

Suppliers' Tips

How important is adhering to supplier recommendations for a mixer's total and working volumes? What's the difference?

It's critical that the mixer supplier's total and working volume specifications be correct and followed during mixing or the equipment will underperform or perhaps not mix at all.

A mixer's *total volume* is the mixing vessel's top-to-bottom material fill capacity, while its *working volume* is the level the mixer can be filled to prior to mixing. Because the mixer lifts, folds, and blends the material during processing, the working volume will be slightly less than the total volume to allow space for the mixing action to occur.

Filling the mixing vessel beyond the working volume can result in less-efficient mixing action, causing the process to take longer or stop altogether. For some materials this can cause damage to the mixture from excessive particle impact, heat generation, or both. During the mixing process the mixture will become entrained with air (or *aerated*.) The aerated mixture is larger in volume than the original, unmixed material volume, so the working volume must leave room for the mixture to grow. Overfilling the mixer can overload the mixer's mechanics, causing damage or premature equipment failure. On the other hand, some mixing processes may require a minimum amount of material to mix properly.

A mixer's working volume is material specific because some materials fluidize or expand more than others during mixing. This expansion is calculated based on the material's characteristics. An equipment supplier may even choose to confirm the calculation with modeled or full-scale testing using the specific material recipe to ensure that the mixer size is correct.

A reputable equipment supplier will be able to determine the necessary total mixer volume needed to efficiently mix the desired working volume

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Each mixer supplier tests its mixing equipment with diverse materials to evaluate the ideal working volume and achieve the best possible performance in terms of mixing quality and mixing time.

Factors such as the mixing vessel's shape, the mixing tool type, mixing action — laminar or turbulent — and the material characteristics of the mixture ingredients all influence the mixer's ideal working volume for an application.

Some liquid materials don't need free space in a mixing vessel, therefore the mixer's working volume can be close to the unit's total volume. Powder materials in a high-intensity mixer with turbulent mixing action, on the other

hand, might require a 70 percent maximum working volume because the mixer needs the remaining vessel space to create a mechanically fluidized material bed. Establishing a minimum filling ratio is also important because too little material can produce insufficient mixing. The real world might differ slightly from the supplier's recommendations, however, because there are countless materials in mixing applications. Most users will experiment to find out whether and how far they can stretch the supplier's recommendations to improve their process.

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In most mixing systems there's a difference between the amount of material the mixer can physically hold and what the mixer's fill level needs to be to achieve an efficient and complete mix. The difference between a mixer's total volume and working volume is influenced by the type of mixing action that's required for your process. In low-shear mixers that tumble the material, such as a roller mixer, twin-cone blender, or V-blender, you must have space for the ingredients to rise and fall to intermingle, so the mixture may only occupy 50 percent of the vessel's total volume prior to the mixing process. Overfilling a tumbler-type mixer will inhibit its ability to achieve a good mix because the desired mixing action can't take place. However, a tumbler-type mixer, is very tolerant of small batch sizes. A horizontal ribbon or paddle mixer works by moving the material from one end of the mixer to the other. An inner set of ribbons or paddles moves the material in one direction and an outer set of ribbons or paddles moves the material in the opposing direction. The space that the ribbon or paddle agitator occupies is known as the mixer's swept volume. These mixer types shouldn't be filled past the swept volume because overfilling creates a dead zone where material can "float" above the mixing tools where no mixing action takes place. It's also usually not advisable to fill these mixers below half capacity because it can affect the batch cycle's repeatability. The mixer supplier will be very familiar with its mixer's performance characteristics, so it's extremely important to follow the supplier's recommendations.

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Equipment suppliers are a valuable source of information about equipment and processes. In light of this, each month we ask suppliers a question of concern to our readers. Answers reflect the suppliers' general expertise and don't promote the suppliers' equipment. If you have a question you'd like suppliers to answer, send it to Kayla Carrigan, Associate Editor, Powder and Bulk Engineering, 1155 Northland Drive, St. Paul, MN 55120; fax 651-287-5650 (karrigan@cscpub.com).