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Ask Joe! Column

Testing Materials with Large Particles

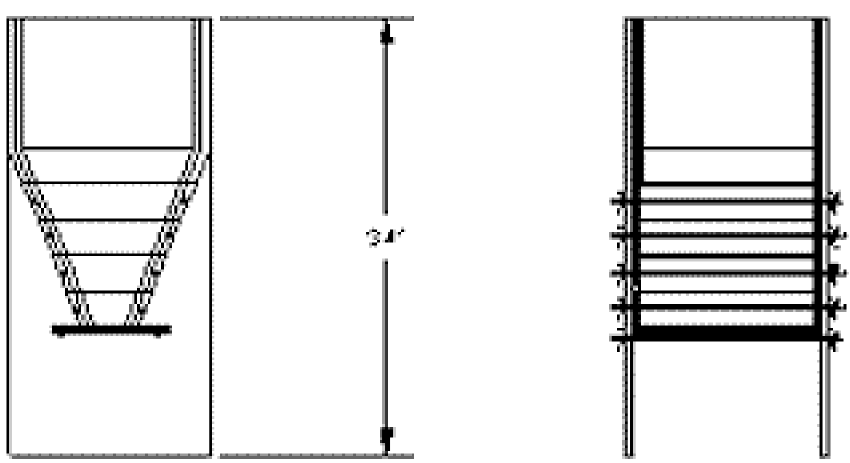
by Joseph Marinelli

The Jenike Shear Test is the standard for evaluating bulk solids flow properties in the United States, through ASTM. This approach is the preferred method to determining the cohesive and wall friction properties of your material. However, the standard test uses a 3.75-inches diameter shear cell, which limits the size of the particles that can be reliably tested. This particle size limit is usually about 0.25-inches. Particles larger than this cannot be sheared properly and introduce errors in the testing. There exists, specially designed larger shear cells that are 8-inches in diameter that can reliably test materials that have particles that are less than 0.75-inches.

These reason for running shear tests is that you are concerned with the cohesiveness of the material (the ability of the material to compact, gain strength, and bridge and rathole in your bins). Coarse particles (usually greater than 0.25-inches), are not typically cohesive, and as such do not present a bridging problem other than possible particle interlocking, see Mass Flow Design Considerations? (Arching-Part 1) in the Ask Joe archives. Here are just some of the reasons why coarse particles are cohesive:

- The particle’s surface is coated with a sticky material
- The temperature at which the particles are handled is elevated
- There are significant fines to cause the large particles to “lock” together.

As such, we need a method to evaluate these type materials. A method that is commonly used is a hopper test, whereby; large particles can be tested for their cohesive properties. A test hopper is constructed as a wedge shaped hopper. See the figure below for a sketch of a typical geometry.



You will notice that the test hopper has removable side panels that are designed to provide an incrementally larger hopper opening. The test hopper is filled in stages and consolidation weights applied for a short time period to provide even consolidation. If the weights were just applied at the top, all the material in the test hopper would not be consolidated evenly.

After filling and consolidating, the gate at the outlet is removed and material is allowed to discharge, falling freely from the hopper. If the product has cohesive strength, it will arch over the smallest opening. When an arch occurs, the next set of side panels is removed to provide a larger opening. The point at which the material begins to flow is the arching dimension for a slotted opening at that particular consolidation pressure. Additional tests need to be run at varying consolidation pressures to generate a flow function for your material.

Time effect is also considered and the material is consolidated in the test hopper as above, but allowed to remain at rest for the representative time period under the consolidation level being simulated. These tests are obviously time consuming and require patience.

The slot dimension indicated by the test hopper can be converted to a conical dimension simply by doubling the dimension. Remember from previous articles that there is a 2:1 relationship between slotted and circular openings. Typically, a circular opening is required to be about two times that of a slot.

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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.

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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.