SUPPLIERS' TIPS

How can I prevent material segregation during transport and storage?

As material fills a silo, a pile forms and heavier or larger particles move to the silo's perimeter while smaller particles concentrate in the center, creating a segregated material. If you're experiencing funnel (or first-in last-out) flow, the small particles in the silo's center will exit first followed by the large particles near the silo's perimeter. Ensuring a proper mass-flow design for your storage silo that's specific to your material can mitigate segregation. In mass flow, all of the material is in motion, moving downward during discharge, so the same homogenous blend you put into the silo will exit the silo. To determine the proper mass-flow design, either your silo supplier or a third-party lab must complete material flow testing. A sample of your material is tested on specially designed equipment and samples of silo steel coated with a supplier's coating as well as other potential silo metals, such as aluminum, stainless steel, or raw steel. These tests will also determine the necessary hopper slope and hopper outlet size and shape for your material.

A silo designed for industrial use has an estimated service life of 30 or more years and may hold various material types during its lifespan. Consult with your silo supplier before storing a material other than the silo's design material, because each material has different flow characteristics.

One way to rehomogenize a segregated material is to add gravity-fed blend and first-in first-out tubes, which function similar to a direct-flow channel blender. Another alternative is to include an antisegregation cone as part of the silo's discharge flange. The cone's size and shape, including the blend tubes, should be designed by a flow expert and fabricated by a silo supplier.

For example, specific frac sand blends range from 20 to 40 mesh in particle size and will typically segregate as the material is fed into a silo. The large sand particles go to the silo's perimeter and the smaller particles stay in the center. It's common for frac sand silos to be designed with a 45-degree hopper that induces funnel flow to avoid quickly wearing out a steeper-sloped mass flow hopper. The remedy for this segregation includes an antisegregation cone, which normally has four or more 4- to 6-inch-diameter tubes fanning out to the cone's perimeter to direct larger particles to the silo's center to blend with the smaller particles. This replicates homogenous mass flow without abrasion and premature wear in the hopper.

Jay Anzelmo, director of dry bulk sales, CST Storage, 913-621-3700

Before solving a segregation problem it's critical to understand your acceptance criteria as well as the underlying causes. You can run segregation tests, analyze material samples collected throughout the process to identify critical trends, or both. This will likely tell you where and how segregation is occurring. You can then evaluate which specific improvements are needed for your material and application and develop a plan to reduce the segregation. Keep in mind that segregation is a function of the material's physical properties as well as the features of the process and equipment.

In general, there are three approaches you can take to minimize material segregation:

1. Change the material. For example, you can reduce the moisture content, change the particle size, or use a binder.

2. Change the process. For example, you can minimize transfer steps and blend material as far downstream in the process as possible.

3. Change the equipment. For example, you can change specific features of your silo, bin, hopper, or feeder designs.

Carrie Hartford, senior project engineer, Jenike & Johanson, 805-541-0901

If you're filling bulk bags, know your material's density and particle size and focus on your packing method. Preventing material segregation in this process relies on how you fill and densify the bulk bag. Unused space within a bulk bag must be minimized as it can allow material to move more freely during transit, creating instability and possible material segregation.

When filled properly, each bulk bag will be completely and evenly filled. The material should be filled into the bag's corners to create a stable base, the bag sides should be creaseless and upright but rounded out to stretch the bulk bag, the top should have a flattened angle of repose, and the material should be deaerated. The result will be filled bulk bags that are upright, stable, stackable, and that have a firm feel from the bottom to the top. Most importantly, this will minimize possible material segregation within the bulk bags.

Bulk bags can be properly filled through pallet filling with densification via indirect contact through the pallet or by hang-weighing with densification via direct contact with the bag's bottom. Though pallet densification is effective for 80 percent of dry bulk materials, the densification is slightly diffused because the pallet is placed between the densification deck and the bulk material. Materials that don't have a large range in densities from loose to tamped should densify successfully with pallet densification.

Materials or mixtures that have a large range in bulk densities (such as kaolin clay) should be filled using a hang-weighing and direct densification filling system. This method provides maximum densification energy transfer directly to the material and raises the bulk density to the tamped density while the bulk bag is still on the filler. This method can compact material so that little or no segregation is possible.

Well-packed bulk bags ensure your material doesn't segregate during transport or storage and can be stacked and efficiently packed in trucks, rail cars, ships, airplanes, or storage facilities.

Deron Seibert, regional sales manager, and Carolynn Sarver, director of marketing, Spiroflow Systems Inc., 877-298-9595