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RESEARCH ARTICLE

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Air quality impact of carbon monoxide emission from diesel engine electric power generators

Bamidele Sunday Fakinle[1] | **Oyetunji Babatunde Okedere**[2] | **Sunday Adekunle Adebanjo**[3] | **Adewole Johnson Adesanmi**[4] | **Jacob Ademola Sonibare**[4]

[1]Department of Chemical Engineering, Landmark University, Omu-Aran, Nigeria

[2]College of Science, Engineering and Technology, Osun State University, Osogbo, Nigeria

[3]Department of Chemical and Polymer Engineering, Faculty of Engineering, Lagos State University, Epe, Nigeria

[4]Environmental Research Laboratory, Department of Chemical Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria

Correspondence
Bamidele Sunday Fakinle, Department of Chemical Engineering, Landmark University, Omu-Aran 251101, Kwara State, Nigeria.
Email: xdales@yahoo.com; fakinle.bamidele@lmu.edu.ng

Abstract

An emissions inventory and the AERMOD View dispersion model were used to estimate the concentrations and the potential effects of carbon monoxide (CO) from diesel engine electric power generators operated by and providing electricity to a textile factory in Nigeria on its host air shed. The CO emissions from simultaneous operations of all of the electric power generators in the factory resulted in: 1-hr average CO emissions of 4.2 to 54.5 micrograms per cubic meters ($\mu g/m^3$) and 24-hr average CO emissions of 0.3 to 20.9 $\mu g/m^3$. The estimated 1-hr averaging period maximum ground-level concentrations of CO were deposited within the factory, while the 24-hr maximum ground-level concentrations are estimated at a distance 90 meters (m) from the factory in a southeast direction. The ground-level concentrations of CO emanating from the textile factory are within the stipulated ambient air quality standards.

KEYWORDS
diesel, emission inventory, energy, ground-level concentration, textile industry

1 | INTRODUCTION

In developing countries such as Nigeria, energy demand is growing rapidly due to urbanization and industrialization. This trend is likely to continue as the country's industrial development increases. Energy has a major impact on every nation's socioeconomic life and development. An inadequate supply of energy will restrict socioeconomic activities, limit economic growth, and adversely affect the quality of life (Ugwu, Nwankwojike, Ogbonnaya, & Ekoi, 2012). The inadequate supply of energy from the power sector in Nigeria has led to a loss of faith among citizens, causing them to resort to the self-generation of electric power through the use of diesel engine generators in order to meet their required energy needs (Adegbola, Kolawole, & Olabiyi, 2012). In regard to the operation of diesel engines, gaseous emissions are of great concern. A major component of the criteria air pollutants emitted by generators is carbon monoxide (CO) (Idiata, Omoruyi, & Alwize, 2010), which is the focus of this study.

The environmental impacts of air pollutants cannot be overemphasized, and their impacts on agriculture have been established (Lieffering, Kim, Kobayashi, & Okada, 2004). Water in the atmosphere serves as sink for sulfur dioxide (SO_2) (Johnson & Fegley, 2002), and the resulting water can be harmful to vegetation (Cape, 2003) and aquatic life (Havens, Yan, & Keller, 1993). Other impacts may be human health based (Adler, 2010). CO is readily absorbed from the lungs into the blood stream, resulting in competitive binding between it and oxygen to hemoglobin in the red blood cells, forming carboxyhemoglobin and oxyhemoglobin, respectively. Carboxyhemoglobin causes a decrease in the oxygen carrying capacity of the blood, thus inducing toxic effects that are dangerous to human health (World Health Organization [WHO], 1999). Furthermore, several health effects associated with NO_x have created a need for a threshold level in the atmosphere (WHO, 2000).

The impacts of pollutants released to the atmosphere are not always restricted to the point of release. Contaminants discharged into the air are transported over long distances by large-scale airflows and dispersed by small-scale airflows or turbulence, which serve to mix contaminants with clean air (Gilmore, Adams, & Lave, 2010). Emission rates, wind speed, and wind direction are strong factors influencing the transport of these pollutants away from their sources. Atmospheric dispersion models are widely used to make predictions and/or to solve problems associated with the emission of pollutants into the atmosphere (Zannetti, 1990).

The focus of this study is on the nearby environmental impact of CO emissions from the diesel power generating facilities of a textile factory located in one of the industrial estates in Lagos State, Nigeria.

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