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OCCUPATIONAL EXPOSURE TO PETROLEUM COKE DUST AT AN OIL REFINERY: SOURCES, HYGIENIC ASSESSMENT, AND PREVENTIVE MEASURES

Mamatova Sh.I.

Background. Petroleum coke dust is a significant occupational hazard in oil refining, particularly during delayed coking, crushing, transportation, and loading operations. Exposure to airborne coke particles and associated chemical contaminants may adversely affect workers' respiratory health. This study aimed to identify the principal sources of petroleum coke dust, assess occupational exposure levels, and propose preventive measures to improve working conditions at the Fergana Oil Refinery in Uzbekistan.

Materials and Methods. The study was conducted at the delayed coking unit UZK 21.10–600, with a design capacity of 600,000 tons of raw material per year. Occupational exposure to petroleum coke dust was assessed at ten workplaces during the warm season. Airborne concentrations of hydrogen chloride (HCl), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2) were also evaluated. Dust concentrations were compared with the reference occupational exposure limit of 6.0 mg/m³ reported in the study. Technological processes, particle-size characteristics, chemical composition, and occupational protective measures were examined.

Results. The main sources of petroleum coke dust included hydraulic coke removal, crushing, conveyor transportation, storage, railway loading, and furnace cleaning. Petroleum coke contained approximately 92–95% carbon, 0.58–6.0% sulfur, and metals including vanadium, nickel, and iron. Fine particles, particularly the PM10 and PM2.5 fractions, represented a substantial component of airborne dust. The highest measured dust concentration occurred among loading-unit operators (7.5 mg/m³), followed by grab-crane operators (7.2 mg/m³) and equipment reliability mechanics (6.4 mg/m³). These measurements exceeded the reference limit by 25.0%, 20.0%, and 6.7%, respectively. Carbon monoxide concentrations ranged from 2.0 to 3.8 mg/m³ and remained below the reference limit of 5.0 mg/m³. Nitrogen dioxide concentrations reached 0.5 mg/m³, exceeding the specified limit of 0.4 mg/m³. Sulfur dioxide reached 0.6 mg/m³ at several workplaces, exceeding the reference limit of 0.5 mg/m³. The hydrophobic properties of petroleum coke dust reduced the effectiveness of conventional water-based dust suppression. According to the study, wind speeds above 2 m/s were associated with possible transport of dust beyond the industrial site. Working conditions in the most exposed areas were classified as harmful (classes 3.1 and 3.2) according to the sanitary standards applied in the study.

Conclusion. Petroleum coke production and handling were associated with elevated occupational exposure to airborne dust and chemical contaminants, especially during loading and material-handling operations. Proposed preventive measures include enclosed transportation systems, continuous dust monitoring, effective ventilation and dust collection, and properly fitted high-efficiency respiratory protection. Wind-protection screens up to 6 m high near open coke storage areas were proposed to reduce dust dispersion; their effectiveness requires field verification.

Keywords. petroleum coke dust; occupational hygiene; oil refinery; delayed coking; PM10; PM2.5; occupational exposure; respiratory protection; dust control.