From Powder and Bulk.com

Ask Joe! Column

Frequently Asked Questions, Part II

by Joseph Marinelli

Having been a consultant for many years I have obviously been asked some of the same questions concerning solids flow, time and time again. Here are some more frequently asked questions and answers:

1. How can bulk solids flood or flush out of a bin?

Answer: Fine solids flowing in funnel flow (some material moving some material stagnant) typically experience flooding problems. In funnel flow, a preferential flow channel forms, usually directly over the outlet.

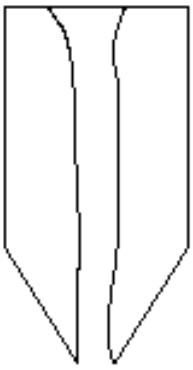


Fig. 1 Stable Rathole

If fresh material is placed in the container, it will flow into the preferential flow channel and not have enough time to deaerate. The bulk solid now behaves as a fluid. As it reaches the outlet, the feeder which is designed to meter a solid cannot control a fluid, and the aerated product will flow uncontrolled from the vessel.

Additionally, if a “rathole” forms, where the preferential flow channel empties and forms a stable pipe, fresh product brought into the vessel or material that sloughs off the top of the pile will fluidize and flush from the bin. See Fig.1.

2. What are the requirements for a properly designed mass flow bin?

Answer: There are two major considerations:

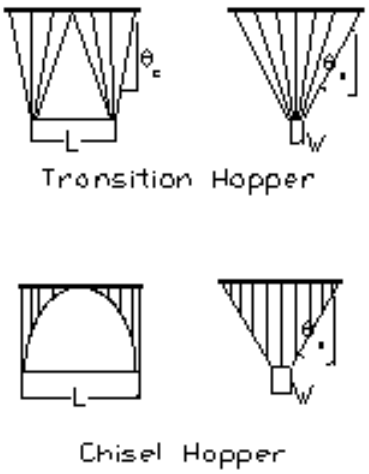
- The opening size required to prevent arching and
- The hopper slope required to ensure flow along the walls.

The definition of mass flow is that when material is removed from a bin, all the material is in motion. Obviously, if the material is cohesive, it may arch (bridge) over the opening causing a flow stoppage. As well, in order for all the material to remain in motion, it must flow at the walls of the bin.

There is friction that develops between the bulk solid and the wall surface of the hopper. If the walls are too rough or too shallow, the material will flow on itself than on the rougher/shallow walls. In mass flow, the walls are typically steep and smooth to ensure flow along them.

3. Am I restricted to steep conical hoppers to ensure mass flow?

Answer: Not necessarily. Wedge shaped hoppers are a great alternative to conical hoppers. Wedges, such as chisel or transition type (see Fig. 2), are more forgiving from a flow standpoint.



. 2 Wedge Shaped Hoppers

Keep in mind that material in a conical hopper has to converge in 360°. While in a wedge configuration they converge in only one dimension. Wedges use slotted openings which require smaller widths to prevent arching and shallower hopper slopes to ensure mass flow. Because of the long slot, wedges will provide a higher discharge rate.

One very important consideration is that the feeder design is as important as the wedge. If the feeder (likely a screw or belt) is not designed to discharge material over its entire cross sectional area, mass flow will be destroyed.

4. My material's angle of repose is 46.3°. How do I use this data to design a bin?

Answer: You cannot design a bin just from the angle of repose. What opening size do you use? What is the hopper slope, 46.3°?

You have to measure a materials flow properties in order to properly design a bin or hopper. The angle of repose can be used to determine the contour of a pile of material, perhaps to determine volume in a bin or silo, but not design a bin.

5. I have been told that my material segregates, how does this happen?

Answer: Segregation can occur via sifting, fluidization, etc. Segregation requires interparticle motion, a range of particle sizes, etc.

Sifting occurs when filling a bin or forming a pile, the fine particles sift through the coarse particles, allowing the fines to concentrate in the center while the coarse roll or slide to the outside.

Fluidization segregation occurs when solids are dropped into a bin from a conveyor such as a pneumatic conveyor. The coarse particles are driven to the bottom while the fine particles remain airborne and settle on top.

++++++++++++++++++++++++

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.