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Fractional, Component and Morphological Composition of Ambient Air Dust in the Areas of Mining Industry

Authors : S.V. Kleyn, S.Yu. Zagorodnov, A.A. Kokoulina

Abstract : Technogenic emissions of the mining and processing complex are characterized by a high content of chemical components and solid dust particles. However, each industrial enterprise and the surrounding area have features that require refinement and parameterization. Numerous studies have shown the negative impact of fine dust PM10 and PM2.5 on the health, as well as the possibility of toxic components absorption, including heavy metals by dust particles. The target of the study was the quantitative assessment of the fractional and particle size composition of ambient air dust in the area of impact by primary magnesium production complex. Also, we tried to describe the morphology features of dust particles. Study methods. To identify the dust emission sources, the analysis of the production process has been carried out. The particulate composition of the emissions was measured using laser particle analyzer Microtrac S3500 (covered range of particle size is 20 nm to 2000 km). Particle morphology and the component composition were established by electron microscopy by scanning microscope of high resolution (magnification rate - 5 to 300 000 times) with X-ray fluorescence device S3400N 'HITACHI'. The chemical composition was identified by X-ray analysis of the samples using an X-ray diffractometer XRD-700 'Shimadzu'. Determination of the dust pollution level was carried out using model calculations of emissions in the atmosphere dispersion. The calculations were verified by instrumental studies. Results of the study. The results demonstrated that the dust emissions of different technical processes are heterogeneous and fractional structure is complicated. The percentage of particle sizes up to 2.5 micrometres inclusive was ranged from 0.00 to 56.70%; particle sizes less than 10 microns inclusive – 0.00 - 85.60%; particle sizes greater than 10 microns - 14.40% -100.00%. During microscopy, the presence of nanoscale size particles has been detected. Studied dust particles are round, irregular, cubic and integral shapes. The composition of the dust includes magnesium, sodium, potassium, calcium, iron, chlorine. On the base of obtained results, it was performed the model calculations of dust emissions dispersion and establishment of the areas of fine dust PM 10 and PM 2.5 distribution. It was found that the dust emissions of fine powder fractions PM10 and PM2.5 are dispersed over large distances and beyond the border of the industrial site of the enterprise. The population living near the enterprise is exposed to the risk of diseases associated with dust exposure. Data are transferred to the economic entity to make decisions on the measures to minimize the risks. Exposure and risks indicators on the health are used to provide named patient health and preventive care to the citizens living in the area of negative impact of the facility.

Keywords : dust emissions, exposure assessment, PM 10, PM 2.5
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