

How to work with a mixing consultant

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If a mixing problem has everyone in your plant confused or, worse yet, arguing about the problem's source and how to fix it, it may be time to hire a mixing consultant. An experienced consultant can talk with the people involved in your mixing operation, help them reach an understanding of the problem's source while eliminating false assumptions about it, and then recommend a practical solution. This article covers details about hiring and working successfully with a mixing consultant.

Mixing problems can take many forms: A process developed in your lab for a new product doesn't work. A product that used to be homogeneously mixed in just 45 minutes now requires an 85-minute mixing cycle. Or your product is sometimes too moist and discharges in lumps rather than in a free-flowing stream. Hiring a mixing consultant with experience in finding practical solutions to problems like these can be the fastest, most economical way to get your mixing process running smoothly.

One of the first hurdles you may face is how to justify the cost of hiring a mixing consultant. Think of paying for the consultant's services as an investment with a favorable rate of return. The consultant can save your company's time and money by offering an expert assessment of your problem and recommending the course of action most likely to solve it. The consultant often can not only fix the current problem, but prevent future ones and help you avoid time-consuming and expensive missteps along the way.

To locate a qualified mixing consultant, check consultant listings in industry journals and on the Web sites of industry associations and societies. Watch for consultants who teach short courses or write technical articles for industry publications. Other good sources are contacts you or your co-workers may have in other companies like yours.

What you should know before hiring a consultant

Accurately defining your mixing problem will save your company's time and money by helping the consultant properly target the investigation. But defining the problem can be harder than it seems. For one thing, different people in your company often see the problem in different ways. For instance, your production manager may see the problem as a failure to meet the production schedule, the sales manager may see the problem as a final product that doesn't meet the customer's specification, and your process engineer may see the problem as just one operation in the mixer that doesn't work as planned.

You can reach some consensus and better define the problem by asking basic questions like these:

- *What in the mixing process doesn't work?* This often means, "What characteristic isn't satisfactory?" Maybe your final mixture is the wrong color, one ingredient has separated from the mixture, or a product subsequently made from the mixture has defects.
- *Does the mixing problem always occur, or does the process sometimes work correctly?* One of the most perplexing situations is when your mixing process only occasionally has a problem, but this is often a helpful clue to the problem's source.

- *What mixing conditions can we change? Of these, which mixing conditions have we tried to change? What can't we change?* The answer to the first question, which depends on your company's available resources, often is, "Anything, given enough time and money." An example of a costly change may be switching to different mixing equipment. The answer to the second question is usually, "We've tried the easy, obvious changes." Such changes may include altering raw material proportions and increasing the mixer's operating speed. Often the answer to the last question is any time-consuming or expensive change that you must justify to company managers. An example may be a specific mixing condition that ensures that your pharmaceutical product will meet FDA validation or other regulations.

Sometimes, answering this series of questions still won't help you precisely define the problem or define it in a way that satisfies everyone in your company. In such a case, you may need to hire the consultant *before* arriving at a definition. The consultant can then serve as a facilitator: By asking detailed questions that reveal what people do and don't know about the mixing problem, the consultant can stimulate discussion, correct some false assumptions about the problem, clarify what items need more investigation, and sometimes even elicit peoples' creative ideas about the problem's source and potential solutions.

How to hire a consultant

Plan on interviewing prospective mixing consultants before you hire one. This will help you find a consultant who has good listening skills, strong business ethics, and a willingness to share mixing know-how.

During your interview, assess the consultant's listening skills. Good listening skills will help the consultant fully investigate what the people closest to your mixing process know about the problem. Asking appropriate questions and listening to the answers can help the consultant discover all relevant information, including what methods for solving the problem have already been tried without success.

An equally important factor in your hiring decision is the consultant's integrity. The consultant should not only be honest, but avoid breaching customer confidentiality. A consultant who keeps company names out of discussions about previous consulting experiences is more likely to keep your company's proprietary information confidential. You should ask if the consultant has any conflicts of interest — for instance, if the consultant is currently working for or has recently worked for a company producing the same product as yours. Once you decide to hire the consultant, you should both sign a confidentiality agreement. With the agreement in hand, you can freely disclose raw material, process, and equipment details to the consultant. This will help minimize the chances that the consultant will misunderstand the problem's cause and come up with an incor-

rect solution. Note that in some cases, as long as you fully reveal a raw material's physical characteristics — the most important characteristics for mixing — you may be able to withhold some extremely confidential details about the material's chemical characteristics without affecting the consultant's investigation.

Also make sure that the consultant is willing to share knowledge based on past industry experience. Does the consultant provide more than one answer to your questions? Do the answers come with an explanation of which answer is better than another, why it's better, and how you may be able to apply it? And does the consultant seem prepared? For instance, even at an initial visit, the consultant should bring supporting information about the equipment in your mixing process.

Agreeing on a mixing vocabulary

After hiring the consultant, there's one more issue you need to resolve before your partnership can begin: how to define mixing terms. Your consultant has been exposed to many more mixing applications and equipment types than those in your plant. As a result, the consultant may use a different vocabulary to describe your processes and equipment than you do.

Even *mixing* can have different meanings. It's often used to describe different processes, such as blending, agitation, and dispersion. But some people specifically use the term



Courtesy of Kamutec Group, Bristol, Pa.

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to describe a process that combines materials with different properties to form a new product with uniform properties. Most often, this means liquid mixing to produce a stable product, such as dissolving a powder in liquid to form a solution or dispersing materials in liquid to form an emulsion.

Blending is sometimes used interchangeably with *mixing*. But many people describe blending as combining two or more dry materials that, after blending, each retain unique properties at the particle level.

Processing, of course, can mean not only mixing or blending but liquid addition, drying, agglomerating, deagglomerating, heating, cooling, or other physical or chemical changes. And each type of processing equipment can also be known by several names.

Don't let this variety of technical terms lead to confusion as you work with the consultant. By agreeing ahead of time on how to define terms for your process and equipment, you can prevent time-consuming miscommunication.

Evaluating your mixing problem

Expect the consultant to begin evaluating your mixing problem by asking some basic questions about your process, raw materials, and mixing equipment.

Questions about your process. More often than not, a mixing problem's source is some kind of process change. The consultant will ask questions about your process to see where a change may have occurred. Typical process questions are similar to those you used to define the mixing problem before you hired the consultant. They include:

- Did the mixing process ever work?
 - Did the process work in the lab, but not in production?
 - Did the process work before you made changes in the raw materials, equipment, site, or anything else?
- How do you know the mixing process doesn't work?
 - What characteristics indicate the process is a success?
 - What characteristics indicate the process is a failure?

Asking whether the mixing process ever worked is a natural starting point because it helps pinpoint where in the plant — for instance, the lab, the process development department, or the production floor — the mixing problem may have started. In any case, the consultant will seek information from all those who have a hand in the mixing process.

With a new product that's different from your existing products, the problem's source is harder to pinpoint because so many process factors can be different from those

for your existing products. With a new product, sometimes a very minor problem in the lab is passed along to the process development team, because the lab folks expect that the problem, along with others potentially created by the change in process scale, can be resolved before the process goes to production. Then the process development team does the best it can and hands the process to production, knowing that the equipment operators will have to refine the process once production begins. The end result can be a production mixing problem with a number of potential starting points. In this case, finding out when the process worked correctly, if ever, can help the consultant find the problem. In many companies, a new product has a “champion” — that is, one person with primary responsibility for bringing the product into production. In such a case, the consultant can work closely with this person to identify the problem's source.

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With an existing product, any change in raw materials, equipment features, process location, or other factors can create a mixing problem. Several people in the plant are likely to have a hand in running the process, so the consultant must direct questions to all of them. Some people involved in only a minor way with the process may not think that their information is relevant to solving the mixing problem, but even small details can be helpful. Often the equipment operators are the most knowledgeable, because they run the process day after day and have experience monitoring and adjusting the process. The consultant may be able to discover a problem's source by listening to operators explain how they have tried to fix past mixing problems; sometimes a minor variation in their efforts can be the source of the new problem.

Identifying how you know your process doesn't work often means determining which characteristics indicate that the product is a success or failure. These indicators are often product characteristics, such as excessive moisture in the final product or an off-spec particle size distribution.

Questions about your raw materials. Typical questions the consultant will ask about your raw materials include:

- What are the characteristics (such as composition, particle size distribution, particle shape, moisture content, fri-

ability, flowability, and angle of repose) of the raw materials in your mixing process?

- What are your raw material specifications?
- Have you recently switched raw material suppliers?

Answers to these questions can reveal a difference in the characteristics you've specified for your raw materials and the characteristics of the materials you've actually received. The answers can also reveal that your raw materials have changed, whether you've wanted them to or not. For instance, a weather change, especially in humidity, may have changed the raw material's flow properties. Or a material supplier may have changed the way it processes the material, changing its physical characteristics.

If you determine that raw material variations have caused the mixing problem, the consultant can help you find the solution. The answer may be changing a raw material's specification, using better humidity control methods in your process, switching to a new material supplier, or another solution.

Questions about your mixing equipment. The consultant will ask questions like these about your mixing equipment:

- Why did you choose this mixing equipment?
- Why did you think it would work?
- Do you know the equipment's capacity, speeds, and motor size and type?
- Do you have the equipment's complete description, including dimensions, drawings, and other documentation?
- What functions other than mixing (such as blending, shearing, adding liquids, heating, and cooling) can your equipment provide?
- Have you tried other machines that can handle your mixing application?



Courtesy of Bolz-Summix, div. of MPE Group USA, Pennsauken, N.J.

Protect your process and product details by having the mixing consultant sign a confidentiality agreement.

Mixing equipment can be the source of any of several problems. While any mechanically sound mixer will work under the right circumstances, most mixers work well only for certain materials and applications. Even various models of the same equipment type — such as ribbon blenders — may not handle the same application equally well. While the models may all function similarly, differences in their fabrication details and surface finishes can limit their suitability for some applications. The consultant's questions can often reveal that your equipment isn't ideally suited to your mixing process. While remaining sensitive to your equipment preferences, the consultant can recommend better-suited equipment for your process. **[Editor's note:** Be aware that modifying mixing equipment rather than replacing it can invalidate the equipment warranty and create liability problems. Purchasing used equipment also presents several unknowns, especially if a previous owner has modified or damaged it.]

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In other cases, the problem can result from designing your mixing process to fit your existing mixing equipment rather than choosing the equipment to suit the process. For instance, your existing equipment may allow you to change only the order of raw material addition, mixing cycle time, operating speed, and batch size. If changing any of these doesn't solve the mixing problem, you may need to consider using different mixing equipment. Based on previous experience with mixer capabilities and limitations, the consultant can recommend and even help specify new equipment for your process.

Be aware that equipment selection is particularly complicated for mixing processes. Mixers perform differently based on the flow characteristics of the raw materials they mix, so the mixer type and features must be selected both to handle the raw materials and to produce the desired final product characteristics. For instance, caking and lumps can be a problem in one mixing process, but a step toward making desirable agglomerates in another. Choosing the right mixer for either process ensures that the mixer will achieve a final product with the right characteristics. Hiring a mixing consultant *before* you develop a mixing process or select a mixer for a process can help you prevent equipment-based mixing problems.

Some final advice

Occasionally, even after you've carefully answered each of the consultant's questions about your process, raw materials, and mixing equipment, some unknown factor can obscure the mixing problem's cause. The consultant's empirical experience in observing how materials behave in

similar mixing processes is often the key to solving such a problem.

After completing the investigation into your problem's source, the consultant will recommend a course of action. You may find that implementing this solution is relatively simple, perhaps just involving an adjustment in your raw materials' order of addition or changing the mixing cycle's length. You may even find that the consultant's recommendation reduces your processing costs or prevents you from having to buy a new machine. Or you may find that following the consultant's advice will require a time-consuming plant alteration or an expensive equipment purchase. If you decide that the consultant's recommended course of action is impractical or too expensive, you can always ask the consultant to suggest an alternative for improving your mixing process. But remember that a costly or time-consuming solution can pay for itself relatively quickly, whether by improving your final product, increasing your production rate, or preventing future problems.

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For further reading

Find more information on mixing and related processes in articles listed under "Mixing and blending" in *Powder and Bulk Engineering's* comprehensive article index at www.powderbulk.com and in the December 2003 issue.

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