Vacuum mixing: A closer look at the benefits

By definition, vacuum refers to space absolutely devoid of matter. A perfect vacuum has never been obtained; the best man-made vacuums contain less than 100,000 gas molecules per cc, compared to about 30 billion (30×1018) molecules for air at sea level.

By convention, any closed system with internal pressure significantly lower than atmospheric pressure is considered a vacuum. And though its true concept is unattainable, vacuum serves as an indispensable tool to modern processes and technologies.

Vacuum environments accomplish a number of mixing goals that vary from application to application. For some, it is simply a matter of aesthetics; like adhesives requiring complete deaeration to produce a void-free bond. For other products, deoxidation is necessary in order to prevent decomposition of sensitive ingredients or thwart unwanted chemical reactions and microbial growth.

Mixing under vacuum likewise has a direct impact on end-product performance. Studies show that processing under vacuum reduces porosity and unbound particles. Reducing the number of pores leads to remarkable improvements in strength and fatigue life.

When processing heat-sensitive materials, vacuum drying is an excellent method of driving off moisture and solvents without the risk of thermal degradation. With the aid of vacuum, the changes in physical state – from slurry to paste, and from paste to granules or dry powders – are achieved more quickly as a result of lower boiling points. The volatiles are then captured in an adjacent condenser, preventing them from contaminating the atmosphere and allowing for proper reuse or disposal to meet environmental requirements.

In addition, vacuum conditions enable the injection of lightweight powders and liquids into a low or medium viscosity batch through a subsurface port in the mixing vessel. This accelerates the mix cycle, especially by wetting out low-surface energy powders instantly.

Lastly, product densification as a result of vacuum mixing leads to more efficient dispersion of minor additives and ingredients. Shipping of final product also becomes more economical with the smaller volume of material to be handled.

When done correctly, vacuum mixing provides the advantages just enumerated which certain applications sometimes cannot do without. Indeed, vacuum application is not simply a matter of turning on a vacuum pump at the beginning of the cycle and turning it off after mixing is complete. The real value of vacuum mixing can be maximized only by systematic experimentation. Technique can be more important than the choice of equipment especially for cases when subtle changes in vacuum application produce tremendous effects on bottom-line production and end-product quality.

There is always room to tweak an existing process and make it more productive. But the best time to perfect vacuum-mixing techniques is even before the vacuum mixer is purchased. It is recommended to plan on a program of thorough testing with the equipment manufacturer before specifying any equipment. To confirm the best mixing configuration, experiments should be run on a broad variety of mixers.

After narrowing the equipment selection, focus should go to vacuum-mixing technique. Here, as in the process of equipment selection, the key principle to remember is to abandon any preconceptions. Vacuum mixing requires an unusual combination of analytical and intuitive testing. The application experience of the equipment manufacturer can be relied on to offer and test a wide variety of techniques.

Investing in creative testing at the early stages of capital equipment procurement will pay off quickly in the process line. The benefits are no less than greater production and superior product quality.

Today, most process engineers consider quantitative testing a critical step in selecting and optimizing mixing and blending equipment. The Ross Test and Development Center is equipped with all of our mixers and blenders, as well as sophisticated instrumentation, such as this laser diffraction particle size analyzer, to measure particle/droplet size as well as size distribution. When you leave our Test Center you will have proof of your test results. If you are not already taking advantage of all the experience and expertise Ross can offer, call 1-800-243-ROSS to discuss your needs with a Ross applications specialist. We will be glad to provide you more details on our testing program. We can also provide application information to help make your process operation more efficient, and to improve the quality of your products.

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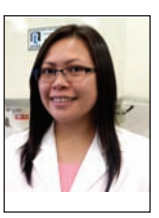

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