Mixers Don't Mix Anymore

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Continuous Mixing. Continuous Expertise.

To compete in today's marketplace, a business must have a unique product that meets the highest standards of quality in its industry. Manufacturers cannot afford to compromise their competitive edge by accepting less than the best from their production processes. Increased control over all aspects of production is essential for their success in the marketplace.

Today's mixing technology brings manufacturers precise control over their products by allowing them to identify and adjust the details involved in the mixing process. To take advantage of the benefits offered by this new technology, however, manufacturers must redefine their concept of mixing. Solids processing for the 21st century will require a new perspective on what mixers do and how they do it.

Batch Mixing

Batch mixing is the method generally associated with the mixing process - Ingredient A is mixed with Ingredient B and blended until the product is uniform in consistency. It sounds simple, but several things happen during that process that can have a profound impact on the final product.

As a product is mixed, the effects of shear and temperature come into play. Shear is the actual process of one material breaking down and dispersing throughout another. In batch mixing, shearing is uneven - some particles are readily dispersed while some are not dispersed until the end of the mixing cycle.

Because the shearing times for particles within a mixture are not the same, their temperatures become inconsistent as well. Once a particle is sheared and homogenized, it begins to heat up. Therefore, those particles that were sheared early in the mixing cycle have higher temperatures than those that were sheared at the end of the cycle.

The effect of shear and heat on a product, and the level of that effect,can be gauged by its shear/heat history. The longer a product is mixed in a batch,the broader its shear/heat history will be.

Batch mixing is often sufficient for small quantities or for products that require long reaction times. However, cost-effective production requires that large quantities be produced in minimal time. Under these circumstances, batch mixing becomes an immense compromise for the manufacturer.

Treating large volumes of a product within a reasonable period of time is difficult in batch mixing - it takes a long time to turn over the entire volume. To obtain a homogeneous mixture, the shear/heat history becomes extensive, and the manufacturer loses valuable control over the final product.

Continuous Mixing: The New Technology

With the development of continuous mixers, manufacturers now have more control over the products they make. While the older batch method of mixing averaged the properties of the mixed materials, continuous technology allows manufacturers to see and control a product's sensitivities to shearing, heating, and cooling. This control offers an ability to make subtle adjustments to the physical and chemical characteristics of their products to ensure top-quality results.

1. Blending/Homogenization. This is the required first step in mixing, but it is actually a minor part of what the machinery does. In a continuous mixing process, the mixture is homogenized in seconds. Blending occurs so quickly that it is almost insignificant, and the shear/heat history becomes extremely short and uniform.
The remainder of the mixing time is used to develop the given temperature and shear that will give the product its unique physical and chemical properties - in fact, its market edge.

2. Shearing with Temperature Control. Once the product is homogenized. It passes through a set of paddles for shearing. The configuration of the paddles is specifically

designed to obtain the final product's desired characteristics. Adjustments in the paddles' type and orientation perfect the results

As material passes through the paddles for shearing, its temperature is regulated by multiple temperature controls on the outside surface of the mixer. These controls, often referred to as "the jackets on the barrel," heat and cool the mixture as it is sheared.

Throughout this phase, production is enhanced by close clearances between the paddles, and between the paddles and the wall of the vessel. Close clearances make uniform shearing possible, and the thin film that is produced heats and cools rapidly, thereby reducing processing time.

3. Extruding/Grinding. The third step in the mixing process provides the product's final form. Once the product's desired physical attributes are obtained, it can be formed into bars, rods or strands, or it can be ground or pelletized.

A contoured extrusion die plate at the discharge end of the mixer can be customized to produce any size or shape required for the final product.

The Product Must Dictate the Process

Manufacturers today need not be satisfied with a mixer that only approaches what they want - instead they can find a mixer that will produce their product exactly. In all cases, the mixing process for a product should be adapted to fit the manufacturer's needs; the manufacturer should not adjust his needs to fit the mixer.
When choosing a mixer, it's important to realize that mixing is no longer a question of equipment alone. Like a computer, both the hardware (the machinery) and the software (the specific mixing processes) must work together to produce the desired effect.

Mixers today can be customized to create a broad spectrum of specific results. And while the mixing machines might all look alike, they play vitally different roles in each manufacturer's circumstances. One manufacturer might consider his mixer a shearer/heater/drier while another might think of his as a crystallizer - and they are both right. The diverse capabilities of this technology can be illustrated by several scenarios.

As a rule of thumb, continuous mixers are most advantageous for products with a viscosity of 20,000 centipoise or more - the consistency of syrup. Production rates as low as kilograms per hour will benefit from the process. Advancements in design to prevent wear have made continuous mixers a realistic choice for powder injection molding users. New wear-resistant materials have been developed for use on the mixing paddles and barrels. An additional benefit of continuous mixers is improved environmental and safety concerns, because the entire mixing process takes place within one self-contained unit. The structure encloses explosive or hazardous vapors and dust. Also, workers are required to do less lifting to move the product in and out of the vessels,resulting in fewer injuries.

Mixer Selection Should Be Done Early

In many product development or improvement scenarios, mixing is an after thought. As the product's formula is determined, small quantities are mixed in batches. Large-volume or continuous production is only considered after the formula is deemed perfect, and that is when mixers enter the equation. By then, however, batch mixing has masked the roles of shear and temperature in the mixing process.

The choice of a mixer, then, should be an integral part of product research because it has a direct effect on the formula. In fact, the final product formula often changes when mixing is done, even resulting in a new product altogether.

Testing of mixers is essential to determine the feasibility of production and to uncover the distinctive aspects of the product's properties. Tests might only take one or two days to complete, and a mixer supplier can assist by providing facilities and equipment.

During the tests, videotaping is often used to document the entire mixing process, but it is important that manufacturers be involved throughout. By participating in the tests, they will learn more about their product than the ever did before. They will learn about the variable involved in mixing and develop and important understanding of how those variables affect their product.

Conclusion

In today's marketplace, competition will not allow compromise in product quality. Manufacturing processes are not simple anymore, and new methods must be found to keep up with a changing world.
To obtain the best product possible, mixing must meet the product's process, not develop it. Manufacturers can and should find the right combination of mixers and mixing processes that will satisfy the exacting requirements of their products.

Examples of Mixing Scenarios

Polymerization. An actual physical change occurs to a polymer during its production. In the initial homogenizing/reaction step, the mixture is a liquid. It changes to a powder while it travels through the shear zone. In the final phase of the process, the polymer is granulated or ground while it is cooled.

Pigments/Toners. Compounding for toners requires that a pigment be embedded in a resin as a first step in mixing. The resin must be melted at high temperatures to embed the pigment. Later stages of the process cool the material and grind it into a powder.

Artificial Sweeteners and Confections. In these applications, the goal is to develop a crystal and precisely control its structure. The process begins by creating a supersaturated solution of the sweetener. The final phase of the process forms the crystalline structure.

Chocolates. The goal for this application is opposite of the goal for sweeteners and confections. It is imperative that the crystalline structure of the chocolate be preserved through the mixing process. Chocolate is easily overheated -it is destroyed at temperatures over 80° - so a regulated, multistep process is developed for homogenization, shearing and cooling.

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