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EXTENDED ABSTRACT

A 5-year cross sectional review of underground vehicle exhaust emissions (elemental carbon and nitrogen oxides) using de-identified data from 13 Western Australian underground mine sites

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Objectives

Underground mining in Western Australia has for decades thrived on diesel engines for operations, fuel efficiency, ease of maintenance, reliability, and durability. Although, diesel-fuelled engines are vital to the underground mining industry, miners could be potentially exposed to high levels of diesel exhaust contaminants when compared to other industries. The aim of this study is to:

(i) review diesel exhaust emissions tests from 13 Western Australian underground mine sites, and
(ii) to evaluate levels of elemental carbon and nitrogen oxides against benchmark criteria, and
(iii) recommending controls for potentially exposed underground miners.

Materials and Methods

A cross-sectional study was undertaken to review the diesel exhaust emission testing data that were collected between 2015-2020 from 13 Western Australian underground mine sites. The diesel exhaust emissions tests measure elemental carbon, carbon monoxide, carbon dioxide and nitrogen oxides using a Diesel Chekmate®, ECOM EN3-F, Testo 340 and DPM-RT. Benchmark criteria used were for elemental carbon (low-risk = <25 mg/m³, medium-risk = 25 to 50 mg/m³, high-risk = >50 mg/m³) and nitrogen oxides (<1000 ppm) (Davies, 2004).

Results

A total of 5,597 vehicle emission tests were conducted over the 5-year period, with 2,804 tests from heavy vehicles and 2,793 tests from light vehicles. Note: due to technical reasons, not all contaminants were collected in each test.

Non-Filtered Vehicles

There were 4,893 elemental carbon tests collected without diesel particulate filters (DPFs), 10 results were over the high-risk limit of 50 mg/m³, 101 results were between 25-50 mg/m³, 788 results were between 10-25 mg/m³ and 3,994 results were less than 10 mg/m³. The 10 results that exceeded 50 mg/m³ had one instance where the result was not rectified. Of the 4,905 nitrogen oxides tests conducted, 12 results returned over 1000 ppm, all of these were from heavy vehicles. Nitrogen oxide results exceeding 1000 ppm were rectified.

Filtered Vehicles

Of the 246 vehicle tests where a DPFs installed, none exceeded the high-risk limit of 50 mg/m³. Eight of these tests were between 25-50mg/m³, 34 were between 10-25mg/m³ and 205 were less than 10mg/m³. There were no nitrogen oxide exceedances.

Conclusions

- Firstly, very few vehicles tested are fitted with DPFs.
- All exceedances were from vehicles not fitted with DPFs.

The management of diesel exhaust emissions is most definitely reactive: there is no proactive implementation of DPFs. The lack of implementation of DPFs in fleets, given the exceedances, indicates legislative motivations are not sufficient to result in their installation. Further research should look at the maintenance and management of DPFs and catalytic converters to understand their long-term performance.

Keywords

Underground mining, vehicle exhaust emissions, diesel particulates, exposure, elemental carbon, nitrogen oxides.