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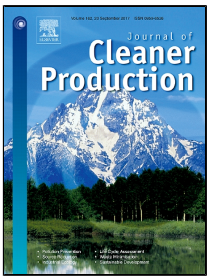

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Analysis of energy consumption and carbon footprint from underground haulage with different power sources in typical Canadian mines

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ABSTRACT

Diesel fuel, the principal power source for haulage in underground mines, is considered carcinogenic for its hazardous gases and particulate exhaust. Filtering, water spraying and ventilating the mine air are amongst most popular and effective mitigating practices. However, these techniques pose high initial and ongoing infrastructure costs as well as other operating expenses. The costs associated with any mine haulage depends on factors such as fuel cost, haul road conditions, idling time, over/under loading, maintenance, operator competency etc. Given the health concerns and the financial burdens of using diesel vehicles for underground haulage, the necessity arises to shift from existing diesel dependency to a more efficient alternative fuel, keeping in mind the mine production, sustainability, financial and health benefits. This study aims to: (*i*) assess underground haulage fuel consumption and fuel costs of diesel, compressed natural gas and electricity on a relative basis in four Canadian provinces (British Columbia, Saskatchewan, Ontario and Quebec); (*ii*) evaluate the effect of mine haulage to the ventilation requirement and potential carbon footprint reduction; and (*iii*) compare CO_2 emissions for the complete fuel life cycles arithmetically and using Life Cycle Analysis in the four provinces by taking into account energy mix for electricity power generation. The study was performed on 36 conceptual mines to represent various mine sizes and haul road distances. The results suggest that electric haulage consumes lesser on-site energy and high potential fuel expense savings, especially in Quebec province, followed by compressed natural gas and diesel. In addition, electric and compressed natural gas haulage yield significant savings in ventilation power requirement and carbon footprint reduction. However, the life cycle analysis suggests that depending on the energy sources in each province, electric haulage does not always produce the lowest carbon emission.

ABBREVIATIONS

LCA, life cycle analysis; CNG, compressed natural gas; GHG, green house gas

KEYWORDS

Carbon footprint; energy consumption; diesel; compressed natural gas; electric haulage; underground haulage