



A Guide to Conducting Successful Mixing Trials

Laboratory testing is an integral part of equipment procurement. In the case of mixing and blender equipment, two or more fundamentally different devices may present to be viable solutions to a particular process and the only way of determining the best technology is by performing lab tests. This hands-on approach works best when the main variables – raw materials, temperature, pressure, batch size, etc. – are simulated as close as possible to the actual process.

Mixing trials can be performed at your plant using trial rental equipment or at the mixer manufacturer's laboratory. Trial renting to test on your production floor or R&D lab is advantageous in that you can perform virtually unlimited mixing trials under normalized process conditions. Testing at the manufacturer's laboratory presents the benefit of evaluating multiple equipment designs and of utilizing the expertise of mixing engineers who can make valuable suggestions based on their observations of your product's behavior during and after mixing.

This article examines several guidelines to help you conduct successful mixing trials.

Reproduce Your Process

As mentioned, it is ideal to simulate your actual process and control as many variables as possible. If raw materials are costly, you could perform lab tests on a mixer no smaller than 10% of the capacity you are looking to eventually purchase.

Skin the Cat Different Ways

When practical, try different methods and orders of material addition. How the bulk of your powder ingredients are added into liquid could be a huge opportunity for improving mixing efficiency. You may find that adding solids sub-surface using a high speed induction device works better for your process than dumping a whole bag into the mix vessel or adding powders scoop by scoop through a feed port.

In the preparation of pastes and dough-like formulations using a planetary mixer, try loading all or majority of the solids into the mix vessel, run the blades, and then gradually add liquid components. Unless there are waxes or resins that need to be melted, it is recommended to artificially raise the viscosity by initially withholding some amount of the liquids. The higher the product viscosity during mixing, the greater the shear that the planetary blades can impart.

Some operators are accustomed to heating the product in order to improve flow in a mixer with fixed agitators. By switching to a planetary mixer with blades that travel throughout the mix vessel regardless of product rheology, the heating step of the process can actually be eliminated. Hence, while conserving energy you are in fact improving shear rates as well as mixing times.

Take Notes

Parameters like mixer speed, mixing time, power load, temperature rise, flow rate, etc. must be noted.

Time not only the mixing cycle, but also the heating (melting) and/or cooling portions, as these steps can add significantly to the total batch time. If the product zone (vessel wall, blades, shafts, etc.) requires a scrape down some time during the batch, factor this in as well.

In addition, take note of the discharge time to see if this will create a potential bottleneck especially if your product is relatively non-flowable or if it cures rather quickly. Also visualize what you will need to deliver raw materials into the mixer so you can estimate the number, location and size of feed ports. Does dusting occur during material addition or product discharge? Discuss with your mixing engineer how to overcome issues like this.

After the mixing trial, observe if the mixer can be cleaned easily for the next batch and how to do so. Ask about mixer features designed to further guard against cross-contamination, minimize dead space and protect seals.

Learn From Previous Experience

Collectively, your experience and your mixing engineer's experience will map out the general course of action of your lab test. If you have previously made the test formulation using a different mixer, what were the positive points and what problems were encountered? What improvements would you like to see?

Your mixing engineer will also be able to advise possible options based on your product's rheology, the desired end results, and his/her familiarity with similar products.

All possible input from both sides will narrow down your search and enable you to focus on assessing the most viable mixing solution.

Monitor Results As Soon As Possible

Even before the lab test, figure out what exactly you are looking for in the mixed product. Is there a way or two to conclude success immediately?

Measuring indicators of success at strategic points will reveal the mixing progression. For example, you can take a sample of an emulsion after each pass through an inline high shear device and analyze for droplet size. If the appropriate inline equipment is selected, the desired results are generally achieved in 1 to 3 passes. Multiple passes can produce improved results, but usually with diminishing returns. Knowing the exact number of turnovers required to reach your goal point is an important optimization opportunity and the mixing trial is the perfect occasion to accomplish this. Two common mixing mistakes are under-processing (which compromises product quality) and over-processing (which not only wastes energy and time, but can also cause undue wear on the mixing equipment). You would want to find out when it is just right to stop mixing.

A laboratory equipped for on-site analysis of viscosity, density, particle or droplet size, fineness of grind, etc. will allow you to fine-tune the mixing trials on the fly. Unless product quality can be readily judged by visual inspection, testing without analytical equipment is like testing in the dark.

Further analysis of mixed samples at your facility is always helpful. This way you can perform the routine quality checks that your finished product has to actually pass. Parameters like conductivity, percent yield, hardness and stability are normally determined only after mixed samples are used to make finished product. When possible, take samples from different parts of the mixer or blender.

Check for Side Effects

When mixing your product using a significantly different technology compared to your R&D practices, check for side effects. How does your product respond to increased shear or heat? Does the application of vacuum during the mixing procedure affect the ratio of volatile ingredients in the batch? Is there a possibility of using a lesser amount of additives due to improved mixing conditions?

Conclusion

Many processes entail proprietary details, which you may not be in a position to share with anyone outside your company. However, you need to clearly identify the goals that you want to achieve with the mixing trial. Develop a plan and discuss the procedures of the lab test beforehand with your equipment supplier. Do not ignore safety issues. Find out if the test area has the proper ventilation that any of your raw materials require. Does your application require the test mixer and controls to be explosion-proof? Be prepared with the adequate amount of cleaning solutions, sample containers, labels, shipping documents, MSD sheets, etc.

Just like any scientific experiment, a mixing trial's success relies on thorough planning, ample resources (mixing equipment, analytical instruments and technical mixing personnel), a safe and systematic procedure and always, an open mind!

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