

SUPPLIERS' TIPS

How can I select a storage vessel that will reliably discharge my difficult-to-flow material?

Designing a storage vessel requires a methodical approach, whether your material flows easily or with difficulty. Causes of improper vessel design include considering the design after selecting other system equipment, designing the vessel without fully investigating your material's flow properties, relying solely on past experience, and designing a vessel based on an inadequate budget that's set before the design process really starts. Accurately measuring your material's flow properties under representative handling conditions will assist in selecting the hopper geometry, feeder type, and flow aid requirements.

You can avoid vessel performance problems, such as material bridging or ratholing, by following a detailed, systematic approach to designing, installing, and starting up your storage vessel. The steps are:

- Defining your operating requirements and conditions.
- Testing your material's flow properties.
- Developing the vessel's functional design.
- Developing the vessel's detail design.
- Fabricating and installing the vessel.
- Starting up and maintaining the vessel.

Work with experts — whether they're from your firm or are independent engineers or consultants — to carefully consider the details of your application. Making the design project a top priority and directing the appropriate resources toward it can help you design a vessel that performs reliably and safely. Finally, don't consider the vessel as "just a silo"; in fact, bottlenecks in bulk handling applications are often a direct result of poor storage vessel operation.

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The answer depends on the type of vessel you have. To ensure that your difficult-to-flow material reliably discharges from a storage vessel that uses a hopper design, there are two discharge approaches to consider: passive and active. If you know the stored material has been successfully discharged with a flow-aid device, such as a screw unloader, a bin activator, or an aeration device, then consider an active discharge approach. If you prefer a passive hopper discharge design, then you should conduct a material flow test. With a flow test report in hand, you can approach different tank and vessel fabricators for competitive pricing.

In all cases, whether you choose a passive or active discharge design, you must ensure that your supplier guarantees the results. It's typical for vendors to skirt this issue by stating that they'll follow the recommendations made by the flow expert, including hopper slope, outlet size, surface profile, and others. However, it's important to know that the flow expert has limited liability associated with following his or her recommendations, and the vessel manufacturer has limited liability associated with following the *flow expert's* recommendations. Therefore, you *must* require the tank or vessel supplier to provide a guarantee for "reliable product discharge" from the vessel. If the supplier isn't willing to guarantee the application, then move on to the next supplier. In the end, your list of approved suppliers will be limited to the true experts in dry bulk storage applications.

To ensure reliable material discharge from a larger size, flat-bottom storage tank or vessel, I recommend a bottom reclaim screw unloader. Again, the approved supplier should be an expert in the field of dry bulk storage applications and should guarantee the system's performance.

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Selecting a storage vessel to discharge a difficult-flowing material will depend on the specific properties of the material and the volume to be stored. Factors to consider include the material's density, angle of repose, moisture content, particle size, and flow characteristics (such as the material's slide angle and its ability to form a bridge or cavity).

Your material's properties are important and directly affect vessel design. Simple tests can help predict the material behavior and prevent unnecessary problems later. Your powder or granule's angle of repose is a good indicator of its flow characteristics: The steeper the angle, the poorer the material will flow. With cohesive materials, the head pressure caused by storing large volumes can cause compaction at the vessel's bottom, creating a blockage.

A particular vessel's suitability will depend on all of the above factors. Once you know the limitations you have to work with, you (or your equipment supplier) can design around potential issues and produce a vessel with the correct construction materials, surface finish, dimensions (including cone angles, volume, shape, and inlet and outlet apertures), and external flow aids, such as vibrators, air injectors, or agitation devices required to encourage flow regardless of the changes in material flow behavior.

Look for an equipment company that has design knowledge and experience with a material similar to yours. Consider the potential costs and production losses that result from a poorly designed vessel that's continually blocked and requires maintenance time to fix the problem. An experienced equipment designer can prevent this type of problem with solutions such as using a flexible-wall vessel instead of a rigid vessel, adding a surface finish inside a rigid vessel, and eliminating ledges, coarse surfaces, and rough welds in the vessel. Low-friction surface treatments in conical areas of vessels are another way to aid reliable material discharge and will save time and money by reducing the need for external intervention. Also, internal baffles or hopper shape can be used to create steeper wall angles, preventing bridging points where materials can compact.

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