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INCREASING THE VISIBILITY AND KNOWLEDGE BASE ON AIR QUALITY WITH BIG DATA AND ITS IMPACT ON THE POPULATION HEALTH

Erasmus+ KA220 Cooperation Partnerships

AIR POLLUTION SOURCES - EMISSIONS (CARS)

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1 INTRODUCTION

While cars are bringing major economic and social benefits, they contribute to road traffic congestion (excess delays), accidents, physical inactivity, climate change and local noise and air pollution.

Regulation of atmospheric pollutants have been discussed for several years already. For these reasons The European Union has adopted increasingly stringent regulations to control the composition of exhaust emissions within the vehicle type approval process, because of the significance of road transport as a source of air pollution (Brand, C., & Hunt, A. 2018). Current European vehicle type approval legislation regulates levels of NO_x (oxides of nitrogen) in exhaust emissions, but not specifically NO_2, an apparent discontinuity in European regulatory policy highlighted by Carslaw and Beevers (2004). Based on Rhys-Tyler, Legassick & Bell (2011) the European Union has accepted regulation on air quality for cleaner air for Europe. This regulation sets a limit value of pollutants that are considered as harmful to human health, especially limited values of nitrogen dioxide (NO2) and particulates (PM10). Diesel and gasoline are the most used fossil fuels due to their high energy release and low cost for engines Fayyazbakhsh, A., et al., (2022). Brand, C., & Hunt, A. (2018) found that the health damage associated with diesel vehicle emissions are around 20 times greater than electric vehicles and at least 5 times greater than those associated with petrol vehicles. The total health cost to the UK from cars and vans is £6 billion each year.

2 BACKGROUND

The immense use of gasoline and diesel fuels that started in the industrial period caused several benefits, especially in providing energy and spurring economic development but environmental problems are significant. Today, air pollution is one of the most critical problems that directly impact the environment and human health Eom et al., (2020). He et al., (2020) adds that air pollution can increase electricity consumption (e.g., central air conditioning to avoid air pollution) and reduce the energy generated by solar cell panels. Generally, air pollution's health problems are divided into short- and long-term effects. Short-term issues, which are temporary, include headache, skin irritation, irregular heartbeat, etc. On the other hand, permanent, long-term problems, such as blood cancer, decreased lung function, and heart disease. Alvarez et al., (2008) describes that the most emissions producents come from road transport such as (engine emissions, tyre or break wear). He specifies that Diesel (compression ignition) engines tend to produce higher levels of NO_x and particulates compared to petrol (spark ignition) engines. Diesel engines also emit a higher proportion of their NO_x as NO_2 compared with petrol engines. Vehicle manufacturers have utilised a range of exhaust treatment technologies to achieve compliance with the increasingly stringent type of approval limits. Carslaw (2005) and Grice et al. (2009) in their study have highlighted the significance of diesel particulate filters, and other exhaust after treatment systems for diesel engine vehicles, in the increasing formation of primary NO_2, and a

subsequent increase in the local NO_2/NO_x ratio. Diesel and gasoline emissions are affected by engine operating factors (load, speed, spark timing, AFR, and fuel compositions (specifically the C/H atom ratio) Wallington et al., (2006). Understanding the exhaust emission of these fuels needs a comprehensive view of both fuel and engine. Substantial changes in global car sales of gasoline and diesel are anticipated over the next few years. In this case, cars with the gasoline engine are expected to reduce from 78% in 2019 to 44% in 2030, and diesel engines from 14% to 4% for the same period. These reductions could result from regulations and policies enacted in the US and other western countries that facilitate the manufacture and use of hybrid cars Borlaug et al., (2021). Conventional diesel cars emit nearly ten times of nitrogen oxides (NOX) and three times of fine particulate matter (PM2.5) more per car and year than their petrol equivalent. Roughly two out of five cars (12 million) run on diesel today, and three out of five (19 million) on petrol. A small but growing share – about 1 in 500 – run purely on electricity. Battery electric cars are the cleanest overall as they produce zero tailpipe emissions but are liable to non-tailpipe emissions from tyre, brake and road wear, just like conventional fossil fuel vehicles. NO_x are inevitable combustion products originating not only from gasoline and diesel engines, but also from industrial furnaces, heating installations and agricultural activities. Although levels of emitted NO_x have fallen sharply, roadside measurements indicate that concentrations of nitrogen dioxide (NO_2) appear to be stabilizing close to the future limit levels in Europe or even to be rising (Carslaw, 2005; Carslaw and Beevers, 2004a, Carslaw and Beevers, 2004b). Particulate Matter emissions are a combination of liquid and solid particles in the air, some of which are visible, while the smallest and most harmful are not visible. Annually millions of deaths around the world are linked to PM emissions. Gasoline and diesel combustion can emit Black Carbon, Organic Carbons, and other aerosols that can act as nuclei of condensation cloud, changing the characteristics of clouds (Daellenbach et al., 2019). PM_{10}, which includes particles with diameters no larger than 10 µm, about 1/7 the diameter of a human hair, can trigger lung problems, among many other health concerns (Yu et al., 2019). $PM_{2.5}$ or fine particles contain particles with diameters no larger than 2.5 µm and are generated mainly through wood-burning or gasoline and diesel exhaust emission that increases the risk for a wide range of health impacts and growing evidence for impacts on dementia (Livingston et al., 2020). The air pollution emissions generated during use of any form of transport are only a part of the total amount of air pollution generated by transport-related activity. For example, 60–65% of life-cycle greenhouse gases from a petrol-engine car are CO_2 exhaust emissions during use with a further 10% being non-CO_2 exhaust emissions during use. The remainder is 10% associated with the car's manufacture (mostly energy use), and a further 15–20% emitted during extraction, refinery and transport of its fuel (Colevile et al., 2001). Road transportations are known as the main source for air pollution. In addition, domestic, commercial, and industrial activities may also cause air pollution. It is reported that more than 70–80% of air pollution in large cities in developing countries are attributed to greenhouse gas emissions from a large number of worn-out vehicles combined with poor vehicle maintenance, poor road structure, and poor fuel quality (Anjaneyulu, M. V. L. R., et al., 2006, Bodami, M. G. 2005, Mashelkar R,

et al., 2002, Molina, L. T. et al., 2007, Molina, L. T. et al., 2002, Singh, A. K. et al., 2007, Wang, H., et al. 2010). According to WHO report (2016), 91% of the world's population experienced the air with quality lower than the standard values. The key air pollutants are: particulate matters ($PM_{2.5}$ and PM_{10}), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), and (O_3) Zhou, T., Sun, J., Yu, H., 2017).

3 CONCLUSION

The cardiovascular effects of ambient PM make an extensive contribution to the substantial burden of air pollution on health. Epidemiological studies have found sizeable (and largely consistent) associations between exposure to urban PM and cardiovascular mortality and morbidities, including myocardial infarction and stroke. Furthermore, exposure to PM has both acute (e.g. alterations in heart rate and increased blood pressure) and chronic (e.g. exacerbation of atherosclerosis) actions on the cardiovascular system. Pollutants such as diesel exhaust particles can exert a multitude of effects on different facets of the cardiovascular system. These include vascular dysfunction, increased susceptibility of the heart to ischaemic damage, and an increased propensity for thrombosis (Miller, M. R., & Newby, D. E. (2020).

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