Electrostatic charge causes ignition

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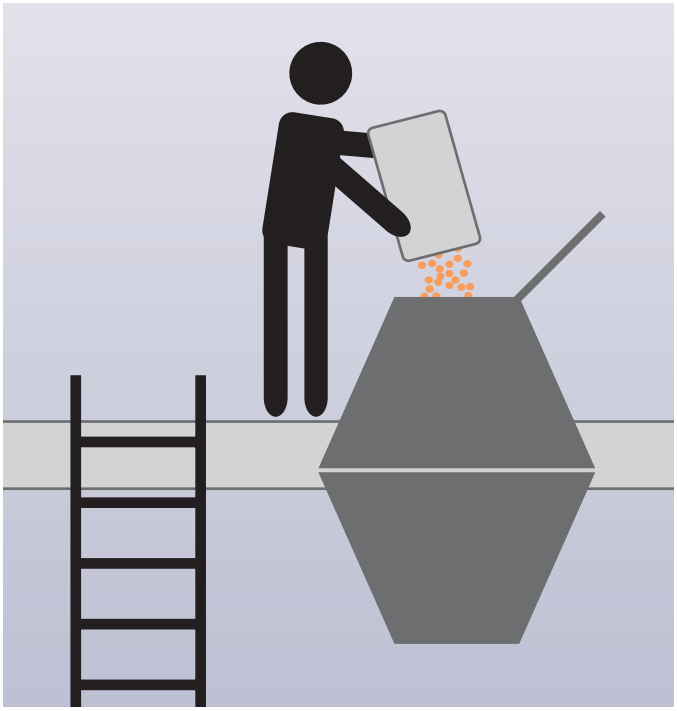

Since 2003 the Technical report CLC/TR 50404 ›Code of practice for the avoidance of hazards due to static electricity‹ has existed and has largely been adopted into the German Berufsgenossenschaftliche Regel, BGR 132. One of the statements made by this report is that brush discharges, i.e. the weak crackling discharges that may originate from charged plastics, are not capable of igniting dusts according to knowledge available up until now (exception: dusts of high inflammability with a minimum ignition energy MIE < 3 mJ). Corresponding statements can also be found in BGR 132.

Hardly anyone would suspect that intense discussions, extending over many years would take place as it was necessary to prove that something did not happen. Theoretically, furnishing proof of this type is not possible; the decisive factor at long last was that no corresponding ignitions were known. Why is this statement actually so important? Without it, the handling of combustible substances in dust form in packaging materials made of chargeable plastics (e.g., icing sugar in a plastic bag) would basically not have been permitted.

How the incident took place

In a pharmaceutical plant two dust explosive powdery substances delivered in polyethylene sacks were to be mixed in a stainless-steel tumbling mixer. One batch was to be produced every day, after which the mixer was emptied. After being cleaned, firstly with water and then with propanol, the mixer was allowed to dry.

Monday morning the mixer operative emptied the first polyethylene sack of product into the mixer and was visibly shocked when he heard loud swearing from staff on the floor beneath. The reason was that he had forgotten to close the emptying flap so that the product added to the mixer at the top immediately fell through to the bottom and covered his colleagues below in dust.

This being very embarrassing, the mixer operative decided to close the emptying flap immediately after cleaning the mixer so as to prevent a repeat of such a mishap He did not shut the feed opening (at the top) so that the mixer was able to dry out.

Early the next morning the mixer operative, still mindful of having closed the emptying flap the day before, emptied the first polyethylene sack of product into the mixer. As he shook out the remnants of the product from the sack, a flame suddenly shot out of the filler opening.

Explanation

Staff of the department was first perplexed. After all, the procedure used was correct and in accordance with the BG Rule. Someone then suspected that brush discharges might nevertheless still be capable of igniting explosive dust/air mixtures. This reawoke memories of the many years of discussion on this topic. Finally, the various steps of the incident were again researched step-by-step.

The mixer had been last cleaned with propanol. After the solvent had drained off, the emptying flap was closed. The upper flap remained open allowing the mixer to dry out overnight. However, propanol has a higher density than air. This meant that the mixer was, admittedly, dry on the inside but still full of solvent vapour. When the first sack was emptied, some of the vapour was displaced upwards by the bulk material added through the feed opening and was able to form an explosive mixture at this point. The polyethylene sack charged by the product and sliding out during the process of emptying led to brush discharges at the nearby rim of the opening, which, as experience shows, are able to ignite such a vapour/air mixture. This primary ignition was then able to ignite the dust/air mixture of low inflammability, and this combusted immediately with an intense flame.

Conclusion

When elaborating the explosion protection documentation, consideration was also given to the possibility of a hybrid mixture (see also BGR 132; 3.4.3). However, it was assumed that after the mixer had been cleaned, the upper and lower flaps would always remain open through to the following day. This precluded the possibility of explosive vapours collecting in the mixer.

These details were not known to the mixer operative. His job was to ensure that the mixer was clean and dry before loading it. He doubtlessly did this.

Even minor changes considered insignificant in process workflow must be checked in order to see whether they are significant with regards to technical safety.