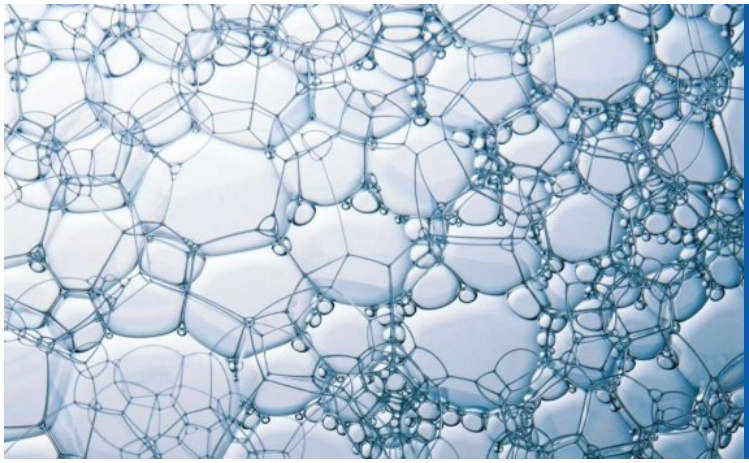
PROCESSING
INSIGHTS



2 common powder mixing challenges – and how to solve them

MIXING & BLENDING, PREPARED FOOD

Consumers insist on a perfect product every time. To achieve this, food processors must stay in complete control of every aspect of their production. Mixing – the process of dissolving, emulsifying or dispersing powder and liquid ingredients into a liquid medium – aims to efficiently achieve a smooth, homogenous product with consistent quality. But it involves a highly complex operation that, done incorrectly, can have a seriously impact on both process efficiency and end-product quality. Here are two of the most common powder mixing challenges, and advice on how to solve them.

1. Air incorporation and foaming

The challenge:

One of the main challenges in mixing powders with liquids is how to prevent unwanted air and foaming. Air may be incorporated into a product by mixers with a whipping action, or when adding ingredients such as powder, which tends to trap air.

Air bubbles rise to the surface and then escape. However, if foam-stabilizing ingredients such as protein are present, they stabilize into foam at the product's surface instead. Air may dissolve into products and cause foaming later in the production process.

Air incorporation causes major problems in processing. Air in the product may cause increased fouling in heat exchangers, cavitation in homogenizers, and unwanted whey formation in fermented products. Fouling in heat exchangers leads to shorter running times and increased cleaning time. Cavitation in homogenizers leads to higher maintenance costs.

In terms of product quality, air in the product can cause oxidation, both during processing and in the package on the way to consumers. Oxidation increases risk for off flavours, browning, and loss of sensitive nutrients such as vitamin C. Air incorporation can also lead to significant product losses in production – if the air creates large volumes of unwanted foam in mixing tanks and other equipment, since foam is nearly impossible to remove.

The solution:

The right solution will overcome these challenges and ensure efficient operations with longer production hours, lower maintenance costs, and safe, high-quality end products.

First you need to choose the right mixing equipment. It is important to look at the entire processing line and take all measures to minimize air and foam – especially when working with a product that is sensitive to air incorporation and foams easily. It is important to consider the type of mixing equipment, the design of the surrounding equipment, how powder is added, and processing temperature.

Also important is to look at the type of powder and ingredients you want to dissolve and how fast you need to be ready with your mixture. Different powder requires different shear and time to be dissolved.

When we look at ingredients that are fairly easy to dissolve and the mixture is non-viscous, typically below 300cP, a mixer with lower shear can often be used.

There are some ingredients that require higher shear forces, like stabilizers. The more viscous a mixture is, the more important it is to minimize the air incorporation when the mixture is mixed.

One good alternative is then to use a vacuum mixer, where the mixing tank is evacuated and a vacuum is created inside. The liquid surface then borders vacuum instead of air, and so the whipping action inside the mixing tank does not create air bubbles. Ingredients are injected through powder inlets positioned on the mixing tank body well below the liquid surface.

When not using a vacuum mixer, it is of utmost importance to control the whipping action in order to minimize the air incorporation. When strong mixing is done at the surface of a mixture, a vortex is created, which then draws air into the product. In order to not draw air into the product, the surface activity in the mixer should be calm but in the mixture there should be a good flow. This mixing should be efficient in the mixer both at a high level and at low level in a tank.

It is important to minimize mixing time and thus minimize the time during which air could be incorporated into the product. For more difficult such as stabilizers and aspartame powders, a higher shear force can minimize the mixing time. Such a solution is a mixer that utilizes a rotor and stator to produce the high shear forces required to efficiently dissolve, emulsify and disperse ingredients and thereby achieves a smooth, homogenous product.

With this approach, liquid and powder are forced down to where the blades underneath the rotor push the mixture through the perforated stator. This motion creates the high shear forces required to ensure that both ingredients dissolve efficiently and completely.

When a powder that is easier to dissolve is to be mixed, a lower shear is good enough and will not influence the dissolving time significantly. One mixing technology that can be used then is the radial jet mixing technology, which has a lower shear and that minimizes air incorporation through its a calm surface activity.

Finally, it is also important to choose the right processing temperature for each product. For example, it is useful to perform the mixing process at a higher temperature since air is less soluble in a warm environment.

2. Lumping and clogging

The challenge:

The formation of lumps when mixing powders with liquids is of particular concern when working with high-viscous stabilizers and other powders, such as cocoa, that are difficult to wet. Lumps occur when a large amount of powder is added to the liquid phase all at once.

When this happens, stabilizers can form a gelling surface around powder particles. The gelled surface prevents the liquid from fully wetting the powder and causes the powder to lump. The functionality of a stabilizer is not utilized efficiently when lumping occurs, meaning that more must be added to the recipe to achieve the same functional results.

Powder lumping reduces the stability of a product and may lead to sedimentation, which shortens shelf life. Lumps may also cause sterility problems in the product, since the inner temperature of lumps may not meet the required temperature during heat treatment.

The formation of particularly large lumps in a product can be an issue if the cohesive powder ingredient has been exposed to moisture. These large lumps can cause clogging in equipment, reducing production capacity and operational efficiency.

The solution:

To prevent lumping and clogging, it is important to handle the powder correctly, choose the right equipment with high shear forces, control how the powder is added to the mix, and choose the right mixing temperature.

Some cohesive powders, such as stabilizers, tend to lump if not stored or handled properly. Powders stored in a humid environment, for example, absorb moisture and form lumps.

Vacuum mixing makes it possible to store and dose the powder in a separate processing hall designed for storing and handling powders. This ensures that powders are not exposed to the humid environment of the mixing area and prevents related lumping and clogging issues.

Many powders that tend to lump, such as stabilizers, are also notoriously difficult to disperse. These difficult powders require high-shear mixing to prevent lumping and clogging. To achieve the high-shear forces required for full dispersion of difficult powder ingredients, it is important that the design of the tank and the rotor and stator are optimized.

Batch mixers, with the mixing unit inside the mixer tank, are the ideal solution when dealing with difficult powders and highly viscous products. Dosing powder on the liquid surface and transporting it quickly down towards the mixing head in a controlled vortex achieves optimal wetting of powder by ensuring maximum exposure to the liquid medium.

Since there are no circulation loops around the mixer, the entire mixture in the vessel is forced through the mixing head more often than in conventional systems with circulation loops. This efficiently mixes powders with low wettability or solubility as well as products with very high viscosity.

These same difficult powders also benefit from being mixed with other powder ingredients, such as sugar, before being added to a liquid mix. This allows stabilizers, for example, which must otherwise only be introduced intermittently and in small amounts, to be added all at once in a steady stream and dispersed more quickly into the liquid.

To more easily dissolve high-viscosity powders in larger amounts, it is common to process at a higher temperature. Some powders with specific functional properties may also require processing at a higher temperature in order to activate these properties.

Our experts are well-equipped to solve your powder mixing challenges. Please contact us to discuss your needs.

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