# Effective Mixing of Dry Solids

READCO KURIMOTO, LLC
*Continuous Mixing. Continuous Expertise.*

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Effective mixing of dry solids is an important consideration for many manufacturers. There are several options available to companies that want to improve their dry mixing capabilities. Companies often base their mixing purchases on product familiarity or cost rather than the attributes of different mixing machines. How do you know which mixing machine is best for your company? This article examines several types of mixing machines and provides the information that will help you determine the best dry mixing solution for your company.

## Mixing Considerations

Some of the most important considerations when choosing a mixer are:

- Cost: Companies need to find the machine that provides the most value for their investment dollar.
- Simplicity of operation: Manufacturers tend to shy away from complicated mixers that are difficult to use.
- Floor space: Companies must find a mixer that will fit into their manufacturing footprints.
- Ease of installation: Manufacturers that a mixer that can be installed and ready-to-use in a short period of time.

There are secondary considerations that are not as common, but are just as vital:

- Type of products being mixed: Firms must ensure that the machines they purchase have the ability to mix ingredients effectively. This is especially impor tant when the mixed material is hazardous or includes mixing challenges such as irregular shapes or textures.
- Particle size reduction/distribution: Some mixers are more adept than others at reducing and distributing particle size.
- Flexibility: The mixing machine must accommodate multiple variations of the same mixture.
- Cleaning and related down time: Frequent cleaning or other reasons for down time is neither cost efficient nor productive.
- Contamination: The mixer should safe-guard the mixture against dust and other air-borne particulate. It should also provide a handling system to avoid workplace contamination by hazardous or toxic mixtures.

The capacity size of the containerized batch mixer will depend on the specific product or use of the mixer.

## Mixer Choices

How do decision makers determine which type of dry solids mixer is best for their companies? First, they have to understand the mixer choices available to them. There are three areas of distinction that affect mixer types: container captivity, mixing action and speed.

## Container Captivity

The captivity or non-captivity of the containers in which a company's products are combined can play a major role in dry solids mixing.

A "captive" container is a fixed part of the mixing machine. Machines with captive containers can be troublesome for manufacturers. Once the mixed material is emptied, the container must be cleaned before a new mixture can be started. This creates a great deal of downtime and non-productive man-hours.

Non-captive containers are separate from the mixing machine. Upon the completion of the mixing cycle, the

container is removed from the machine and taken to a separate location usage, discharge, and/or cleaning. Another container can then be inserted directly into the mixer. By changing containers, mixing can continue uninterrupted for many different batches or formulations. This fully maximizes the mixer's capabilities and eliminates most down time. This system also reduces the potential for workplace contamination from potentially hazardous or toxic mixtures.

## Mixing Action: Container Movement and Impeller Forced

Mixers use different methods to combine ingredients. The primarily types are container movement and impeller-forced mixing.

- In container movement, the container that houses the combined dry solids rotates to accomplish the mixing action. Tumble-only mixers such as V-blenders and slant cones are examples of container movement mixers. This type of mixing action is limited by the rotational speed it can generate. Although relatively low cost, there are dis-advantages in cleaning, susceptibility to dust, and the limited ability to achieve particle size reductions or particle distribution.

*One of the smaller versions of containerized batch mixers, this unit has a 10 cu. Ft. capacity.*

- Impeller-forced mixing uses an impeller to "stir" the materials and facilitate the mixing action. There are two main types of impeller-forced mixing:

  - **Stationary machines**
    Impellers are introduced into a stationary machine to assist in the mixing process. This process has some of the characteristics of container movement with relatively low-speed impeller action.

  - **Trough mixers**
    Both impeller and mixer are stationary. Ribbon blenders, pug mills, and pin mixers are examples. Trough mixers have some of the same advantages and disadvantages faced by container movement mixers.

Impeller-forced mixing can have an advantage of higher RPMs when compared to container movement mixers. Unfortunately, impeller-forced mixing alone does not have the particle distribution capabilities to handle jobs were sophisticated blending is extremely important. Please see the chart below.

| | Stationary Container | Container Movement (Tumble Only) | Tumble/ Impeller/Captive Container | Tumble/Impeller Non-Captive |
|---|---|---|---|---|
| Cost | Low | Low | Medium | High |
| Horsepower | Low | Low | Medium | High |
| Blend Time | High | High | Medium | Low |
| Tumble Speed | N/A | Low | Low | Low |
| Impeller Speed | Low | Low | Low | High |
| Particle Size Reduction | No | No | No | Yes |
| Removable Vessel | No | No | No | Yes |
| Ease of Cleaning | High | High | High | Low |
| Cross Contamination | High | High | High | Low |
| Environmental Concerns | High | High | High | Low |

## Speed

The third characteristic of mixer types involves the ability to impart speed to a mixing process. RPM limitations impact particle size reduction and particle distribution. This is particularly significant in more sophisticated dry solids blending, such as pharmaceuticals, where extremely small amounts of active ingredients are blended with a very large percentage of inactive ingredients without making multiple passes through the mixing machinery. This can only be accomplished by utilizing a combination of impeller speed and container rotation.

As previously mentioned, the tumble-only container movement approach has rotational speed limitations. Trough-type machines and stationary mixers are faster, but are generally limited to the 1,000 – 2,000 RPM range. More sophisticated machines, such as Containerized Batch Mixers, have the ability to achieve up to 6,000 RPM while maintaining the integrity of container size and footprint.

## Containerized Batch Mixers

The Containerized Batch Mixer (CBM) combines the best aspects of a non-captive container system with the benefits of container movement and impel-forced mixing.

In a non-captive CBM system, one container is charged, sealed and rolled to a mixing station for a short (three-to-eight minute) mixing cycle. When the cycle is complete, a second container is inserted to start a new batch while the first container is rolled to another area for discharge and cleaning. This process allows for c omplete maximization of its ability and eliminates most down time.

CBM's mixing action incorporates both impellers and container rotation making speed its primary advantage. With rotational speed as high as 6,000 RPMs, the ingredients can be mixed faster and more thoughly while permitting higher levels of particle size reduction and particle distribution.

## Current applications for Containerized Batch Mixers (Tumble/Impeller/Non-captive containers):

Cosmetics
Ceramics
Pharmaceutical
Plastics
Pigments
Specialty Foods

## Industries that should consider Containerized Batch Mixers (Tumble/Impeller/Non-captive containers):

Powdered Metal
Photographic
Adhesives
Dental
Sealants
Spices
Electronics

## Summary

There are many factors to consider when selecting mixers for dry solids applications. The development of advanced mixing machinery is utilizing the best of standard mixing technology and increasing its ease-of-use and speed. A manufacturer must assess all of its dry solid mixing options; determine which factors are the most important to both its total plant operation and its dry solids mixing success.

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