ANALYSIS OF AIRBORNE FINES IN CYLINDRICAL BIOMASS STORAGE SILOS
IV International Conference on Particle-based Methods: Fundamentals and Applications – PARTICLES 2015

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ABSTRACT

Biomass handling industries are transporting and storing huge quantities of biomass materials (i.e. Drax Power Station which produces 7% of the UK electricity and burns ~12m tonnes of wood pellets annually). During transportation, wood pellets can be subject to attrition (a process that generates additional fines and dust. When filling large volume storage silos or bunkers (often 50,000m^3 plus) the fines tend to concentrate in certain areas within the mass of material, depending upon the size of the particles and their sensitivity to the method of filling (Zigan et al. 2008). These particles are easily made airborne when discharged from the storage scheme and can represent an increased health related hazard for operators if inhaled. In plant operations where a high mass fraction of fines concentrate in an airborne plume, the risk of dust explosions increases. Previous researchers have developed dust explosion models in order to assist practitioners from industry to minimise the health and safety risks for their plants. [1]

This research studies the significance of airborne fines concentration in different silo locations. The fines concentrations will be evaluated using the dimensional analysis approach described first in Zigan et al. 2008. The dimensional analysis includes process parameters such as the material feeding rate and the air ventilation rate as well as the dimensions of an experimental silo that will be used for validation. The experimental silo is cylindrical and saw dust will be fed by gravity centrally into the silo.

It was found that for the loading regime that was under consideration, fines tended to accumulate near the silo wall. This can partly be explained by a segregation phenomenon called air current segregation (ACS). ACS is present in the silo as an effect of both circulating air currents generated by the falling particle jet and the silo air extraction system. The circulating air currents apply a buoyant force on the fines which is larger than the gravitational force and thus, the fines follow the dominant air flow direction. The fines are conveyed away from the central feeding point and settle near the silo wall because of the reduced air velocity and wall surface contact effects.

An additional aspect of safety that has also been considered is that of the possible influence of triboelectric charging on particle attraction to the wall of silos and the potential for electrostatic discharge.[2]

This research shows the importance of including a consideration of the fines concentration in any modelling approach developed to indicate the propagation and mobilisation of fugitive particulate material during filling operations.

REFERENCES

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