

Contamination of the city of Ndola (Copperbelt Province of Zambia) by dust fall from local cement plants and lime kilns: Atmospheric modelling and ground geochemical verification

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The area of the city of Ndola (population of 490,000) in the Copperbelt Province of Zambia is strongly affected by dust fallout from cement plants and lime kilns located east of the city. The annual cement production in this area can be estimated at 588,000 tons, the annual lime production at 50,000 tons. For modeling the concentration fields around cement plants and kilns, the Gauss code type was selected, based on the stationary solution of turbulent diffusion equation (Model SYMOS0 97®; Matějček et al., 2008). Annual concentrations of PM₁₀ particles in the air, which pose a risk to human health, reach up to 500 µg/m³ in the central part of Ndola, well above an annual guideline value of 40 µg/m³ (WHO 2021).

The results of modeling were verified by ground-based geochemical survey of topsoil. It was found that high carbonate carbon concentrations (C_{carb} 0.015 to 1.10 wt.%) and high pH values in topsoil (7.5 to 8.5) coincide well with the modeling results. In the area of soils contaminated with dust from cement plants and lime kilns, increased concentrations of total sulfur (up to 0.09 wt.%) and increased concentrations of Hg (up to 1.1 ppm) were also found in the topsoil. High mercury contents can be attributed to the combustion of low-quality fuel (fuel oil) in cement production. Based on the above results, a proposal for the dustiness monitoring system in Ndola was prepared, and a proposal of measures to be implemented for a reduction of solid emissions from cement and lime works was developed.

References

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