

## Ask Joe! Column

### Silo Damaged by Plastic Powder - A Case Study

Guest article by David Stuart-Dick of Powder Engineering Systems.

One of the largest manufacturers of Purified Terephthalic Acid (PTA) in the world has had some serious structural problems with their silos. PTA is a plastic powder that is processed into terelene and other polymers for manufacturing fabrics. During production of PTA, the un-purified form, (TA) is usually stored in large silos before being washed to become PTA.

#### Problem

At one of this manufacturers production plants that had been operating for more than twenty years a problem was noticed that appeared to be serious. One morning, operators noticed that powder was leaking from the side of one of two 17-m diameter, 5,000-ton TA silos. On closer examination it was found that powder was leaking from a crack in the hopper. The hopper sections of both silos were slightly deformed but the one that was leaking was worse than the other.

One of the immediate concerns was to get the silo emptied and to determine the cause of the deformations and the crack so that a new hopper, with thicker walls if necessary, could be commissioned. The existing hopper walls varied from approximately 26-mm thick at the top to 6-mm thick at the outlet. The crack was at the top of the 6-mm thick plate sections.

The plant operators investigated various possible operational causes. The possibilities of a high gas pressure in the silo or a sudden vacuum were considered. Previous problems with pressure and vacuum relief valves made this a real possibility.

Powder Engineering Systems was asked to investigate the cause of the problem and to predict hopper loads so that remedial work could proceed. With very high production rates involved and the holiday season approaching, the results were required quickly.

#### Silo Analysis

Our engineers determined that the problem had its beginnings in the way the powder flowed in the silo. Although the stainless steel walls of the hopper were steep enough for mass flow, other factors were causing the powder to flow in funnel flow. In funnel flow a flow channel forms within the powder so that some powder remains stagnant - sometimes for long periods. In the PTA silo, temperature gradients driving moisture into the stagnant regions and other factors allowed the stagnant product to form hard lumps. Evidently, falling lumps had deformed the hoppers of both silos and a large lump had caused the one hopper section to tear.

As a result of our analysis we were able to confirm that replacing the damaged hopper section with one based on the same structural design would be adequate. Rather than trying to design for dynamic loads, which would be more difficult to predict and would probably require excessive structural stiffness, the silo should be made to flow in mass flow, as originally designed. In mass flow the product loads are predictable and are reasonable. In addition, avoiding lumps in the product would make production of PTA easier.

Our report included an analysis of initial and flow loads due to product in the silo. Subsequent analysis by the client's metallurgists of the piece of plate that had been torn confirmed that the tear was a result of a local overstress.

## Restoring Mass Flow

To restore mass flow, we recommended that problems with a slide gate valve interface be corrected and that the design of the screw feeder be corrected. The existing feeder had been designed to increase in capacity along its length. However, while some of the principles of making a correct mass flow feeder are well known, there are pitfalls. Unfortunately, the existing screw feeder probably had pinch points along its length. Screw feeders under both silos in the plant had broken regularly but they had always been replaced with screws of identical design.

The PTA silo has been corrected and has been back in operation for a year. According to the manufacturer: "We are happy that Powder Engineering Systems could help to identify the root cause of the problems and recommended course of action. The job was well done and I have not heard of any problems since".

Thanks Dave for the case history. Dave can be contacted at:

Mr. David Stuart-Dick  
Powder Engineering Systems  
Carrington Business Park  
Manchester, M31 4YR  
United Kingdom

Phone: +44 161 667 4523

Fax: +44 161 667 4524

Web site: <http://www.powderengineering.com>

+++++

**Welcome to Ask Joe!**, a monthly column by our resident materials handling guru, Joe Marinelli of Solids Handling Technologies. Joe addresses the issues that bug you the most. And Joe knows!! Formerly with Jenike & Johanson, Solids Flow and Peabody TecTank, Joe is an expert on materials handling.

For past articles, **Ask Joe!** Archived Articles.

Guest articles for the **Ask Joe!** Column are always welcome, for more information please contact Joe Marinelli directly at his email address: [joe@solidshandlingtech.com](mailto:joe@solidshandlingtech.com).

© Powder and Bulk.com