Tips & Techniques for Mixing & Blending Success (Part I)

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The following tips and techniques will help you accomplish your goals by better understanding the art and science of mixing and blending. For over 75 years, Marion Mixers has been manufacturing industrial processing equipment. Our depth of knowledge will assist you in the areas of mixing, cleaning, energy efficiency, testing and making the right equipment choices.

First, let's get our terms straight. Is it called mixing or blending? These words are commonly interchanged. However, some experts use mixing to describe the combining of wet and dry materials, and blending to describe the combining of dry materials. The term blending is typically reserved for powders, flakes and granules of varying bulk densities and particle size where gentle mixing is required with minimal contact area from blades. Another term synonymous with mixing is agitation. In processing, it is used to ensure a faster completion of the mixing process to reach homogenous mixture.

The mixing of free-flowing powders is a necessity in many industries. An effective mixing geometry is the starting point for many of these processes. Some geometries mix well; others do not. Particle properties may include size distribution, shape, particle density, composition and internal structure. Bulk properties include flowability, bulk density, mixture quality, segregation tendency, dustiness and rheology (physics of flow and change shape.) Fluctuations in raw material composition, feed rate and process variables will also impact particle properties which can lead to off-specification product and equipment downtime.

Tips

The following tips and techniques should at least make you aware of the efficiencies and best practices to accomplish safe, cost-effective mixing and blending while achieving your goals.

Mixing

1. The amount of shear imparted to the mix could be adjusted by varying the

speed to accommodate the different mix consistencies. Scaling up mixers from smaller trial units to production models needs careful overall design consideration to ensure continuity of mixing accuracy and consistency.

2. If the mixture forms lumps very easily (compact and agglomerate), then a medium- to high-shear mixing action will be required. If products and mixture flow very freely, then a medium- to low-shear mixing action will be required.
3. Humidity and compaction can cause agglomeration. Agglomeration prevents the spread of materials. We recommend the use of choppers for size reduction of agglomerates. These optional accessories add shear for additional dispersion. They also provide a stable, uniform dispersion of an insoluble phase with a liquid phase.
4. Demixing can occur through a number of different mechanisms. Differences in size can lead to demixing. Smaller particles sieve through larger particles. For example, in a box of cereal, fines go to the bottom of the box by this product imperfection. Fines with very large particles might require the addition of a binder to keep the material mixed.
5. Static cling can prevent material from flowing into the process to begin with and can cause dust explosions. By changing the material of construction, adding a liner or increasing the humidity, plants could minimize static cling.
6. Feed the mixer in an appropriate manner. Minor ingredients should not be added first to a completely empty vessel. This precaution prevents the material from getting into the nooks and crannies of the vessel, which are sometimes difficult to reach by mixing. Different feeds should be layered to avoid this problem.
7. Mixing during the addition of materials is always a good idea (if it can be executed) because it prevents stratification.

Design

1. Ingredient shape and hardness will significantly increase the horsepower requirement of the mixer. We recommend a machined bevel on the leading edge of the blades. This relief reduces the amount of product that can be trapped between the leading edge of the blade and the mixer trough.
2. Consider a paddle-style agitator. It can offer better clean-out between batches; better mixing of random shapes, such as crystals, powders and flakes; less horsepower when mixing crystals; better interface with high-speed choppers; larger variations in batch size; and better field adjustment to accommodate wear.
3. The ease of cleaning can be affected by a number of features in the mixer and its location in the process line, but as a rule of thumb, the easiest mixers to clean are those with the least surface area and number of parts in the mix.
4. Mixers are usually sub-parts within an overall process cycle, and therefore, consideration should be given to how they integrate within this overall system, including upstream and downstream product handling. Consideration should also be given to future plant requirements so that designs have a high level of future-proof longevity with minimal cost

implications and plant disruption. Choosing the right mixer may not always be as straightforward as expected.

5. Some batch systems can be designed as semi-continuous while still having the advantages of batch processing. If you have a continuous upstream process, there are ways to handle the continuous flow in a batch process. For instance: you can collect the material in a hopper and discharge it in batches to the mixer; you can use multiple batch mixers that are sequenced to handle the continuous flow; or you can use a hybrid (continuous-batch) system in which surge hoppers hold material from a continuous upstream process or in-feed system to allow rapid batch mixing without lengthy downtime for material handling.
6. The batching plant that produces product on a continuous basis, but provides tight control may have these steps: Materials contained in a silo(s); sent to pre-weigh bins; fed into the mixer(s); discharged to a surge hopper; and sent to packaging.

Energy Efficiency

1. The amount of energy required to ensure an efficient mix is, to a large extent, dependent on the flow properties and the tendency of the mixture to form lumps or agglomerates. Mixing can be a very energy-hungry process, and therefore, it is important to strike a balance between optimizing mixing efficiency and minimizing power consumption. This is achieved by accurately matching the mixer speed to the mixing time required to achieve the ideal mix. It is particularly important where high shear or abrasive products are to be mixed and a reduction of 10 percent in speed can lead to a 30 percent savings in power.
2. In another example, control of solids content or viscosity of the concentrate leaving an evaporator can lead to energy cost reductions. If the solids content is too low, then more energy is required in drying, and if the viscosity of the concentrate is too high, it will disrupt the atomization process and the drying process.

Testing

1. The most challenging applications occur when chemical reactions are designed to take place during the mixing process. Exothermic or endothermic reactions inside the mixer can dramatically change the consistency of the ingredients. Don’t take chances. Arrange for testing. We offer on-site testing for factory validation research at your plant. Free lab-scale test units may be scheduled for up to three weeks. We also can arrange for testing at our state-of-the-art test facility as well.
2. Various conditions can be demonstrated by test and accurately scaled up to deliver ongoing savings at the production scale. Carrying out product trials is an essential part of ensuring the best engineered solution is achieved.

Please tune into the Chemical Equipment Daily *tomorrow for part two of this two-*

part piece. For more information, please visit www.marionmixers.com [1].

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