Dust emission in silicon carbide and alumina-coated silicon carbide particles used for long-term industrial processes

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ABSTRACT

Silicon carbide (SiC) particles used in long-duration industrial applications releases potentially hazardous dust which can also change the bulk material quality. However, most dustiness tests do not study dust release over a long duration, nor do they measure the effect of dust generation on the bulk powder [1], [2]. This is due to the fact that most dustiness testers emulate applications lasting for short duration (few minutes) which have minimal effect on the bulk sample.

In this study, we test the number and mass dustiness of two different samples of SiC powders with median particle sizes (X_{50}) of 66 μm and 38 μm, over six hours using a vortex shaker [3], [4]. Further, we test and compare the dust generation behaviour of core-shell coated SiC-alumina (Al_2O_3) particles with alumina film thickness of approximately 400 μm for one of the SiC powders (with X_{50} = 66 μm). Additionally, we characterize the bulk sample for change in shape and size distribution due to testing.

All powder samples release respirable fraction of dust particles but differ in dust generation behaviour. The dust generation mechanism might include the release of aerosols due to the attrition of particles owing to inter-particle and particle-wall impaction. SiC-Al_2O_3 core-shell particles show lower dust emissions than the pristine SiC particles, possibly due to the differences in the nature of the collisions between particles. Further experimental tests are proposed to understand the effect of coating on dust generated from micron-scale particles.

The study emphasizes the need for long duration dustiness tests for hard materials like SiC and characterization for change in bulk material properties due to dust generation and release. Furthermore, the results can aid in selecting the bulk material for long-term applications based on dustiness and potential risks in the handling of new and used powders. We acknowledge the support received from EU FP7 Marie Curie Actions ITN T-MAPPP (https://www.t-mappp.eu/) and Région Picardie/ Hauts de France and by the Programme 190 (French Ministry of Environment).

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