Sampling powder blends

Taking samples to determine when your materials are adequately blended is a vital step in the powder mixing process. But if you're like most powder processors, you've probably wondered about your sampling method's effectiveness. Questions might come to mind such as:

• How can I be sure that I'm getting a truly representative sample of the blend?
• How do I know I'm using the right sampling device for my application?
• How do I decide at what point to sample the blend — during blending or as the mixture leaves the blender?

As important as these queries are, initial sampling questions should be more about why and what than how. Understanding why you need to take blend samples can help determine how to take them. Start with these questions: Why do I need to take a sample, and what information do I need?

If you take samples from your blender to decide whether the batch has reached the desired mixture uniformity, you must take the samples at specified times during the process. This is called intermediate sampling. But if you take samples of the blend to maintain records of the final product batches, then you need to take samples after blending is finished and as near to your packaging step as practical.

Intermediate sampling during blending

How to take intermediate samples to determine mixture uniformity depends on your blender type and even on your powders. For example, many blenders and many powders blend quickly, sometimes in less than 1 or 2 minutes, and often in less than 50 revolutions of the blender or its agitator.

To collect a series of samples during blending so you can observe mixture uniformity changes, you need to quickly start and stop the blender (and lock it out for safety), sometimes before it can reach normal operating speed. But the blender's rapid blending speed can be a real challenge to your ability to analyze a blending trend or endpoint from the samples: Small quantities of an important ingredient in the samples (such as an active ingredient in a pharmaceutical) or small differences between samples may not be measurable by the analytical method you're using. So, before you take samples during the blending process, know what you're measuring and how well you can analyze it to make sure that any mixing changes between the samples will be observable.
In cases where the material in the blender quickly reaches mixture uniformity, sampling for exceptions to uniformity may be more practical. In any blender, poorer mixing conditions exist in some locations, such as at the blender’s sides or ends, at the center of rotation for a tumbling blender or an agitating blender, or near the unit's discharge. Intermediate sampling in these locations will better display any mixture nonuniformity by showing whether a minor ingredient is not present or present in excess. A well-blended batch should be uniform at these poorly mixed locations within the batch’s product-quality limits.

**Sampling devices**

Whether you need to take intermediate samples to test for mixture uniformity or exceptions to uniformity, aim for simplicity. Let’s go over several manual devices that are commonly used to take samples from both batch and continuous mixers after they’re safely shut down:

**Cup or scoop.** A cup or scoop is an effective device for removing a sample, especially if you carefully remove the surface layer of material in the blender before using the device. In a blender location with less well-mixed material, the surface layer can contain more large particles, so removing this layer can ensure that you obtain an undisturbed sample.

**Thief sampler.** Another common device is a thief sampler, as shown in Figure 1a. The thief sampler has an inner cylinder with sample chambers, each with a hole in the cylinder wall, and an outer cylinder, also with holes and a pointed tip. Before the sampler is inserted into the bulk material, pointed tip first, the inner cylinder is twisted so that its holes don’t align with the outer cylinder’s holes; when the sampler reaches the proper location in the blended material, the inner cylinder is twisted again so that the inner and outer cylinder holes align, which allows the powder to enter the sample chambers. The inner cylinder is twisted once more to close the holes before the sampler is removed from the material, and the samples are removed from the chambers. A problem with the thief sampler is that it often drags material from the surface down into the blend (Figure 1a.), which results in collecting a distorted sample with a composition different than that at the mixture’s center.

**Core sampler.** A core sampler, as shown in Figure 1b., can be a more effective device. This sampler consists of a hollow tube and an end cap. The hollow tube is first inserted without the end cap into the bulk material; then the end cap is placed on the tube, creating a vacuum that holds the material in the tube as the sampler is withdrawn. Because the sampler doesn’t push material from...
the surface down into the mixture that’s collected inside the tube, the core sampler doesn’t create a distorted sample.

No matter what device you use to take intermediate samples during blending, make sure that the total amount of material removed for sampling is less than 5 to 10 percent of the total batch to avoid changing the remaining blending process.

**Sampling after blending is done**

For maintaining blend quality records of the final product batch after blending is complete, you should take at least three samples during the mixture’s discharge from the blender, as close to your packaging operation as practical. Take the first sample as discharge begins, the second about halfway through, and the third as discharge ends. Depending on the discharged material’s flow rate and accessibility, any of the sampling devices previously discussed can be suitable for sampling the discharge, as long as the method allows the operator to stay safe.

If your final product will be filled into small packages, such as a powdered drink mix packet, the sample should be equal in size to one entire packet. For a very small final product, such as a pharmaceutical tablet or vitamin, the sample size should equal one tablet. With larger packages, such as bags, bulk bags, and drums, take samples from a convenient point just before or after the material enters the final package; the samples should be large enough to be analyzed properly but small enough to avoid affecting the package weight.

**Sampling’s cost**

Another consideration for any sampling method is its cost — in time or money. The financial cost of analyzing the samples is often the most significant component of the sampling cost. Thus, a cost-saving strategy can be to take many blend samples and retain them for your records but analyze only a few for each batch. For example, taking several small samples from a batch, from one location in a blender, or during packaging may be fast and economical. As long as you conduct an initial analysis on one entire set of samples in which you analyze all the samples and find that all the samples are similar and of acceptable quality, you may be able to obtain the batch quality information you need in the future by analyzing just one sample from a batch.

**Point of use: The final blend quality measure**

Whatever your reasons for sampling your powder blend, remember that the end-use customer is the ultimate judge of the blend’s effectiveness. The best blend discharged from the blender is only as good as the blend the customer actually receives, and we all know that good blending results are often lost during shipping and storage. So be sure that your quality control efforts include testing samples of the packaged product shipped to your customer. Also test effects of long shelf life on your packaged products, which you can do by analyzing samples of packaged product you’ve retained for your records.

**For further information**

Find more information on this topic in articles listed under “Mixing and blending” in *Powder and Bulk Engineering*’s article index in the December 2019 issue or the article archive on *PBE*’s website, www.powderbulk.com.

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