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Optimization of Air Pollution Control Model for Mining

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Abstract : The sustainable measures on air quality management are recognized as one of the most serious environmental concerns in the mining region. The mining operations emit various types of pollutants which have significant impacts on the environment. This study presents a stochastic control strategy by developing the air pollution control model to achieve a cost-effective solution. The optimization method is formulated to predict the cost of treatment using linear programming with an objective function and multi-constraints. The constraints mainly focus on two factors which are: production of metal should not exceed the available resources, and air quality should meet the standard criteria of the pollutant. The applicability of this model is explored through a case study of an open pit metal mine, Utah, USA. This method simultaneously uses meteorological data as a dispersion transfer function to support the practical local conditions. The probabilistic analysis and the uncertainties in the meteorological conditions are accomplished by Monte Carlo simulation. Reasonable results have been obtained to select the optimized treatment technology for PM_{2.5}, PM₁₀, NO_x, and SO₂. Additional comparison analysis shows that baghouse is the least cost option as compared to electrostatic precipitator and wet scrubbers for particulate matter, whereas non-selective catalytical reduction and dry-flue gas desulfurization are suitable for NO_x and SO₂ reduction respectively. Thus, this model can aid planners to reduce these pollutants at a marginal cost by suggesting control pollution devices, while accounting for dynamic meteorological conditions and mining activities.

Keywords : air pollution, linear programming, mining, optimization, treatment technologies
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