and was obtained from Sigma-Aldrich. Other chemicals and reagents used in the study were either HPLC grade or analytical grade.

Apparatus: An ACQUITY UPLC system with a Quattro Premier XE triple quadrupole mass spectrometer (Waters, Milford, MA, USA) was used for the analysis. The analytes were identified by two characteristic Multiple Reaction Monitoring (MRM) transitions in a specific ion ratio occurring at a particular retention time. The confidence interval of the ion ratio was ± 20% and ± 1% for the retention time. Quantification was performed by internal standard calibration using deuterated analogues of the isocyanates.

Sample collection: Urine samples were collected at the end of the work shift. The biological half-life is around 2 - 4 hours so results only reflect recent exposure.

Sample preparation: The work-up procedure of the urine samples was performed using a modified version of the protocol developed by Skarping [8] and Williams *et al* [9]. Briefly, 1 mL of a urine sample was hydrolysed with 1.5 mL of 3M H_2SO_4 and heated to 100 °C for 16 h. Prior to the hydrolysis, 50 µL of internal standard solution containing 100 µg/L of each of the deuterium labelled amines in 1 M H_2SO_4 were added to the acidified urine solution. After hydrolysis, the samples were cooled and neutralized by the addition of 5 mL saturated NaOH solution. The amines were then extracted into 2 mL of 50% iso-octane/toluene. The samples were shaken and the organic phase separated by centrifugation. The organic phase was then taken and 20 µL of PFPA added and the mixtures were immediately shaken. The excess of the PFPA reagent and the acid formed were removed by extraction with 2 ml of 1 M phosphate buffer solution (pH 7.5). The organic phase, containing the amide derivatives, was evaporated to dryness using a vacuum centrifuge. The dry residue was reconstituted into 1.0 mL of acetonitrile and placed in an ultrasonic bath for 10 min. The sample solutions were subsequently transferred to vials and analysed using UPLC-MS/MS.

Method Validation

The method was verified by the analysis of three post shift urine samples obtained from the spray painters applying HDI-containing paint in auto-repair shop in Perth. The samples were treated using the work-up procedure and analysed using UPLC-MS/MS.

Chromatogram. The analytical columns used in this analysis had very small particle size (<3µm) giving narrow chromatographic peaks with an average peak width of 0.2 min. This gave high sensitivity and good separation of the 4 isocyanate-derived amines in a relative short run time (10 min). A typical UPLC-MS/MS chromatogram of urine samples spiked with amines at 10 µg/L and with the deuterium labeled amines at 5 µg/L is shown in Figure 2. The Figure shows that no interfering peaks were observed in the MRM chromatograms.

Calibration curve. The calibration curves were prepared by spiking blank urine from unexposed individuals. The curve was generated by linear regression and it was found to show linearity up to 20 µg/L with a correlation coefficient for all analytes above 0.98.

Limit of Quantification (LOQ). The detection limit of the method was found to be as low as 0.01 µg/L. Background levels of HDA are found in unexposed individuals. An analysis of 80 unexposed individual's urine samples was performed, showing a level of up to 0.2 µg/L of HDA. For the purpose of assessing the exposure to isocyanates it was decided to use a LOQ above the background amine level and was therefore set at 0.5 µg/L amine in urine. This level is comparable with other recently reported analytical methods for the determination of isocyanates [10].

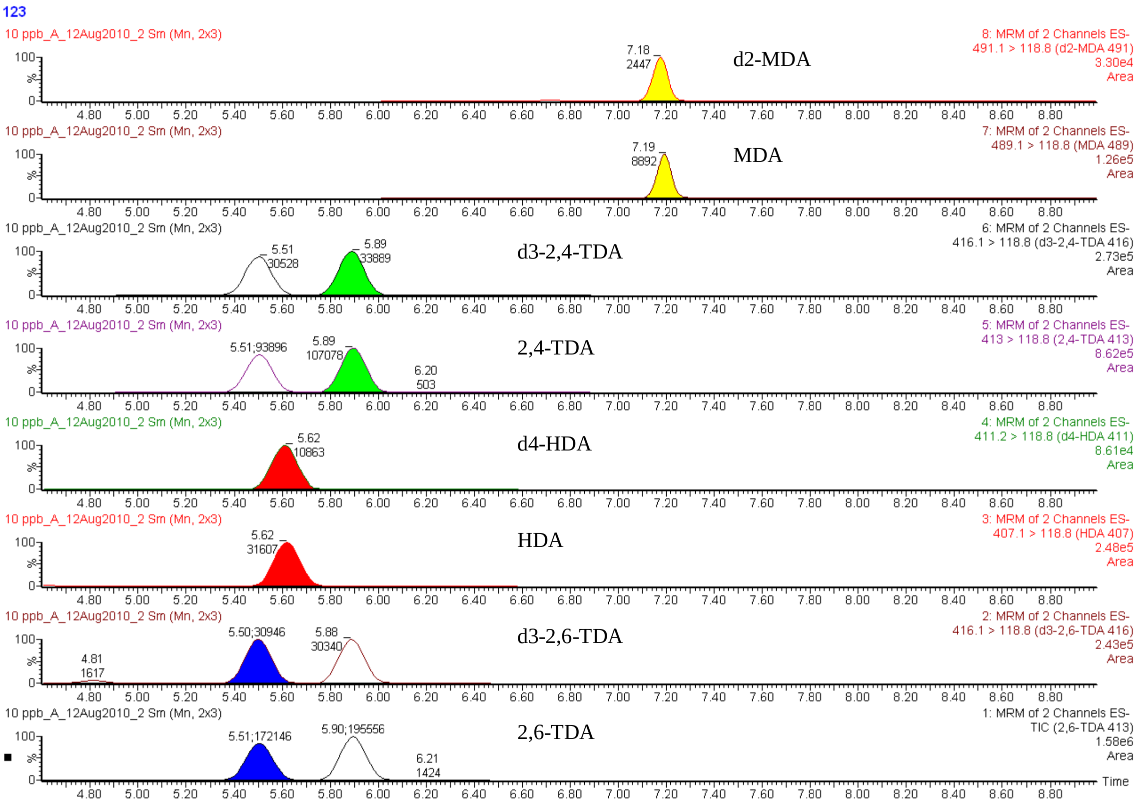

Figure 2. LC-MS/MS chromatograms of work-up urine samples spiked with amines at 10 µg/L and with the deuterium labeled amines at 5 µg/L.

Precision and Trueness: The precision and trueness of the method was determined by spiking known concentrations of the amines into blank urine samples. Five replicates at each concentration level were processed through the entire sample preparation and chromatographic procedure. The analytical intra-day and inter-day precision and trueness data are shown in Table 1. The Table shows that the method has good precision (< 6.3%) and trueness (< 4.5%) for the quantification of isocyanate-derived amines in urine. The method gave slightly better %RSDs for 2,4-TDA and 2,6-TDA than for HDA and MDA.

Table 1. Precision and trueness data of the method.

	Precision, 10 µg/L		Trueness, 10 µg/L	
n = 5	Within day RSD (%)	Day to day RSD (%)	Within day X (%)	Day to day X (%)
2,6-TDA	2.3	5.4	0.1	1.4
HDA	2.4	5.7	1.6	2.2
2,4-TDA	2.7	3.6	0.1	1.6
MDA	2.7	6.3	1.1	4.5

Relative recovery of the amines:. The relative recoveries of spike water samples to urine matrix samples were compared (*n* = 5). Both sets of samples were processed through the entire work-up procedure and analysed using the UPLC-MS/MS system. The MRM transition ion ratios of the urine samples were compared to those of the water samples. The results are presented in Table 2. The mean relative recoveries for the aromatic amines 2,4-TDA and 2,6-TDA and MDA were between 101.2 and 119.3%. The mean relative recovery for the aliphatic amine, HDA, was between 95.8 and 100%. The above recoveries were in agreement with similar results previously reported [7]. The absolute recovery performance of the aliphatic and aromatic amines is thought to be due to the extraction efficiency of the extracting solvent mixture of iso-octane/toluene. The use of deuterium labelled internal standards compensates for loss of amines in the procedure. The good recovery achieved is testimony to the effectiveness of the internal standards employed in the procedure.

Table 2. Recovery data of amines during work-up procedure.

µg/L	2,6-TDA %	HDA %	2,4-TDA %	MDA %
5	103.3	91.8	115.2	130.0
10	101.1	99.0	113.0	116.8
20	99.3	96.7	106.4	111.0
Mean	101.2	95.8	111.5	119.3
SD	2.0	3.7	4.6	9.7

Hydrolysis. Isocyanates undergo metabolism in the body, resulting in the formation of the diamines that are excreted in the urine. A significant proportion of the diamines are conjugated to other sugar molecules. To obtain a sample where the total amount of the isocyanate diamines is present in the free state, an acidic hydrolysis is necessary. Experiments are ongoing to optimize the best hydrolysis conditions of isocyanates metabolites.

Case Study

A total of 3 urine samples obtained from 3 spray painters using HDI were analysed by the presented UPLC-MS/MS method. The levels of HDA in the hydrolysed urine samples are displayed in Table 3. The air concentrations of the isocyanates were also determined by the established method of the HSL method 25/3 [11] and the results are also shown in Table 3. The Table shows that no HDA exposure was detected in the air samples above the detection limit. However, positive results were obtained in the urine samples of 0.6 to 0.8 µmol/mol creatinine.

The Health & Safety Laboratory, in the UK, has a biological monitoring guidance level of 1 µmol HDA/mol creatinine [12]. Our survey, the average HDA level was 0.7 µmol/mol creatinine indicating the workers are employing good controls. It should be noted that this guidance value is based on a recommendation for good occupational hygiene practises and not based on protection from health effects caused by HDI exposure [12]. Although the presented study here had a limitation with sample size, it still shows that biological monitoring can give useful indications of exposure particularly at very low exposure levels.

Table 3. Results of air monitoring and biological monitoring for three workers at different Motor Vehicle Repairs.

Location	Field	Sample Type	HDI (µg NCO/Sample) LOQ: 0.1µg NCO/Sample	HDA (µmol/mol Creat) LOQ: 0.5µmol/mol creat
Worker A	Spray painter	Filter	ND	0.8
	Spray booth	Filter	ND	
	Mixing room	Filter	ND	
	Field blank	Filter	ND	
Worker B	1 x personal	Filter	ND	0.6
		Impinger	ND	
	Spray booth	Filter	ND	
	Field blank	Filter	ND	
Worker C	Spray painter	Filter	ND	0.8
		Impinger	ND	
	Spray booth	Impinger	ND	
	Field blank	Filter	ND	

Conclusion

A fast and specific analytical method has been developed for the detection of aliphatic and aromatic isocyanates metabolites in urine using UPLC-MS/MS. The method has a relatively simple sample preparation and gives good sensitivity with a LOQ down to 0.5 µmol isocyanate-derived amine mol^{-1} creatinine. The average relative recovery for all analytes was 96 - 119% and the calibration was linear in the concentration range of 0.5 - 20 µg/L urine and gave a very good correlation coefficient ($r^2 > 0.98$). The method was applied to urine samples collected from workers who worked in car smash repair garages and were exposed to hexamethylene diisocyanate (HDI). Air monitoring was performed at the same locations to compare to the biological monitoring test results. The results indicated that the biological monitoring method gave a more sensitive assessment than the established air monitoring method. This illustrates that biological monitoring of isocyanate derived diamines is a useful alternative method that the occupational hygienist has in assessing the exposure of workers to isocyanates.

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Four ways to really connect with a client AND achieve buy in for your professional advice

Christine Hepburn
The Defining Edge Training and Development

In any professional environment it is essential to have engagement and buy in from the clients, managers and colleagues with whom we deal with daily.

Often the challenges we face, such as having managers understand their OH responsibilities, followed by achieving their obligations in this area can be affected by the simple matter of how they perceive us along with the relevance we have in their mind.

If our desire is to have our professional opinion and instructions noted, followed and implemented, there are critical factors which can make the difference between this happening or not.

Obtaining that necessary engagement, understanding and buy in for our own role to be effective, is possible if we change the way we approach these issues.

If what you are currently doing works for you in all instances with all people, then I congratulate you for your success. If not, then please consider an alternative way of looking at your professional relationships to see where these may be enhanced to your advantage.

I do not for a minute profess to know your business as you do. What I do know is how to establish rapport, foster professional relationships and influence maximum engagement for a mutually beneficial outcome.

For those of you who are about to glaze over thinking that this is lightweight or doesn't apply to your particular situation, please bear with me.

Consider that in many cases, the people you are attempting to influence professionally to fulfill their OH obligations will not necessarily be approaching the issue from the same platform as yourself. Add to that, we each have different learning styles, personality profiles and mindset priorities.

Someone with a scientific and technical mindset and approach will not find it an easy matter to communicate effectively with someone who comes from a alternative style, unless they communicate from the other persons perspective.

To give you a personal example, I love modern technology and what it can offer me however, if anyone who excels in this field starts to discuss any aspect, or instruct me in how to use it using their technical terminology or assuming I know certain aspects that are so familiar and basic to them, my mind immediately tunes out regardless of my interest level.

To engage me and have me firstly want to understand, then to actually understand what it is they wish me to grasp, it is essential reach me on my own wavelength. I have experienced both approach styles and when any description or instruction is explained in a way that makes full sense to me, allowing me to understand the why, absorb the detail and ask questions, I respond well, learn and enjoy the process.

Consider that your priorities are not necessarily the same for the other person. Their understanding of the 'why' may inhibit the buy in or follow through, so unless you can communicate the benefits, associated with the importance to them of complying and how easy the process can be if they follow your guidelines you will often experience difficulties or resistance.

There are the basic personalities profiles of directing, influencing, supportive or conscientious styles you will have to deal with.

The directive and determined person will communicate directly and very much to the point. To some they may seem harsh and insensitive.

Influencers on the other hand are talkative and fun loving persuasive communicators who tend not to be detail oriented. They will not respond well to the same basic set of facts as the directives will.

Now with a supportive style they are steadfast and will stick to a task until it is completed. They like structure and routine and don't like unplanned changes or surprises and need plenty of notice. They also need a step by step practical approach to accomplishing anything.

Finally, with corrective/conscientious people they pay attention to important detail, take everything seriously, examine situations and think things through before taking action. They need to come to their own conclusion however need all the information to enable that to take place.

Understanding your own style of communicating as well as the alternatives, then adapting your approach to suit, will go a long way to building rapport and gaining interest. For instance one person may need just the basic facts such as what needs to be done, can it be done and how much will it cost. Too much detail or time wasting will not engage them at all, yet this approach for someone else will be abrupt and inadequate, once again removing your ability to create an effective result.

The next person you deal with may require you to spend time on small talk, with just a brief overview of the essential tasks required.

We have four ways we connect with people.

We are evaluated and classified by these four contacts:

What we do

How we look

What we say

And how we say it

Your brand is not your logo. What does your personal and professional branding say to your prospective clients, existing clients and colleagues?

Let's briefly explore these four contact points and their relevance for you professionally.

1. What we do.

As you can imagine, what we do is an extremely important element of communicating a desired outcome, especially if the outcome is not something the other party sees as particularly necessary, an immediate threat, a high priority or doesn't take your professional opinion seriously.

So what can you do differently in your approach?

- Think about it from the other person's perspective
- Ask questions to understand where they are coming from
- Consider reformatting your facts so they present as benefits
- Identify the problem and clearly outline the solutions

- Take a look at how you deliver your instructions

2. How we look.

How you present yourself, your image is more influential than you think.

Take an objective look at how you present yourself, opt for a professional opinion, or ask someone you can trust to be honest.

Your professional image can make a major difference to how any other person perceives you, even though you may believe that your physical appearance should be completely unrelated to the more important facts of your intelligence and technical ability. Unfortunately our personal, professional branding can be an influencing factor to how people listen, relate, or take notice of us.

An emotional decision is made within the first four seconds when we encounter someone.

Recently I demonstrated the power of personal branding to a group of delegates in a workshop. The manager of the organisation generously agreed to play a part by arriving on the first morning dressed more casually than he normally would, which also had a subtle affect on his confidence and demeanour. The introductions were made as if nothing was unusual, yet not one of the participants 'bought' his level of importance or paid full attention to what he had to say.

Later that same day the manager returned dressed in his usual professional manner, with evidence of his normal air of comfortable authority. Introductions were made again in the exact manner they had been earlier, yet how each participant responded to him at this point was entirely different.

Each delegate was asked to arrive dressed in an appropriate professional manner the following day, where we were then able to assess how that not only made them behave, but how others responded to them. The major difference on both counts was noted by all participants.

3. What we say.

In face to face communication we have three influencing factors.

- Words, which make up 7% of our communication
- Tone which makes up 38%, then
- Body language, which makes up the other 55%.

It is important to have our verbal and our physical language aligned. It is amazing what we can say to others without saying a word.

You may have heard someone say "please don't speak to me like that," with a response of "what, I didn't say anything wrong." Finding the right words, with the right tone, can set the balance in your favour in any communication. Add positive body language to the mix, and you increase your chance of success exponentially.

Non face to face communication changes the percentages dramatically.

- 82% tone
- 18% words

This element is important to consider when dealing with people on the telephone. Distraction shows even when you can't be seen. Smile and focus on the other person.

Email and written communication takes on yet another perspective. Brevity can be translated as rudeness, and what you intend in the tone of the email or document is not necessarily how it will be received. This is heightened if the receiver doesn't share your personality profile and communication style. Take a few moments to think about how it will read to the recipient before pressing send.

Find positive framing to use when approaching management, clients or potential clients. Remove all negative words and focus on the desired outcome for the client or management rather than on the expected barriers.

We get what we focus on.

4. How we say it.

Once again, it is essential to maintain focus, tone and positive wording to obtain an outcome beneficial to all parties, along with using the language style suitable for the recipient. We can be as efficient and professional in our role as we think, however if the other party doesn't respond it is not going to bring about an effective outcome for everyone.

People are much like an iceberg where we display only 20% of ourselves to the outside world, keeping the other 80% hidden. Like an iceberg, the visible 20% is what we react to, yet the hidden 80% is the part that has the strongest affect. We all know what the hidden section of the iceberg did to the Titanic!

We filter our interactions through our own beliefs and experiences. How someone responds or interacts with you will be influenced by their own earlier interactions or life experiences, so your approach can tip the balance without you understanding why.

Creating strong relationships with your client base can be as simple as considering that your colleagues, managers, and clients are all your customers and then offering them an exceptional customer experience with you.

This can be done in a number of ways and considering the following can help.

- Who are you?
- How are you perceived?
- Who and what do your managers, clients, potential clients or colleagues see?
- Who do they interact with?
- What should that interaction look and sound like?
- What can you do to meet any potential client's expectations?
- What can you do to meet any existing client's expectations?
- What makes people feel threatened?
- What makes people feel comfortable?
- How much is too much or too little?
- Be consistent
- Involve the other party in the solution
- Identify their expectations by asking them how you can work together to achieve the desired outcome

- Ensure you grow and maintain that relationship in between your official calls

Building relationships is essential to good business regardless of what that business is and what role you have in it.

The ideas I have presented to you here may not feel familiar or comfortable to each one of you, yet everything starts as an unfamiliar or uncomfortable task. Putting new habits in place starts with the first step, so take the few first steps and see what changes you can bring into your work environment.

Unless everything you are currently doing is working perfectly for you, try it, you have nothing to lose and everything to gain.

When is "Green" not necessarily "Clean"?

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Abstract

Over the past decade we have evidenced a noticeable shift by the chemical industry to embrace a "Green" focus on operations that have traditionally been regarded as "dirty".

With the recent increase in economic and political pressure, and the imminent changes to the occupational health and safety and MHF legislative framework, it appears that the chemical industry may have inadvertently reduced their focus on health issues in preference to improvements gained from pursuing a "cleaner" company image. The increase with environmental compliance may have induced a subsequent decline in the focus on pursuing effective health outcomes, particularly in the area of emergency preparedness.

A review of recent incidents and the continued use of traditional chemical processes in the chemical industry has highlighted the potential for significant improvement to be gained in health outcomes from increased application of occupational hygiene intervention.

A Screening Method of Identifying the Potential Presence of Respirable Size Asbestos Fibres in Soil

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Abstract

An improved screening method of identifying the potential presence of respirable size asbestos fibres in soil samples has been developed in-house. The design of the equipment and the methodology has significantly reduced the risk of potential airborne fibre exposure to personnel undertaking the assessment by an alternative method currently employed at various mineral exploration sites.

The equipment and method has been tested by spiking non-asbestos containing soil samples with known concentrations of asbestos. The equipment and methodology are now being utilized at two exploration sites.

Key words: Respirable Size Asbestos Fibres, Minerals Exploration

Introduction

Within the Pilbara Region of Western Australia, iron ore deposits and the surrounding geological morphology are typically known to contain asbestiform minerals, principally in the form of Crocidolite, or Blue Asbestos, and is commonly known as the "curse of the Pilbara". Tremolite and to a lesser degree Actinolite have also been observed within this region, while the Amphibole Group (excluding Crocidolite) and Serpentine asbestiform minerals also persist in the nearby Yilgarn and Kimberley regions.

As part of the risk assessment process, mining companies have concluded that it is necessary to assess whether percussion drill samples taken during mineral exploration or blast hole drilling during mining processes have the potential to release airborne respirable fibres, particularly asbestos. This is critical to determining whether a given site is safe and/or at least viable for further exploration or mining, as it may contain asbestiform minerals. Hence, a screening tool was developed to identify whether the drill cutting material contained respirable fibres which if present were sent to a laboratory for confirmation of the type and presence of asbestos fibres using Scanning Electron Microscopy (SEM) fitted with an Energy Dispersive Spectrometer (EDS).

One device currently used in Australia comprises of a tube into which a sub-sample of the drill sample material is placed, which is then blasted with high pressure air to create an atmosphere of dust that can be sampled and tested, using the membrane filter method to collect the sample.

A problem with this system is the risk associated with the expulsion of the dust, which has the potential to contain asbestiform minerals, which can be inhaled by an operator of the device or nearby personnel. It is understood that the operator was required to wear respiratory protection in addition to a hard hat, due to the expulsion of the material from the tube to prevent the material from impacting upon the operators exposed head.

Having identified this situation, an improved screening method of identifying the potential presence of respirable size asbestos fibres in soil samples was developed in-house. The design of the equipment and the methodology significantly reduced the risk of potential airborne fibre exposure to personnel undertaking the assessment by our alternative method currently employed at various mineral exploration sites.

Basic Theory of Operation

The operation of the unit is based on three principles; the generation of a dust cloud, and by utilising the relationship of Equivalent Aerodynamic Diameter (EAD) behaviour of fibrous particles, which deviates significantly from non-fibrous particles[2], Stokes Law relating settling and sedimentation rates of particles, and the use of a negative pressure system which allows containment of the generated dust cloud.

From these two principles, a representative sample of the particles within the dust cloud is able to be collected using the NOHSC membrane filter method to subsequently determine the presence of respirable fibres.

System Development

The first consideration was how to generate a dust cloud from the soil material within a chamber, guaranteeing that it was sufficiently homogenous to provide a representative sample while also ensuring that the material was ground and agitated to release particles and fibres to be suspended within the chamber. This was achieved by creating a dry-operating ball mill, which ground the particles while generating the dust cloud.

The next consideration was sample collection, ensuring that laminar flows occurred in the sampling chamber at the sample collection point, so that even distribution across the filter occurred. This resulted in the construction of an elutriator, with the sample collection point in line with the dust flow and sufficiently distant from the inlet to allow laminar flows to exist.

The final task was to develop a system where the sample is drawn from the dust generation chamber into the elutriator, ensuring that generated dusts cannot escape into the environment. The use of a vacuum pump connected to the system ensured the system operated under negative pressure to contain the dusts, and together with the use of particulate filters, subsequently resulted in the system being designed and constructed to achieve these conditions.

Development of this system was aimed as a screening tool and being qualitative in its application. The collection of fibres onto the sampling media was the primary concern, and not the measurement of the concentration of the fibres present in the generated dust cloud.

A search of the literature indicated a similar application used in the United States, known as the 'Superfund Method' was developed by Berman and Kolk in 1997, and was modified in May 2000[2], which incorporated several cost-saving modifications and other refinements.

However, a more practical and simplified system was sought and developed, with the resultant system depicted below in the schematic Figure 1 and design drawing Figure 2.

[1]Timbrell, V.: The Inhalation of Fibrous Dusts Ann.N.Y. Acad. Sci. 132:255-273 (1965)

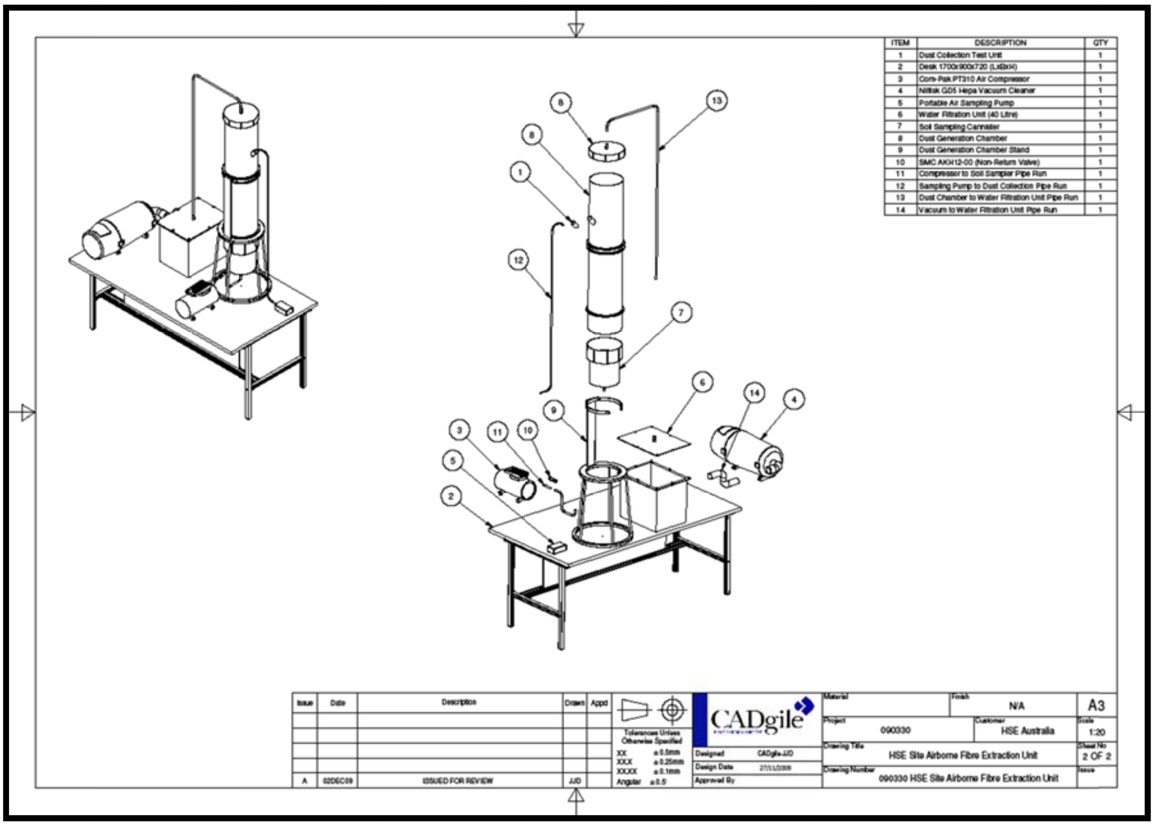

Figure 1: Schematic of SAFE Unit

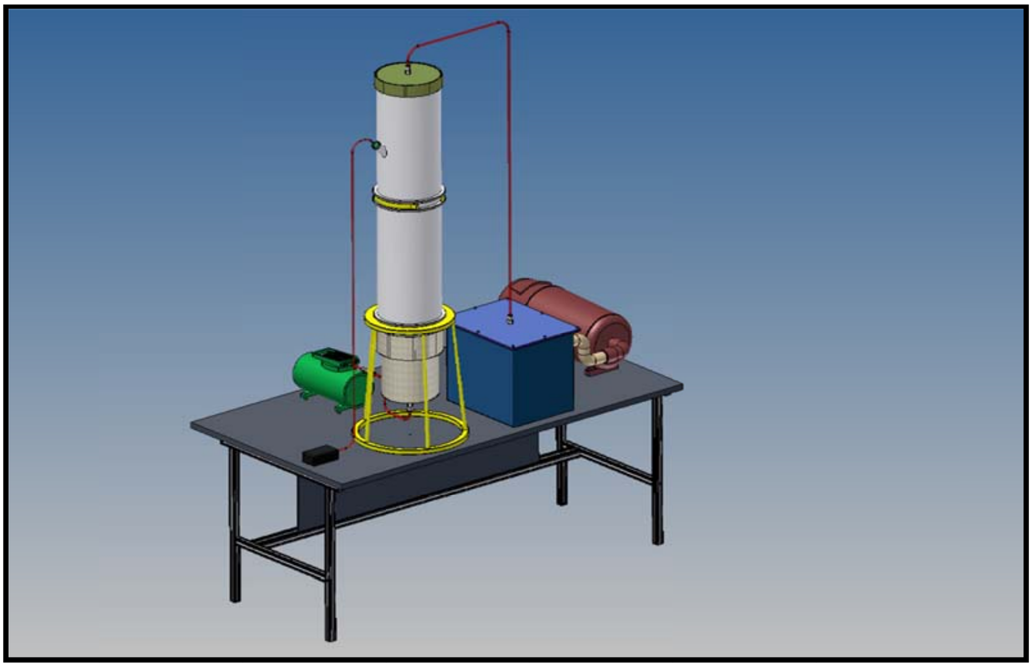

Figure 2: Design of SAFE Unit

Site Airborne Fibre Extraction (Safe) Unit

As part of the design feature of the system, materials in the construction of the system had to be readily available, and that it was portable, easy to use and provide repeatability of results.

From this, modification of the system as compared to the original schematic occurred during materials sourcing and the construction phase of the SAFE Unit, while still retaining the original design parameters. This included sourcing of an agitator and vacuum system and construction of the elutriator, while also incorporating equipment commonly used in occupational hygiene monitoring. The final prototype and operational SAFE Unit is presented below in Figure 3 and 4.

Figure 3: Operational SAFE Unit

The SAFE Unit employs a tumbler to agitate and crush the sample, with the resultant dust cloud being drawn into the elutriator by a vacuum pump. Air flows are carefully monitored using rotameters installed prior to the tumbler and at the vacuum pump.

A sample is then collected by drawing a known volume of air through an airborne fibre sampling cowl which is located inside the elutriator.

Following sample collection, all dust inside the system are then removed and captured in a P3 particulate filter located inside the elutriator during a purge phase. The sampling cowl is then removed using a safe work procedure to ensure that contamination from remnant fibres in the system do not escape and become airborne in the work environment.

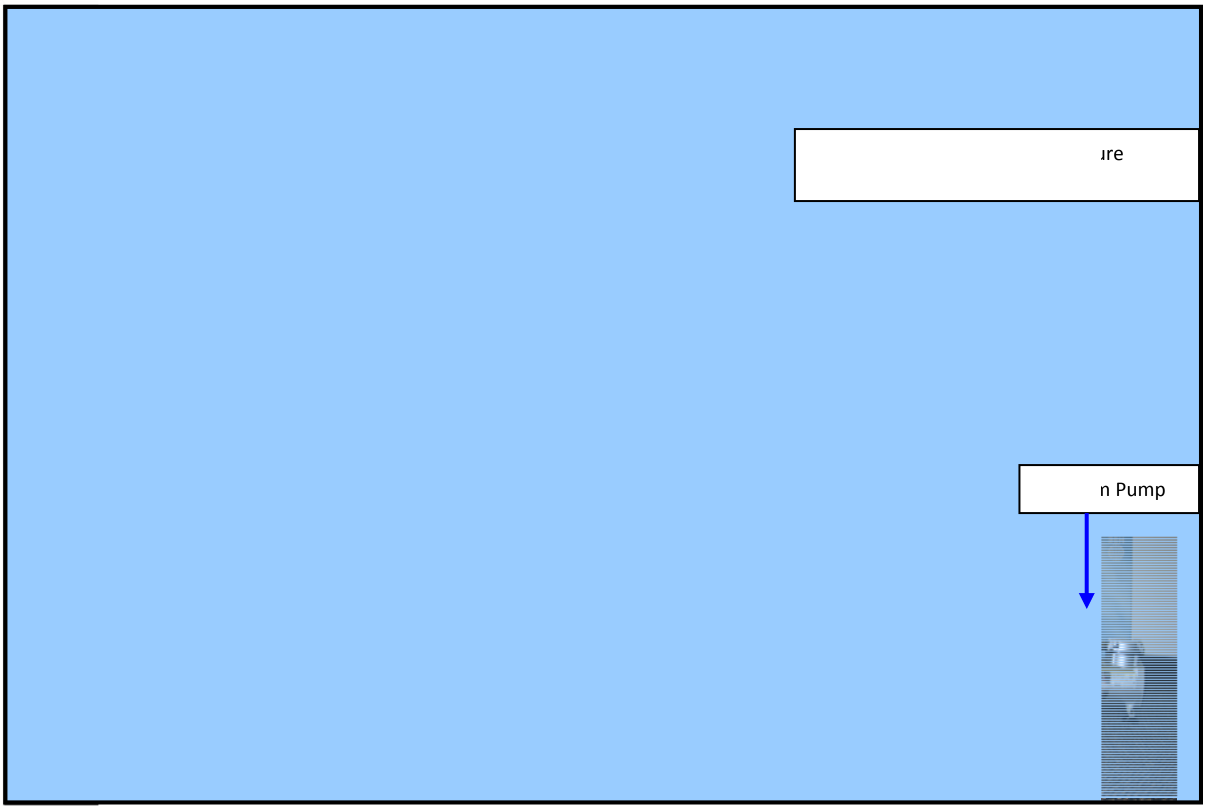

Figure 4: Components / Operation of the SAFE Unit of

Respirable Fibre Definition

Under West Australian Mining Regulations, the criteria for a countable fibre as per the NOHSC Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres (NOHSC:3003) (maximum width <3 µm, length > 5 µm, and length / width ratio >3:1) has been modified to remove the over estimation of fibres on the sampling filter, as the NOHSC method does not distinguish between asbestos and non-asbestos fibres (such as clay minerals, iron oxide, gypsum, mica, hornblende and talc) or other artifacts that comply with the NOHSC criteria.

This modification defines a countable fibre as any object having a maximum width of $\leq$ 1 µm and a length > 5 µm, which results in greater selectivity between asbestiform and non-asbestiform minerals. Hence, this criterion was used to define a countable fibre to provide this selectivity of fibrous forms on the sample media.

The number of fields counted on each sample remained as per the NOHSC criteria, thereby retaining the theoretical Poisson Distribution and Coefficient of Variation inherent in the method.

Validation

Initially, testing of soil samples was undertaken to confirm that they did not contain asbestiform minerals, which was carried out using different analyses methods on each sample, which included Polarised Light Microscopy (PLM) in Soils (as per Australian Standard AS4964) and X-Ray Diffraction (XRD). These samples were then run through the SAFE unit and the results of our tests indicated that no respirable fibres were detectable. Additionally, a representative number of these samples were also submitted for SEM, also confirming no asbestiform minerals were in these samples.

To assess the repeatability of the system and the method, samples were tested by spiking the non-asbestos containing soil samples with known concentrations of asbestos. These spiked samples contained 0.7% Crocidolite (W/W), 0.17% Crocidolite (W/W) and 0.4% Chrysotile (W/W).

During testing of the unit with contaminated soil samples, inhalable dust concentrations were also measured within the chamber and found to vary significantly up to 50 mg/m^3. It was concluded that different types of soil material released varying quantities of dust during the grinding and agitating process. This indicated that variances in fibre counts may occur, being directly related to the dust generated by the agitator and the concentration of fibres in the soil material.

Airborne fibre sampling was also undertaken in the room where the SAFE Unit was located during validation to confirm that fibres were contained within the system and that personnel were not exposed to hazardous airborne fibre concentrations.

Tables 1 – 4 below indicate the results of fibre counting for spiked samples used during the SAFE Unit validation process.

Table 1: Sample A (No Asbestos Content)

Count #	Fibres / 100 graticules	Fibre Concentration in Room During SAFE Unit Operation (fibres/ml)
1	0	<0.01
2	0	
3	0	
4	0	
5	0	
6	0	

Table 2: Sample A spiked with 0.17% W/W Crocidolite

Count #	Fibres / 100 graticules	Fibre Concentration in Room During SAFE Unit Operation (fibres/ml)
1	9.5	<0.01
2	15.5	
3	10.5	
4	22.5	
5	24.5	
6	23.5	

Table 3: Sample A spiked with 0.7% W/W Crocidolite

Count #	Fibres / 100 graticules	Fibre Concentration in Room During SAFE Unit Operation (fibres/ml)
1	4.5	<0.01
2	6.5	
3	4.5	
4	6.5	
5	5.5	
6	7.5	

Table 4: Sample A spiked with 0.4% W/W Chrysotile

Count #	Fibres /100 graticules	Fibre Concentration in Room During SAFE Unit Operation (fibres/ml)
1	10.5	<0.01
2	8.5	
3	2.5	
4	8	
5	7.5	
6	11	

Random samples were also submitted which had been subjected to the alternative method and confirmed by SEM techniques. Of these, a 100% comparative success rate was achieved by the SAFE Unit.

Statistical Analysis Of Results

Determination of the validity of the results was undertaken by statistical analysis of the fibre counts for each sample. The criteria for obtaining a positive result was determined from the upper and lower limits of Poissonian 95% confidence interval, where set at three countable fibres, provides an upper and lower limit of 9 and 0.5 fibres respectively, which is in line with the West Australian Mining Regulations Criteria for the reporting of respirable fibre concentrations. The results of the statistical analysis are presented below in Table 5.

Table 5: Results of Statistical Analysis for Spiked Samples

Sample ID	Mean	GSD	Distribution	% Above Criteria
Sample RCO9SIL515 spiked with 0.17% W/W Crocidolite	17.78	1.53	Lognormal	>99.9
Sample RCO9SIL515 spiked with 0.7% W/W Crocidolite	5.8	5.73	Lognormal	99.03
Sample RCO9SIL515 spiked with 0.4% W/W Chrysotile	8.0	1.72	Normal	99.3

Discussion of Results

The results of sampling of the spiked samples consistently provided respirable fibres counts (in a 100 fields counted) above the criteria of 3 fibres / hundred fields. It was observed that the fibre counts had variability in their range, and for the most part provided Lognormal distributions, with Geometric Standard Deviations (GSD) below two, indicating a homogenous sample. One sample (spiked 0.7 % Crocidolite) was observed to have a high GSD (5.73) indicating non-homogeneity, while the sample containing 0.4 % Chrysotile provided results of Normal distribution. Inspection of these samples indicated that the "spiked" material was principally non-homogenous, as insufficient agitation had not allowed the material to be incorporated into the sample material, as shown in Figures 5 and 6. However, the issue of non-homogeneity is not expected to occur during analysis of drill samples, as veinlets of Crocidolite or Chrysotile in the drill cuttings would be pulverized due to the percussive action of the drilling rig and subsequent mixing and collection of the sample.

Figure 5: Spiked Sample 0.4 % Chrysotile, exhibiting non-homogeneity of fibres in the sample

Figure 6: Spiked Sample 0.7 % Crocidolite, exhibiting non-homogeneity of fibres in the sample

Conclusion

The development of the SAFE Unit has resulted in consistent detection of respirable fibres present in soils as a screening tool, as well as providing a safe and efficient method to assess their presence.

The equipment and methodology is now being utilized with success at two iron ore mining and exploration sites.

Table 6 (below) provides examples of SAFE Unit results in comparison to SEM results, showing comparable and confirmatory results between the two methods

Table 6: Comparison of SAFE Unit Analyses and SEM Results

Hole Id	Hole Depth	SAFE Unit Results		SEM Analysis	
		Fibres	Fields	ID No.	Fibres Detected
1	118-124	2.0	100	A6052	No fibres detected
1	136-142	3.0	100	A6053	Amosite, Crocidolite, Grunerite & Reibeckite fibres detected
1	142-148	3.5	100	A6054	Amosite, Crocidolite, Grunerite & Reibeckite fibres detected
2	34-40	5	100	A11270	Non-asbestos fibres detected
3	0 - 6	1	100	A11271	No fibres detected (QC)

It is also believed that with further testing, the limit of detection may be reduced to < 0.01 % W/W asbestos fibres. Additionally, this system may also have an application in determining the presence of respirable fibres in contaminated soils with friable and/or bonded asbestos-containing materials.

A patent application has been lodged for this sampling method.

References

[1] Timbrell, V.: The Inhalation of Fibrous Dusts Ann.N.Y. Acad. Sci. 132:255-273 (1965)

[2] Berman D. & Kolk A., Modified Elutriator Method for the Determination of Asbestos in Soils and Bulk Material, Aeolus Inc. and EMS Laboratories (2000)

[3] Management of Asbestos in Mining Operations, Guideline, MOHSAB, Department of Industry Resource, Government of Western Australia (2001).

Asbestos Exposure Comparison Utilizing PCM and TEM During Small-scale Asbestos Abatement Projects in New Zealand

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Abstract

Nine separate asbestos abatement projects (in 5 geographic locations) typical of asbestos abatement activities in New Zealand were monitored for worker exposure during asbestos abatement. Two outdoor asbestos removal operations of cement asbestos roofing were monitored. Seven indoor projects involving demolition of plaster, asbestos cement board, residual cementitious asbestos coating on concrete, decorative spray-on ceiling insulation; and 2 involving decontamination of contents and locations where asbestos was previously present were sampled. A total of 35 samples were analyzed by PCM: none exceeded the workplace exposure limit of 1.0 fibre/ml. for TWA samples and 6.0 fibres/ml. for STEL samples. Twenty of the 35 were analyzed by both PCM and TEM. Of those analyzed by both methods, TEM results (asbestos structures/ml.) were less than PCM results (fibres/ml.) for 10 (50%) of the samples; TEM results were greater for 10 (50%). In 3 of the 10 where the TEM results were greater than the PCM results, the measured levels differed by more than an order of magnitude, and for 2 of these 3, the TEM results were significantly in excess of the relevant workplace exposure standard but the PCM results below the TWA exposure limit of 1.0 fibre/ml. Comparison of results via the two sampling methods will be discussed.

Material Safety Data Sheet Issues & the Occupational Hygiene Profession In A Clean, Green, GHS *Age of Aquarius*

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Abstract

Major issues of Material Safety Data Sheet (MSDS) quality are interpretation, accuracy, adequacy and compliance. The consistency of MSDSs currently impacting workplaces varies, depending on the understanding and acceptance which MSDS preparers have of disclosure requirements. A comparison of selected current national requirements for Australia, Canada and the U.S.A. is presented. Adoption of the GHS proposals can be expected to improve MSDS quality but deficiencies will not be totally eliminated. Audits indicate that many MSDSs are deficient in essential requirements, often owing to non-specificity of disclosed information. Document review overestimates MSDS compliance, as shown by confirmatory chemical analysis of product ingredients. Evaluation of MSDSs with a trade secret component demonstrates that MSDS quality can be significantly improved when suppliers diligently provide unabridged data. Occupational hygiene professionals can have a key role in the successful implementation of the GHS proposals regarding MSDS quality.

Key Words

MSDS requirements, disclosure, quality, GHS, accuracy, adequacy, interpretation, compliance, enforcement, trade secrets

Introduction

The MSDS is a legally required document for conveying information on the safe handling of hazardous materials in the workplace, and is critical to product stewardship. If the information provided on MSDSs is inaccurate or incomplete, the potential for adverse human health effects and financial loss is considerable (Merritt, 2004). The primary issues presently confronting preparers, users and regulators of MSDSs are INTERPRETATION (of the legislated requirements) and ACCURACY (of the data); ADEQUACY and COMPLIANCE are secondary issues. Evaluations of the accuracy of MSDS information often expose deficiencies in essential items. Governmental approaches to enforcement of MSDS quality can vary significantly, according to jurisdiction. Even between occupational hygienists, there will be differences of interpretation according to the requirements of the regulatory regime under which they practise. A comparison of selected current national requirements will be presented, together with a discussion of results from a selection of surveys of MSDS accuracy.

The advent of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) presents a unique opportunity to provide a consistent approach to MSDS content and quality worldwide (UNECE, 2009). Although the GHS proposals might be viewed as the panacea for the ills of MSDS quality, the issues that are currently experienced will persist in the GHS era. The occupational hygiene profession is uniquely placed to confront and address these issues.

Discussion

Requirements for MSDS content

The MSDS is a legal entity within worker health and safety legislation. At the most basic level, whatever meets the *minimum* requirements of the legislation would, by definition, legally comply. Information "applicable" to the product and "available" to the supplier, and information "of which the supplier is aware or ought reasonably to be aware" – information necessary for worker protection – and satisfying right-to-know requirements, would be construed as "adequate" by Industry and the regulators, now and in the future. Legislation is always subject to interpretation, and diversity of opinion will inevitably occur for suppliers, workers, users, professionals and regulators, unless disclosure requirements are unambiguous and comprehensible.

MSDSs in Canada

The content of MSDSs for hazardous materials throughout Canada is regulated under federal (criminal) legislation, in contrast to the provincial (civil) legislation typically governing workplaces. MSDS disclosure requirements are specified in the *Hazardous Products Act* and *Controlled Products Regulations*: fifty-four items are specified, including some prescriptive elements (Health Canada, 1996). Although the intent of including prescriptive elements was to reduce ambiguity in interpretation of key MSDS requirements, implementation can be problematical for suppliers with a performance-oriented approach.

MSDSs in the U.S.A.

The requirements for MSDS content are given in the OSHA Hazard Communication Standard (OSHA, 1989). The requirements for content disclosure are comprehensive and include "physical and chemical characteristics" of the hazardous chemical, together with physical and health hazards. The MSDS requirements are similar to those of most other jurisdictions but seem to be interpreted (and enforced) in a flexible, performance-oriented and non-prescriptive fashion. Generic identities or trade names can often appear on MSDSs of U.S. origin, probably owing to a flexible interpretation of the phrase: "…any chemical or common name which will clearly identify the chemical..." Disclosure of ingredient concentration is optional. No specific MSDS format is prescribed and the consequent variability is often a source of user frustration.

MSDSs in Australia

MSDS requirements are defined in state legislation, with details provided in a Code of Practice (NOHSC, 2003). In a broad definition of chemical identity, the common chemical name or name as in various official lists is required or if none of the above, the recognized chemical name as used in readily available scientific literature. For concentration, the exact value, or range is required. The allowable concentration ranges are somewhat different to the Canadian, as shown below:

Allowable Ingredient Concentration Ranges	
CANADA	**AUSTRALIA**
0.1-1%	
0.5-1.5%	
1-5%	
3-7%	
5-10%	<10%
7-13%	10-<30%
15-40%	
30-60%	30-60%
40-70%	
60-100%	>60%

Impact of the GHS on MSDS Quality

Under the GHS, the requirement for standardized, complete, accurate and *unambiguous* MSDS information is explicitly emphasized (UNECE, 2009). The extent to which the unenforceable concept of "clarity" will be embraced by suppliers remains to be seen. The requirements for a 16-header format, a unique chemical identifier and disclosure of exact concentration are concise and enforceable but national authorities' concepts of acceptable concentration ranges and requirements for confidential business information already differ. Proposals of intent to align national hazard communication requirements with those of the GHS have been released in the U.S.A. (DOL, 2009) and Australia (Safe Work Australia, 2009) and the respective national associations of occupational hygienists have published their positions (AIHA, 2005; AIOH, 2009).

Some eighteen items of physico-chemical information are specified and about 75 disclosure items in total. Because these items differ only marginally from current content requirements across the various jurisdictions, MSDS providers might well consider that the financial cost in re-assessing and revising the content of the huge volume of existing MSDSs outweighs the benefits of "improved" documentation of mere technical details.

Surveys of MSDS Quality

Many aspects of MSDSs have been surveyed over the last two or three decades. Three audits conducted in the U.S.A. and Canada in the mid-to-late 1990s, are of special interest and remain relevant, as no superseding, definitively remedial enforcement initiatives have been undertaken by those regulators.

In the U.S.A., OSHA commissioned a seminal study of 150 MSDSs, examining the correctness and completeness of the information provided in five areas considered crucial to the health of workers: chemical identification of ingredients; health effects of ingredients; recommended first aid procedures; personal protective equipment; exposure level regulations and guidelines (Kolp, et al., 1995). The evaluation was performed jointly by a board-certified occupational physician and a toxicologist who was also a Certified Industrial Hygienist.

Two particular audits were carried out by occupational hygienists in Canadian regulatory agencies: federal – Human Resources Development Canada (HRDC, 1994) – and provincial – Ontario Ministry of Labour (MOL, 2000). MSDSs were considered inadequate if information was deficient or non-specific, or if incompleteness would have required reference to secondary sources of information. MSDS content was assessed using standard references current at the time. These two government audits stand prominent in the literature, in verifying disclosed ingredient identity and concentration by chemical analysis (see Table I), and product flash points by physical measurement.

Table I. Canadian MSDS Compliance Audits, MOL & HRDC*

MSDS Disclosure Item	COMPLIANCE, %		
	Document Review	**Chemical Analysis**	**Combined Review & Analysis**
Ingredient Identity	64 (77)	88 (85)	55 (65)
Ingredient Concentration	69 (77)	64 (73)	40 (58)
Combined Ingredient Identity & Concentration	50 (65)	62 (65)	26 (46)

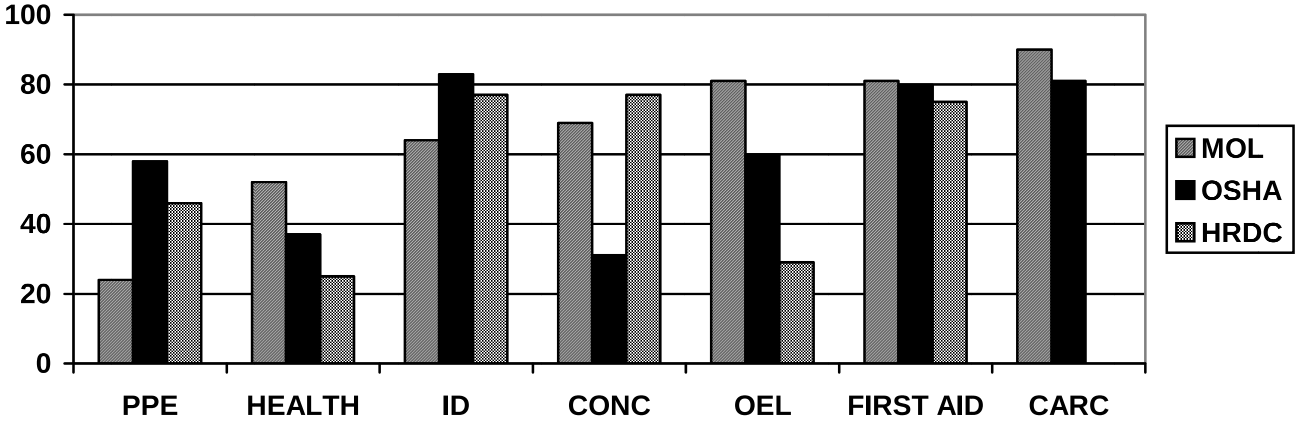
* HRDC results in parentheses

These confirmatory audits by chemical analysis for the identification and quantification of ingredient composition provide information that is almost mutually exclusive – overlap is small – of that from document review. In the Ontario audit, when the results from chemical analysis were considered, compliance for ingredient identity and concentration was reduced by 9% and 29% respectively, from the results of 64% and 69% indicated by document review. (Results of the HRDC audit were comparable.) Further, flash point measurements indicated that about one in ten of the flammable/combustible materials tested – about 5% of the total number of products audited – was incorrectly classified; product liability and safety issues should be of major concern in such cases.

A comparison of the Canadian and American surveys is shown in Figure 1. The results show many similarities. Not surprisingly, ingredient concentration fared poorly in the OSHA survey, disclosure of concentration being optional under the OSHA Hazard Communication Standard. Notably, a critical MSDS component of personal protective equipment (PPE) applicable to gloves and respirators had very poor compliance (24%) in the Ontario audit, owing to non-specificity of information such as: "wear impervious gloves" and "use an approved respirator".

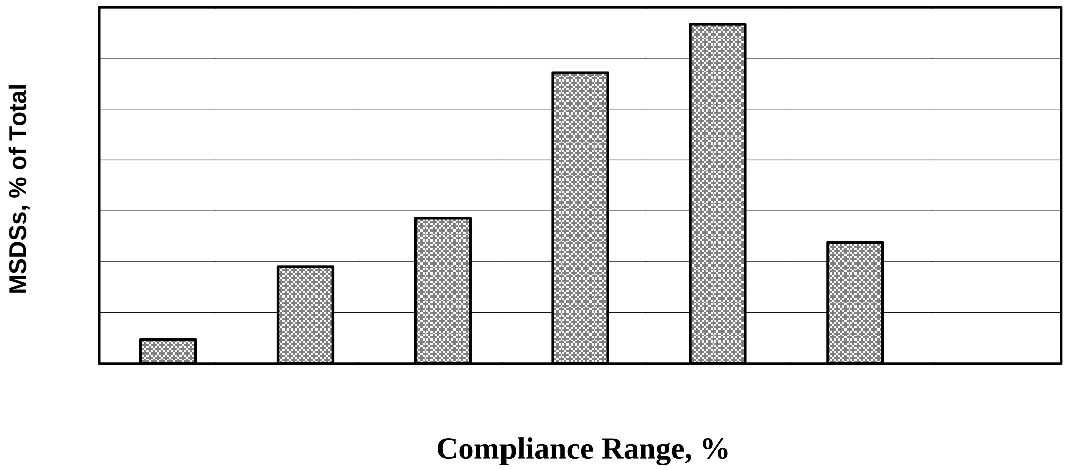
Figure 1. MSDS Accuracy by Document Review, Compliance (%)

OSHA (1995), HRDC (1994) & MOL (2000)



Compliance for the MSDS content of 42 individual products in the Ontario survey ranged from 57% to 93%, with an average of 82%; only 12% of MSDSs reached 90% compliance or better; no MSDS was considered totally compliant but few are very poor. See Figure 2.

Figure 2. Product MSDS Compliance Summary



The 54 disclosure items were also evaluated individually. Compliance is summarized in Table II. Many of the items were adequately disclosed: greater than 90% for about half and less than 50% for only about one in ten. Information on the effects of chronic exposure is the item most frequently flagged as deficient, in MSDS surveys. In the Ontario audit, using a national guideline for disclosure of toxicological information (Health Canada, 1997), this item had 71% compliance. About one in five MSDS disclosure items showed compliance poorer than this marker. Notably, leak or spill procedures (12%) and PPE (24%) appear in this grouping, together with ingredient identity, ingredient concentration and a number of physical properties. It is noteworthy that these items comprise basic compositional information of which suppliers must necessarily be familiar, but has subsequently become “abridged” on the MSDSs. Quality will be dependent upon an appropriate impetus by regulators, clarity of legislation, and of its interpretation, comprehension and acceptance by suppliers.

Table II. Compliance (%) of MSDS by Disclosure Information

COMPLIANCE %	MSDS DISCLOSURE INFORMATION
10-20	Leak or spill procedures
20-30	Personal protective equipment
30-40	Odour threshold
40-50	Freezing point; Water/oil distribution coefficient
50-60	Ingredient identity & concentration; Autoignition temperature
60-70	Evaporation rate; Waste disposal
70-80	Effects of chronic exposure; Name & telephone # of MSDS preparer
80-85	First aid; LC_{50} ; Vapour density;
85-90	Boiling point; Explosion data: sensitivity to static discharge; Exposure limits; LD_{50} ; Odour & appearance; PIN; Product use; Specific engineering controls; Specific gravity; Storage requirements; Teratogenicity/Embryotoxicity; Vapour pressure
90-95	Carcinogenicity; Conditions of flammability; Date of MSDS preparation; Flash point; Handling procedures; Hazardous combustion products; Incompatibilities; Mutagenicity; pH; Physical state; Routes of entry; Upper flammable limit
95-99	CAS #; Conditions of instability; Conditions of reactivity; Effects of acute exposure; Lower flammable limit; Means of extinction; Manufacturer/name/address/telephone #; Reproductive toxicity; Sensitization; Supplier/name/address/ telephone #
100	Explosion data: Sensitivity to mechanical impact; Hazardous decomposition products; Irritancy; Name of toxicologically synergistic products; Product identifier; Special shipping information; Identity/concentration of ingredients with unknown toxicological properties

MSDSs with Claims for Confidential Business Information

MSDSs for most products are unlikely to attract extensive review by external professionals. In Canada, however, MSDSs for hazardous products with “trade secret” claims must be reviewed and approved by professional toxicologists of the federal Hazardous Materials Information Review Commission (HMIRC) before sale is permitted.

In the experience of the Commission – approximately 200 claims per year since 1988 – the most prevalent MSDS violation consistently relates to toxicological properties. Table III summarizes the top category violations in the period 2005-2009 (HMIRC, 2009) but the results have been comparable over the past two decades. Significantly, the reported claims data indicate very low non-compliance for ingredient identity/concentration (14.4%), all physical data (3.6%), and only 0.6% for all Preventive Measures which encompass PPE, specific engineering controls, handling procedures & storage, leak or spill procedures and waste disposal: violations respectively one and two orders of magnitude less than for toxicological properties. The enhanced quality of these MSDSs demonstrates that if suppliers have an appropriate incentive, MSDSs are readily amenable to improvement. On the one hand, for the trade secret products, suppliers have the drivers of official review, considerable guidance information and the obvious desire to avoid the expense and delay inherent in claim re-submission; on the other hand, for general industrial chemical products, creation of a "best-possible" MSDS would be possible if the intent of the GHS proposals were embraced by suppliers, irrespective of the actual legislated requirements – a desirable but probably Utopian situation.

Table III MSDS Violations, HMIRC 2005-2009

MSDS INFORMATION GROUPING	Violations (%)	Av. Violations per Claim
Toxicological Properties	25.0	1.81
Ingredient Identity & Concentration	14.4	1.08
First Aid	7.6	0.55
Physical Data	3.6	0.26
Preventive Measures	0.6	0.04

Addressing MSDS Quality

MSDS quality, *post* GHS, will be defined – and confined – by the precision of the legislative language and the clarity of the requirements. Legalities aside, the occupational hygiene profession has inherent expertise in MSDS authorship and can have a key role in improving the quality and value of MSDS information and implementing the *intent* of the GHS proposals. Individual national jurisdictions can – and will – adopt and adapt GHS units in the "building-block" approach, virtually ensuring that there will still be no unique "GHS MSDS" and assuring a continuing need for the expertise of the occupational hygiene profession.

The intent of the GHS proposals can be realized if all stakeholders have a vested interest in the hazard communication process. Some of the ways towards achieving this goal might be for occupational hygienists to:

- Recognize the impending niche of MSDS authorship;
- Pursue professional development of expertise in the emerging MSDS requirements;

- Continue to urge, as essential, the creation of an MSDS ***authority***, to ensure consistent interpretation;
- Develop ***definitive*** guidelines and expert training curricula;
- Encourage local and national alliances, partnerships and consensus standard groups between stakeholders – regulators, professional organizations, educators and the regulated community – to assist in producing consistent requirements and terminology, towards consistent implementation;
- Facilitate (international) exchange of information on hazardous materials i.e. chemical properties and information on health, safety and environmental hazards, through an electronic data base, such as in New Zealand (NZERMA, 2001);
- Support the promotion of hazard communication training in secondary and tertiary educational establishments.

Conclusions

The requirements for MSDS disclosure content vary according to country of origin; MSDS quality can also vary, depending on the understanding and acceptance which MSDS preparers have of the national requirements.

Many MSDSs are currently deficient in basic requirements, whether through unfamiliarity with the regulatory requirements or through differing interpretation of minimum disclosure requirements. Disclosed ingredient identity and other properties do not always coincide with the results from ingredient analysis. Data for trade secret claims demonstrate that it is possible for MSDS quality to be significantly improved, given appropriate inducements.

Under the GHS proposals, MSDS information will be more specific than currently required. It would be anticipated that MSDS consistency and quality will considerably improve if the proposals are embraced by MSDS providers; occupational hygienists with appropriate expertise can and should have a key role in the process.

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Drug and Alcohol Detection in the Workplace Environment

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Abstract

Many companies in Australia and abroad have implemented drug- and alcohol policies in order to improve and maintain safe working. These policies are the basis for regular, but random tests for alcohol- and drug consumption among the employees, which is a big risk in case people go to work impaired. As long as either alcohol or drugs or even both are in the brain they will have a negative impact on the decision- and reaction behaviour of human beings. User-friendly equipment will help to carry out these random tests to comply with the company policies with respect to the tests themselves but also to allow for proper documentation.

Introduction

It takes about 2 minutes until alcohol reaches the brain via stomach and blood system, here it interferes with communication between nerve cells by interacting with the receptors on some cells. Without going into further details we would just like to highlight some consequences as a result of this interaction, alcohol in the brain leads to reduction of the viewing angle and difficulties to judge distances, slower reaction, especially on red signals, difficulties in coordination and keeping body balance properly, which are the most important consequences from an occupational safety point of view.

Therefore there is a need for sensitive and specific testing equipment for alcohol in the human body which ideally is also convenient to use. It is significantly easier to measure alcohol in body media, as it is just one substance to measure which has a vapour pressure high enough for fast and specific measurements in exhaled air, there is no need for an invasive sample taking.

If we look into the typical drugs, like THC, amphetamines, methamphetamines, and others we are touching a very complex topic. Whether drugs are injected, smoked or inhaled they do always influence the very powerful but also sensitive central computer: our brain. Typical consequences are limited perception of distances, depths and heights, slower speed of reaction and even thinking. Others, like Speed may have different consequences, not to mention having consumed a cocktail of different drugs at the same time, there will always be serious consequences as long as the drugs are in the brain and thus there is a tremendous risk again from an occupational safety point of view.

Drug testing needs different technologies, usually substance-specific immunoassays, and in many cases more complex analytical methods for sensitive and reliable results. State of the art is more and more saliva testing as the first screening method, as it is convenient to be done and both tests, alcohol and drugs, can be performed subsequently in the same room. In case of a positive result of the drug screening test another confirmatory test is to be conducted with a laboratory method in order to proof the quantitative amount and composition of the drugs.

Alcohol detection

State of the art of alcohol detection these days is to use breath as an easy accessible and non-invasive method. Alcohol detectors are usually equipped with a fuel cell or electrochemical sensor to measure the alcohol concentration sensitively and specifically. If regularly calibrated, fuel cells can even differentiate methanol from ethanol which is the closest relative from a chemical point of view. Calibration intervals are between 6 and 12 months, different calibration possibilities are applicable, we can either use so-called dry gas, i.e. a known and certified mixture of ethanol in nitrogen or so-called wet-gas, which is a solution of ethanol in distilled water.

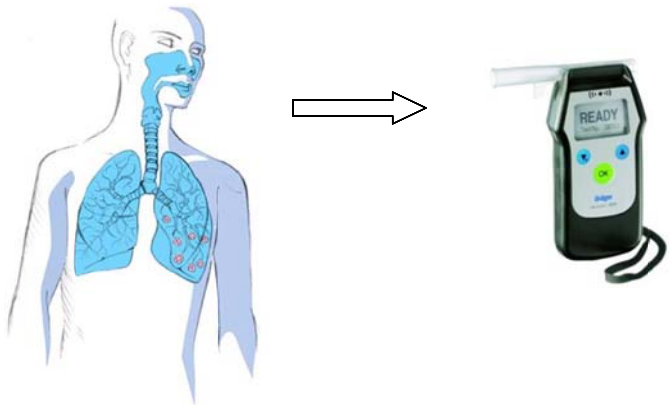

Fig. 1: sampling for breath alcohol from deep lung air

We need to blow about 4 seconds through a mouthpiece into the alcohol measurement device in order to really obtain air from the alveoli's from the lung where there is a direct exchange with the alcohol in the blood based on Henry's law. The latter is also the basis to use breath instead of blood alcohol. Finally we would get the reading of the concentration from the instrument, which would also allow for printing, data storage, and transfer of the data to a computer for storage or any kind of statistical evaluation.

The appropriate calibration equipment depends among other things also on the frequency of use, for regular and frequent calibrations we would recommend the wet-gas method, which comes closest to the natural conditions, but needs heating of the alcohol solution, whereas the dry-gas method is recommended for infrequent use, but here we need to compensate for different heights in comparison to sea-level.

Fig. 2: dry-gas and wet-gas calibration equipment for breathalizers

Drug Detection

As already mentioned earlier we need a different technology for drug detection for two reasons, drugs have no vapour pressure, and we need to be prepared for mixtures of different drugs. For a direct reading to confirm presence or absence of drugs on site we utilize immunoassays to be able to measure sensitive and fairly specific. In principle different body media are available, like sweat, hair, finger nails and urine, which is the most traditional until today, and finally saliva or oral fluid. The latter one is still pretty new but in comparison to urine significantly more convenient to be carried out. We don't need toilets or witnesses, sampling for both alcohol and drugs can be obtained in the same clean office environment in a fairly short time period. However, due to the complexity of potential drug cocktails and their metabolites, most of the drug testing methods in the workplace environment, and even for law enforcement applications are so-called screening methods. We obtain either a positive or negative reading regarding the presence or non-presence of drugs, but no differentiated information about concentration. It is quite common practise to carry out a subsequent laboratory method, usually GC/MS, as a confirmatory analysis in case one test should show a positive reading meaning the presence of one or more drugs.

Besides convenience the saliva-based method has another advantage as this is the only method to detect and determine the original drug components, all other methods would include metabolites as well. In order to prove quality and reliability we went through 3rd party validation at the Victorian Institute of Forensic Medicine in Melbourne, where sensitive (nano-gram level per mL of saliva) and accuracy (standard deviation +/- 5 %) have been confirmed. Drug detection in saliva has a short response time, i.e. just about 10 to 15 minutes after consumption drugs can be detected, which complies with our key objective of impairment testing. Our method is not designed to test somebody for drug consumption 6 months back in history, which is also irrelevant from an occupational safety point of view as the drugs have completely disappeared from the brain after such a long time, our analytical window covers the most important time period from 10 to 15 minutes after consumption up to a day or a little longer.

The detection device itself consists of two major components, one is the cassette for sample-taking and performing the detection process and the analyzer in order to evaluate the lines which are formed in this detection process.

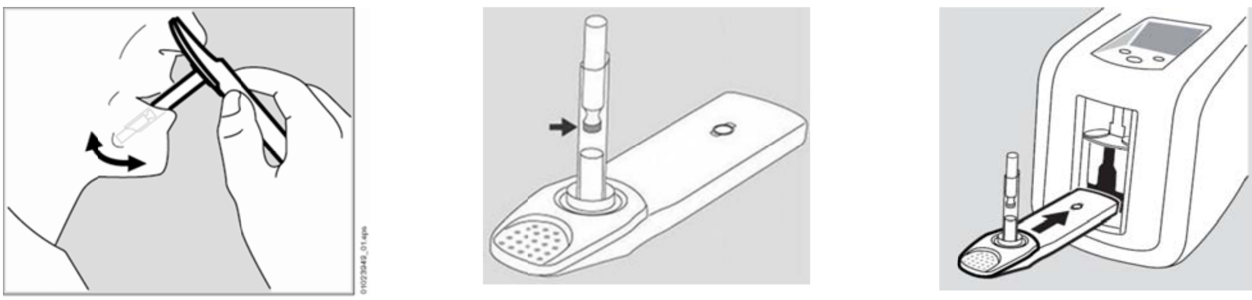

Fig. 3: Sampling of oral fluid for drug testing and subsequent analysis with an opto-electronic read-out

The cassette is hygienically packaged prior to use, goes into the mouth of a person for about 1 minute, a blue discolouration will indicate sufficient volume of saliva. Finally the cassette is put into the opto-electronic analyzer to evaluate the reading in combination with some buffer solution to active the components. The result will be displayed, stored, and can be directly printed from the analyzer as proof of a test on site. The analyzer has a capacity of storing up to 300 sets of data including date and time, they can be transferred to a computer as well for further storage or statistical evaluation.

We decided to go for this electronic read-out for two reasons, one is to avoid discussions if a weak line is present or not, and a second one is the practical convenience of obtaining and storing comprehensive measurement reports from this screening test for drugs.

Conclusion

In order to comply with implemented drug- and alcohol policies in companies and their requirements to measure we have developed user-friendly devices for detection and measurement of alcohol in breath of human beings as well as drugs in oral fluid. Both have data logging and printing capabilities to generate measurement reports and print-out, which can be directly signed in site by the person who has been tested and the testing officer in charge as a proof of measurement. As we are using the same printer for both instruments the whole equipment can be seen as family for workplace diagnostics. Sensitivity, specificity and standard deviation have been tested by 3rd parties in order to confirm ability, requirements, and specifications.

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Emerging health issues – A model of consultation and cooperation in the NSW coal industry

Introduction to the Airborne Contaminants and Noise Sub-Committees of the Standing Committee on Dust Research and Control

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Abstract

The Standing Committee on Dust Research and Control was established in 1954 and is an expert advisory body comprising representatives of the colliery proprietors, mining unions, government departments, Coal Services Pty Ltd medical and engineering personnel and independent consultants.

The main role of the committee is to

- Monitor the results of respirable dust sampling
- Evaluate dust hazards
- Research improved dust control methods
- Disseminate information
- Educate mine personnel in matters related to dust control

Since its inception the dust committee has actively pursued the eradication of dust related diseases among coal mine workers and this role continues today to remain fundamental to the promotion of improved health standards for coal industry workers.

The decision to amend the Coal Mines Regulation Act to implement gravimetric dust sampling in 1983 was based on recommendations from the Standing Dust Committee following extensive discussions, pilot studies and worldwide literature searches undertaken by the Committee.

Over the years the Standing Dust Committee has initiated a number of innovative and important changes in dust control techniques within the industry and produced publications which have been widely circulated. These include, but are not limited to:

- Technical bulletins & reports
- Respirable Dust in Coal Mines booklet
- Dust the Invisible Killer booklet and video
- Disposable dust masks for underground use
- Respirable Quartz booklet
- Diesel Particulate booklet and video

Pneumoconiosis prevalence today is so low that no new cases have been recorded in NSW in the past 15 years and it has been acknowledged that the Standing Dust Committee has been instrumental in effecting this improvement.

In 1997 the Committee became involved in monitoring personal exposure levels for diesel particulate (dp) and organised seminars on dp monitoring in Australia to discuss directions the coal industry may take on the issue. A dp exposure standard was subsequently introduced into the NSW coal industry through the efforts of the Standing Dust Committee and today the Committee is recognised in the UK, Canada and the USA as being a leader in this field.

The Committee developed a working relationship with representatives of the National Institute of Occupational Safety and Health (NIOSH), USA and provided updated statistical information and comments to them on dust exposure standards to assist in the revision of their own dust standards. Through this relationship, the Committee also arranged to borrow the newly developed Personal Continuous Dust Monitor for trials in Australia.

The Standing Dust Committee meets bi-monthly, usually at mine sites. It is currently comprised of representatives of Coal Services Pty Limited's technical and medical personnel, NSW Minerals Council, CFMEU, Department of Industry & Investment and selected industry consultants/experts.

In July of 2010 the SDC introduced the first major change of it's structure in 55 years. The first change was to formally include diesel particulates as a regular topic of consideration and incorporate into name and charter of the committee. It is also planned to include other airborne contaminants on an ad hoc basis, such isocyanates and fumes, to ensure total respiratory protection for mineworkers.

The effectiveness of this model in controlling dust and eliminating mineworkers' pneumoconiosis is also to be applied to dealing with noise induced hearing loss. NIHL is the current health scourge for mineworkers resulting in reduced quality of life, exposure to hazards and massive compensation liability. A focus on noise through regular monitoring and reporting as well as research into methods to eliminate or control through equipment design will move NIHL into the same historical context as black lung in NSW.

The structure and membership of the committee was reviewed to ensure sufficient technical expertise to cover the broader subject matter. It is critical that senior industry participants are involved to ensure influence and action to achieve results. One potential risk to the effectiveness of the committee was that the broader membership may produce a committee that was too large and unwieldy to operate effectively. The solution proposed was to have 2 sub-committees reporting to a single chairman appointed by CSPL. The first sub-committee would consider airborne contaminants and be similar to current SDC. The second sub-committee would consider noise issues and have some common membership with the airborne contaminant sub-committee but also contain additional noise and audiometry expertise.

The airborne contaminant & diesel particulate subcommittee continues to meet at same frequency as the previous SDC.

The noise subcommittee will meet less frequently initially; 2 or 3 times per year and it is expected that first year will be an information gathering period followed by an educational campaign to highlight the nature and extent of noise induced hearing loss and associated issues including:

- Collecting information to determine extent of NIHL
- Publishing resource material

  - Handbook for employees
  - Handbook for employers
  - Other media, eg podcasts, videos, posters, fact sheets
- Undertaking an education campaign
  - Industry seminars (NSW MC safety seminar, DII Check Inspectors conference, DII hazard focus campaigns, etc)
  - Tool box talks (at mine sites, generally by CSPL staff)
  - Information packs and interviews with HR managers & Safety Training coordinators (discuss suitability for employment)
- Noise Management Plans
  - Based on CMHSA/R major hazard management plans
- Review of monitoring data
  - Baseline monitoring
  - SEG programmes
- Feedback and Improvement

  Consider forum similar to Queensland diesel particulate committee.

Plumbism, the Occupational Hygienist and of being Italian

Andrew Orfanos
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Abstract

In 1925 the Royal Commission on Plumbism looked into the incidence of lead poisoning amongst employees of the Broken Hill Associated Smelters Pty Ltd located at Port Pirie, South Australia.

This commission not only identified the lack of a systematic approach by Smelter management to control employee exposure to lead dust and fume but also identified the misclassification of disease.

Using examples taken from this report, this paper will discuss the importance of using a systematic approach to adequately characterise workplace exposures and highlight that the basic hygiene principles utilised in this process have changed very little in 85 years.

This paper will also discuss and suggest that the issues faced by occupational physicians historically and the solutions presented to address the increasing incidence of Plumbism are very similar to those faced and utilised by today's occupational hygienist in addressing workplace exposures.

As a result of these issues, it is the author's belief that the modern occupational hygienist inadvertently perpetuates the perception that many workers have, that within management there is a culture of blaming the worker for exposure to occupational hazards. This perception is reinforced by management's ongoing utilisation of lower order controls to reduce hazard exposure, which predominantly focus on the worker.

Today, we may not blame an individual's exposure to an occupational hazard on ethnicity, but as occupational hygienists, through our actions we inadvertently contribute to perpetuating a cultural stigma that makes employees feel that management unjustly point the finger of blame at those workers who have been identified as being significantly exposed rather than focus on reducing exposure at its source.

On second thoughts, maybe it is those damned Italian's after all!

Keywords: Lead, Occupational Hygienist, Plumbism, Port Pirie.

Introduction

Port Pirie is a coastal town located 390 kilometres west of Broken Hill. Prior to World War One (WWI) the port was used to ship the rich lead, silver and zinc ore concentrates coming out of Broken Hill to Germany for smelting. This could not continue after the onset of WWI and as the British Empire lacked sufficient smelting facilities Broken Hill Associated Smelters Pty Ltd (BHAS) purchased the smelters located at Port Pirie. The role of BHAS was to smelt and refine the lead concentrates, sell the lead on the world market and then return the proceeds to the major Broken Hill producers who were all joint shareholders. By the early 1920's BHAS was the largest single lead smelter in the world, producing about 10% of the entire world's production[1].

On purchase of the old smelters BHAS soon discovered that it had inherited an old and inefficient smelter that needed significant maintenance on existing plant. Significant upgrades were also required to treat both the sulphide ore that was now being extracted by the mines operating at the extremities of the Broken Hill lode, and the slime concentrates that were also being produced at Broken Hill.

The installation of plant to treat these new raw products, along with an overall increase in production at the smelter meant that workers were now being exposed to not only more lead dust and fume but also to lead in a more bioavailable form. This brought about an increase in the number of workers presenting with signs and symptoms of lead exposure resulting in the number of BHAS employees receiving workers' compensation for lead poisoning increasing from 1 case in 1917 to 261 in 1925[2].

A Royal Commission set up in 1925 to identify the root causes of this epidemic concluded that the majority of cases were incorrectly diagnosed and in fact illnesses associated with carbon monoxide poisoning[2]. In those that were attributed to lead exposure the Royal Commission identified the majority had occurred among southern European immigrant workers who were labelled as either 'susceptible' or 'malingering'. They were portrayed as careless individuals who refused to wear respirators, did not wash their hands prior to eating and rarely showered at the end of the shift[2].

Mining magnate and financier W. S. Robinson went one step further to claim that the increase in compensation claims was due to a fraudulent scheme organized by an Italian organisation, in which Italian workmen deliberately consumed sugar of lead (lead acetate) in order to receive lump sum compensation payments[3].

Discussion

The very first task an occupational hygienist is required to undertake is the identification of all potential hazards that may be present in the workplace. This can only be successfully undertaken if the hygienist has a sound understanding of the processes carried out in the workplace and of the raw materials being utilsed[4].

Once identified each hazard must be appropriately characterised. By identifying the chemical and physical nature of a hazard, the most likely pathway(s) of entry into the body can be determined and the potential risk of exposure to workers ascertained.

The Royal Commission first interviewed the General Superintendent of the Smelter to have the entire refining process explained[2]. This included a listing of all of the raw materials processed at the refinery as well as those used in processing the various lead containing ores. The numbers of people working in the various areas of the Smelter were also identified to determine who may be potentially at risk.

Lead sulphide (galena) represented a significant proportion of the feedstock and was brought to Port Pirie in two forms, mainly as concentrate and also as slime, the result of a flotation process. The slimes were much finer than the concentrates, and when dried produced a very fine dust. Although galena was a relatively less toxic form of lead compared to lead oxide and lead carbonate, the physical form along with the treatment of the ore, which required the use of high temperatures, resulted in significant quantities of fine lead dust and fume being discharged into the general workplace atmosphere.

It was also communicated to the Royal Commission that inhalation of these lead compounds was a significant route of exposure, and that the hazardous nature of any lead compound was not only proportional to the size and solubility of these particles in the respiratory tract but also in the gastrointestinal system.

Not only can the potential for occupational exposure to a hazard be significantly altered as a direct result of increased production but can also arise by a change in the process that alters the chemical and/or physical form of the hazard. This can alter the exposure profile of the hazard, either by increasing exposure through an already identified pathway (i.e. inhalation) or by allowing another route of exposure to become significant (i.e. ingestion).

The BHAS management of the day could not understand why the number of new cases of Plumbism being reported was rising as they believed that smelter conditions had significantly improved. However they did not appreciate the impact that increasing production, plant modification and the processing of different types of feedstock through the smelter had on both the amount and bioavailability of lead workers were potentially exposed to.

It was perceived by BHAS management that the installation and subsequent expansion of the baghouse to filter the gases emitted by the blast furnaces would significantly reduce the incidence of Plumbism amongst workers. However this was not the case, nor was it the motivation to install a baghouse in the first instance. Tests conducted prior to BHAS ownership in 1908 showed that there were significant losses of metal through the smelter stack that could be collected and reprocessed. An ever expanding baghouse provided an avenue for workers to be exposed to large concentrations of lead fume whilst undertaking periodic maintenance on this piece of plant. Due to the objections of workers of British stock to undertake this work (workers would be covered head to foot in black fume), workers of mainly Greek and Italian origin made up the bulk of these maintenance crews[5].

The potential for generating new hazards was also not appreciated. It was not until the Royal Commission went through this detailed characterisation process that another potential hazard was identified. Now that BHAS was processing sulphide ores, the lead concentrates had to be roasted in a sintering plant to remove the sulphur and agglomerate the ore into a sinter suitable for smelting in the blast furnace. This generated another occupational hazard that smelter management were unaware of, workers were now potentially being exposed to sulphur dioxide.

Another important aspect of hazard characterisation is to understand how a workers physical location and specific work activities can impact on their potential exposure to a hazard. A walk through inspection of the workplace is mandatory to not only characterise the process but to document the numbers of employees, tasks undertaken and worker movements throughout the various work areas[4]. This is also necessary to attempt to explain any worker-worker variability of personal occupational hygiene monitoring data.

Hazard exposures coming from less obvious sources can also be easily missed if this is not adequately undertaken.

Smelter maintenance workers, along with other occupations such as motor mechanics historically used leaded petrol as a washing solvent to clean their hands and various metal components[6]. As a result, dermal exposure to tetra ethyl lead was a significant source of lead for workers undertaking this poor work practice, which contributed significantly to their overall body burden of lead. Even today, poor work practises that use harmful solvents to clean hands, tools and various metal components can lead to dermal exposure being a significant exposure pathway. Only through detailed observation of work practices would such an exposure source be identified.

Significant exposure to a particular hazard may also be identified through appropriate characterisation of worker signs and symptoms (health effects) that are associated with exposure to a specific hazard.

The Royal Commission identified that many of the cases reported as Plumbism at the smelter were in fact disorders associated with carbon monoxide exposure. It was identified that no fewer than 53 of a total of 97 men examined were in fact suffering not from disability arising from lead absorption, but carbon monoxide inhalation[2]. Conclusions were reached from a study of the symptoms and signs presented, and from investigations made in the work places where these persons had been employed[2].

Today, it is unlikely that workers will present with such obvious signs and symptoms of hazard exposure. However, health surveillance in the form of biological monitoring can be a very useful tool to identify how much of a particular chemical hazard is being taken up by an individual. It is also a very important tool in determining whether other exposure pathways such as ingestion and dermal absorption are significant[4].

It should be noted that biological monitoring and health surveillance for the most part is a retrospective indicator of hazard exposure. Biological monitoring is NOT a control strategy in its own right. However, it can serve as a useful tool in determining the overall effectiveness of a workplaces hazard exposure reduction program. Biological monitoring can determine the effectiveness of site engineering controls, respiratory protection programs, employee training programs or whether personal hygiene strategies are effective in mitigating exposure[7].

Information gathered through a comprehensive hazard and worker characterisation process can also be used to identify non-occupational sources on rare occasions.

Such an example is where in a recent investigation at the Smelter, individuals working in low lead risk areas of the smelter were identified through blood lead monitoring to have unacceptably high BLL (> 35µg/ml) even though a thorough characterisation of the plant, materials and tasks that these individuals were exposed to indicated that potential exposure was minimal. Further characterisation of worker activities outside the smelter identified that these individuals were avid anglers on their days off. They were not only eating and smoking after handling lead sinkers, but they were in fact placing the sinkers between their lips during the angling process. In some cases individuals were making their own lead sinkers in their backyard shed. These non-occupational activities were shown to have a significant impact on the individuals BLL.

This example also reinforces the importance of worker awareness, how they may be potentially exposed to a hazard in and out of the workplace and the tools available to the worker to mitigate exposure.

The Royal Commission identified that of 429 cases of Plumbism reported between 1917 and 1924, 28% occurred within the first 12 months of employment. When this figure was segregated into nationality groups it was identified that 50% of total cases reported were Italian, 47% Greek, 46% Maltese and only 20% British. Of the total reported cases 46% occurred in persons having not more than 2 years service. Of the cases reported amongst the various nationality groups 81% of Greeks and 76% of Italian employees had less than two years service. In contrast only 28% of British persons identified as having plumbism had less than 2 years service[2].

This highlights the importance of employee hazard training prior to or as soon as employment commences. In this manner employees are made aware of the exposure reduction strategies utilised within the workplace by both management and the individual to mitigate exposure. By giving workers appropriate training they will not only understand the risk, they will also be armed with the various strategies available to them to minimise exposure. This also empowers the new worker to have the confidence to undertake the work in a safe manner even in the presence of an older worker who may be displaying poor individual work practices.

It is also critical to identify your target audience to ensure effective learning or simply to get the message through. Today, like the past, a new wave of non-English speaking migrants exists that need to be considered when determining the most appropriate methods to deliver a training program.

Although worker education and health surveillance are both important components of a comprehensive site occupational health and hygiene management program, neither has the ability to reduce the level of hazard in the work environment. The hierarchy of controls and the use of higher order controls such as isolation and engineering to control workplace exposures is constantly preached, however, as hygienists we inevitable fail to follow this mantra. Predictably we fall back on recommending or utilising lower order controls which focus on the worker, such as personal hearing and respiratory protection controls, administrative controls and worker education training.

This was also the case at BHAS in the 1920's, where the smelter's occupational physician focused on educating workers to avoid the ingestion of lead dust, even though it was generally accepted that the conditions experienced at the smelter at this time lent towards the ingestion of lead being only a minor exposure route in comparison to inhalation.

The focus on educating workers reflected the practical limits placed on the industrial physician at the time. He lacked both the engineering skills that would enable him to judge whether possible improvements were technically feasible, and the authority within the managerial hierarchy to ensure that any higher order controls recommended were acted upon[1].

As such the recommendations focusing directly on worker behaviours only reinforced management's views on the causes and means of prevention of lead poisoning. As a result, attention was shifted away from the source of the problem, the production process, and redirected at the behaviour of workers.

Rather than attempting to remove or engineer out the hazard, the removal of "susceptible" workers was encouraged and educational campaigns that tended to shift the blame onto the alleged carelessness of workers were conducted.

The modern occupational hygienist faces very similar challenges. One such challenge is mounting and defending a comprehensive business case to management that recommends the appropriate higher order controls using the systematically acquired exposure data and their knowledge of what will have the greatest impact in terms of sustained reduction.

For a business case to succeed in influencing management the following critical information needs to be put forward;

- The evidence that highlights that the current exposure profile for a specific hazard is unacceptable. This evidence is obtained by appropriately summarising all of the available data that was obtained through the comprehensive and systematic characterisation of the hazard,
- The impact that this exposure may potentially have on the individuals exposed, the community and on the business as a whole, and
- The recommendation of appropriate and specific higher order controls along with information to support their efficacy in reducing exposure such that the benefit of exposure reduction will outweigh the cost associated with the high order control.

The ability of occupational hygienists to effectively communicate their work through formal processes such as a business case is not a new challenge to our profession. Martin Jennings in the early 1990's identified that a focus on the technical aspects of the profession meant that occupational hygienists tended to overlook the importance of being able to effectively communicate their concerns to management and thus influence the decision making processes in their organisation[8].

Another aspect that challenges our ability to present a strong business case is our technical expertise. Traditionally, individuals that come into the profession of occupational hygiene do so with a chemistry background rather than an engineering background. Recent AIOH membership records show that amongst full members and Certified Occupational Hygienists there were approximately 108 with a chemistry degree compared to only 14 with an engineering degree[9].

As such, mounting a strong business case that presents compelling evidence and appropriate higher order controls that can be confidently defended by the occupational hygienist can present a significant challenge.

This may bring us to focus on those control strategies which we are more familiar with and confident undertaking. Such control strategies are likely to be lower orders of control that focus on the worker (PPE) and their behaviour (education).

Conclusion

Today, more than ever employee behaviours are critical as workplace conditions improve and we aim to reduce exposure to workplace hazards to as low as reasonably practicable.

However the focus cannot just be on workers, particularly where workplace monitoring shows that airborne hazard levels are still a significant source of hazard exposure. The worker must be able to see that management are also directing money, resources and labour to higher level controls.

Mounting a successful business case to management that presents compelling evidence and appropriate higher order controls that can be confidently defended can present a significant challenge to the occupational hygienist.

As a result our energies may be directed to those activities that our academic background and workplace experience allows us to undertake with confidence and conviction. Such activities are likely to involve more workplace monitoring and focusing on lower order controls that deal directly with the worker, such as PPE and worker education.

Just as in the past where the worker or ethnic minorities were blamed for their exposure to workplace hazards we unwittingly perpetuate this "Italian effect" through our actions that directs management to continue to utilise lower order exposure control strategies that focus on PPE and worker behaviour. The ongoing use of lower order controls and associated lack of commitment to plan and budget for future implementation of any higher order controls by management results in workers feeling that management believe that they are to blame for their exposure.

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Assessment of Exposure to Cyclophosphamide and Ifosfamide by the Analysis of Wipe Samples and Urine using Ultra High Pressure Liquid Chromatography / Tandem Mass Spectrometry

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Poster Abstract

Cyclophosphamide and ifosfamide are common antineoplastic drugs used for the treatment of cancer in hospitals. The International Agency for Research on Cancer classified cyclophosphamide itself as a human genotoxic carcinogen (Group 1) (IARC 2009) and ifosfamide as a probable carcinogen (Group 2). Health care workers such as nurses and pharmacist handling these drugs during preparation, administration and nursing of treated patients can potentially be occupationally exposed. The exposure pathways are by inhalation and through the skin.

TestSafe at WorkCover NSW has recently developed two analytical methods to assess the exposure to the cytotoxic drugs cyclophosphamide and ifosfamide. The first method uses wipe sampling to assess the surface contamination in work environments and the second method uses biological monitoring of urine to assess personal exposure of the health care workers. Both of these methods use ultra high pressure liquid chromatography tandem mass spectrometry (UPLC/MSMS) with positive electrospray ionization. This analytical technique was developed to be selective and sensitive allowing low level exposure assessments to be performed. For the urine sample, solid-phase extraction was used in the sample preparation, while for wipe sampling the swab was treated with methanolic sodium hydroxide to extract the amines. Each method was fully validated and gave good quality assurance parameters.

Occupational Contact Dermatitis: Does the worker's understanding of their condition alter their clinical outcome?

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Poster Abstract

Occupational Contact Dermatitis (OCD) is an inflammatory skin disease that results from skin exposure to substances and conditions found in the workplace [1]. OCD is a common, but preventable disease that has a significant negative effect on a worker's quality of life. [2&3].

The aim of this study was to analyse one aspect of data that was gathered during a follow up survey of patients (*n* = 110) who had attended the Occupational Dermatology Research and Education Centre in Melbourne. These patients were diagnosed with significantly or partially work-related OCD. The objective of the data analysis was to assess if a worker's knowledge of their skin condition impacts on their disease.

Each of the chosen variables was used to determine if there is a statistical correlation between patient understanding and the clinical outcomes of their disease. Although previous studies have found a link between patient education and clinical outcomes, analysis of this data set showed no statistically significant correlation between any of the variables tested [4].

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Operator Particulate and Formaldehyde Exposure in an Educational Wood Working Shop

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Poster Abstract

During an initial Walk Through Survey [WTS] of the Art Department's model manufacturing workshop at RMIT University, the shop' s operators reported issues with exposure to wood dust, and also a perception of formaldehyde [HCHO] exposure, due to “general” industry knowledge.

As per previous work, wood dust is implicated in an increased prevalence of certain workplace respiratory symptoms and diseases and HCHO is also of concern due to its status as a Sensitizer and Probable Human Carcinogen.

The Model Making workshop is a new facility, fully enclosed in a multi story educational building. The majority of the wood processing equipment is less than five [5] years old, and a dedicated multi point local exhaust ventilation system [LEV] has been installed, prior to commissioning..

A series of inhalible particulate monitoring , both personal and static, and similar HCHO monitoring, using a UMEX100 diffusion sampler was undertaken.

The performance of the LEV was assessed via smoke tube and thermal anemometer.

The study's results indicate very low dust levels, well below current industry and regulator exposure levels, as well as minimal HCHO. These results were reinforced by the excellent performance data of the LEV.

Detection and Quantification of Environmental Food Allergens: The development of sensitive assays with focus on seafood allergens

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Poster Abstract

The food industry employs a large number of workers exposed to potential allergens capable of causing occupational allergies. Workers handling food products and derivatives are at increased risk of developing occupational sensitization. Exposure to food allergens occurs primarily through inhalation and skin contact with dust, steam, vapors, and aerosolized proteins generated during cutting, scrubbing, cleaning, cooking, boiling and drying activities. In particular exposure to seafood allergens during processing has been recently identified by our group as potential high-risk activity for allergic sensitisation. Airborne particulate levels in the seafood processing industry can vary from 0.001–11.0 mg/m3, however, there are currently no established methods available to detect and quantify food allergens at the workplace.

The aim of this study was to develop a novel technique to detect and quantify environmental exposure to a model food allergen. We utilised the major fish allergen parvalbumin which is a small protein found in the muscles of fish. This study focuses on parvalbumin from Barramundi; a major table fish in Australasia and has not been studied previously. Specific anti-parvalbumin antibodies were used to establish an inhibition-ELISA (enzyme-linked immunosorbent assay) to quantify the amount of allergen in dust and aerosol samples. In addition the allergen can be detected using immunoblotting, which allows simultaneous characterisation of additional allergens in the samples.

This study demonstrated that environmental exposure assessment of food allergens can be readily achieved using a combination of physicochemical and immunological approaches. These results form the basis for the development of more sensitive and easy to operate assays for a broader range of environmental allergens.

Operator Particulate and Formaldehyde Exposure in a Commercial Wood Working Shop

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Poster Abstract

Wood dust is implicated in an increased prevalence of certain workplace respiratory symptoms and diseases. Recent European estimates suggest 3.6 million workers are exposed to wood dust daily. French and American regulators are moving to an inhalable limit value for wood dust in workplaces of 1 mg/m3 . [1]. Wood dust may also contain organic binders used in particle board [MDF] manufacture, or release free formaldehyde when used.

In cabinet making a combination wood and wood products, [laminates and MDF], are commonly used, and in this pilot study at an SME facility, workers' exposure had not been measured , nor the effectiveness of local exhaust ventilation [LEV] evaluated.

Within this pilot study, both particulate material and air borne formaldehyde [HCHO], as a primary indicator of organics released / generated when using or handling MDF, were monitored.

Simultaneous sampling for Inhalable Dust, as per AS3640-2009, and HCHO, using a UVEX100 diffusion sampler, was undertaken on a series of typical workdays.

Results indicate worker particulate exposure at levels below the SafeWork Australia Exposure Standard, but above international levels. Formaldehyde sampling results were consistently below the Australian Occupational Exposure level.

1] AIHce – Wood Dust 2, 2011, Call for Papers, AIHA

The Development and Implementation of a Noise Management Plan at a Housing Pre-Fabrication Facility

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Poster Abstract

In a housing pre-fabrication facility a diverse range of activities are undertaken within close proximity of each other and the potential for each worker's noise environment to not only impact upon their own hearing, but also that of their working neighbour is significant.

In this Case Study, from a noise evaluation and management perspective, a green field site was assessed for noise levels, patterns and processes, by conducting noise mapping and dosimetry on representative workers during various activity periods of a typical shift.

In this pilot evaluation, the noise measurements were taken on three [3] occasions, as representative of a typical production workload.

Candidate workers for dosimetry were required to wear dosimetry equipment from the start of shift (at 7.00 a.m.) until shift finish, (at 3.30 p.m.), and data were downloaded on a daily basis.

Noise mapping was undertaken at various times throughout the working day to allow a representative situation to be established.

Results indicate that of the four [4] Similar Exposure Groups [SEG's] monitored, two [2] experienced above acceptable noise exposure, and this was related to the fact the facility had several specific process/work areas where noise levels were above 85dB[A].

The development of a Noise Management Plan [NMP], to minimize worker exposure, eliminate Noise Induced Hearing Loss [NIHL] and maintain good communication and safety on site included:

A] Noise Awareness Training, B] Hearing protection device usage and maintenance training, and C] On-going audiometry for staff and long term contractors.

Survey of the Import and Use of Perfluoroalkane sulfonates (PFAS) in Australia

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Perfluoroalkyl sulfonates (PFAS) are of interest because some members of this group, such as perfluorooctane sulfonate (PFOS), are hazardous to human health and the environment, persistent and bio-accumulative. Australia, in line with other countries, considers the use of certain PFAS should be phased out. NICNAS conducted a survey to collect import and use data for PFOS and other PFAS and related substances in Australia for the years 2006 and 2007 to aid in the development of a national risk management strategy and appropriate regulatory activity.

The survey indicated there was no manufacture of PFOS or other PFOS in Australia. These substances were imported as technical grade or in formulations. Overall there was a slight increase in reported imports of PFOS and other PFAS in 2006/2007 compared to earlier survey results. Import of products containing PFOS were for essential uses only, for which there are no alternatives. No firefighting foams containing PFOS were imported and the existing stocks have reduced significantly.

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Management of Microbiological Contamination of Headsets

Jim Orr

Headsets are used in a large supermarket distribution centre to provide workers with instructions to enable the filling of orders for stores.

A system of allocated and pooled headsets has been developed. Cleaning of these is an important issue with employees.

The poster describes the headset allocation system, the results of testing done on the various cleaning procedures investigated, and the preferred cleaning method adopted.