

Electrostatic Risk Assessment in Semi-quantitative DHA applied to polymer industries

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Abstract:

Electrostatic hazards present a significant safety concern in the polymer industry due to the wide variety of operations capable of generating substantial static charges, such as sieving, pneumatic conveying, and fluid bed drying. The handling of non-conductive powders, which are especially prone to charge accumulation through friction, separation, and contact with processing equipment, further compounds this risk. In such environments, the risk of ignition is heightened, demanding comprehensive risk assessments and stringent control measures to prevent electrostatic incidents in facilities handling explosive, non-conductive powders. The evaluation, conducted within a semi-quantitative Dust Hazard Analysis (DHA) framework where a risk matrix is employed to systematically assess the explosion potential, provides a detailed examination of the electrostatic charge accumulation levels compared to the Minimum Ignition Energy (MIE) of various polymer powders. This methodology enables a precise stratification of risk, identifying powders with lower MIE thresholds as more prone to ignition, particularly under operational conditions conducive to charge accumulation. Special attention is given to the effectiveness of different static discharge types, including brush discharges, propagating brush discharges, and spark discharges (including those generated by personnel). Mitigation strategies are explored, with a primary focus on grounding and bonding systems, which are essential for minimizing electrostatic build-up and safely dissipating accumulated charges. Beyond these foundational measures, the study highlights additional critical strategies for managing electrostatic risks in polymer processing. These include the use of additives to enhance the conductivity of non-conductive powders, thereby reducing their tendency to accumulate charge, and the optimization of charge relaxation times to facilitate the safe dissipation of electrostatic charges and prevent hazardous discharges. The analysis also emphasizes the critical role of selecting and properly using the appropriate type of Flexible Intermediate Bulk Containers (FIBCs), widely employed for powder collection, dust discharge, and sampling purposes. Specifically, Type C and Type D FIBCs, designed to mitigate electrostatic risks through grounding and dissipative properties, are highlighted as important components of a comprehensive safety strategy. Ultimately, the findings underscore the importance of tailoring risk mitigation measures to the specific electrostatic behaviors of each process, contributing to more effective safety frameworks and a safer working environment in the polymer processing industry.

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