Avoiding dust explosions by combining experience with scientifically sound experiments

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The processing of nutritional products can present some severe risks, in particular dust explosions in mills or dryers. The ignition sources causing the explosion can be of different types: Obvious sources like flames or mechanical sparks can easily be avoided. Ignitions resulting from an electrostatic effect are more complex to be deal with but the understanding of the phenomenon involved and the ways to avoid it are now well known. It will not be the aim of this paper to discuss this topic.

We will rather concentrate on a third type of ignition sources: the hot spots. These localised high temperature "points" can ignited a dust and cause an explosion if the Minimal Ignition Temperature of the product to be processed is low enough. These hot spots can be caused by the set-up used to process the product, e.g. mechanical stress caused by transport screws or can be endogenous, i.e. can be produced by the processed product, for example, through decomposition of deposits.

There are a number of analytical methods that can be used to characterise the thermal behaviour of nutritional products; some are based on experience, some other are based on heat balances and quantitative measurements of the heat delivered by the product decomposition.

This paper will present the methodologies available to characterise and therefore prevent dust explosion. It will also present new and advanced methodologies that can be used to assess the safety of drying operations (for example: thermal stability under oxygen at the micro-scale level). Based on the thermal stability of the product the heat balance between heat production (through decomposition) and heat removal (conduction / convection) will be presented. Basic equations can provide very useful information for the risk assessment.

Finally CO-monitoring will be introduced as a powerful toll to prevent a dust explosion. The experimental determination of the limits of this methodology will be presented based on several case studies.

Reference

Grewer, Th. , Selbstentzündung von abgelagertem Staub. Staub, Reinhaltung Luft 31(1971) Nr. 3, S. 97/101.