

## PLASTIC ELEVATOR BUCKETS AND STATIC ELECTRICITY

Historically speaking, there is no evidence that plastic buckets have ever created a spark that led to a dust explosion in a bucket elevator. On the contrary, metal buckets, due to coming loose from the belt or due to collisions with tramp iron in the elevator, are suspected to have caused sparks and are universally considered far more a safety risk than plastic buckets.

Plastic buckets are made from materials like polyethylene, polyurethane, and nylon. These buckets have been on the market since approximately the 1950's and have been very successful since their introduction in the USA. At present, plastic buckets are widely used, also in Europe, Asia, Australia, Africa, and South America.

Plastic buckets have a lower weight, are more flexible, and will bend allowing a certain degree of deformation before breaking. Whereas metal buckets will remain deformed, the plastic buckets will return into its original shape. When meeting an obstruction the plastic bucket will not cause a spark like metal may do when meeting tramp material in the bucket elevator. Plastic buckets are lighter and may allow for lighter belts. In addition, plastic buckets made of such materials as polyurethane and nylon can offer much longer life than metal buckets leading to lower operational cost.

The quality of plastic buckets, depending on application and tonnage handled, is recognized as offering significant improvements over metal buckets. If there is a discussion on quality, it usually centers on the risk of static electricity developed by plastic buckets. There are no anti-static plastic buckets on the market. If the plastic buckets are mounted with steel (conductive) bolts to a electrically conductive belt conforming to ISO 284 or DIN 22104, traveling over conductive pulleys that are grounded through an earth grounded system, the system will conduct static electricity, if any is generated.

Almost all plastic compounds are inherently non-conductive, do not transport electricity, and have insulating qualities. However, static charge does accumulate when frictional contact occurs between the plastic bucket and grain or feed. This normally occurs during loading in both the boot section and when the grain discharges from the bucket in the head section. The existence of this charge can occasionally be seen by the accumulation of dust on the surface of the buckets.

The three resins being used (polyethylene, polyurethane and nylon) have varying degrees of static conductivity that accumulates, holds, and dissipates in varying degrees. Polyethylene holds charges the longest, nylon the shortest, and 55D urethane a very short time.

None of these materials can generate a sufficient volume of electrical charge to be dissipated rapidly enough to produce a blue static spark.

It has been shown in studies by the University of Southampton, UK, that the static spark released from a plastic bucket is only one tenth the magnitude of sparks released from steel buckets striking metal objects. The norms ISO 284 and DIN 22104, both dealing with the electro static resistance of rubber belts, prescribe an electro static resistance for belting of maximal  $3 \times 10^8$  Ohm. The plastic materials used for buckets tested as per the prescribed methods ISO 284 and DIN 22104 give results shown below.

In order to determine the Electrical Conductivity of plastics used for buckets the electrical resistance is measured in Ohm as per test methods ISO 284 and DIN 22104:

High Density Polyethylene 2.2 X 10<sup>16</sup>  
Nylon 2.0 X 10<sup>14</sup>  
Polyurethane 4.2 X 10<sup>15</sup>

The result shows that polyethylene (HDP) buckets display the highest electrical resistance (least conductive) followed by polyurethane and then by Nylon. Overall the static charge that can potentially be developed by plastic buckets is very low and generally considered harmless. Similarly, plastics are widely used in electronic equipment where equally the potential of static charge is not considered a risk to the functioning of the equipment itself.

In the U.S. and Canadian, approximately 90% of agriculture elevators have used plastic buckets for the past 20-25 years. The largest agricultural companies in the world almost exclusively use plastic buckets to move grain, feed, processing, ethanol and fertilizer. As far as is known to us, plastic elevator buckets have never been the cause of an explosion.

