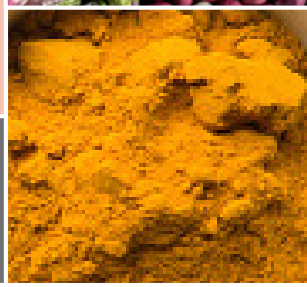
MARION
PROCESS SOLUTIONS

Industrial Mixers:

Processing with Precision for Every Application



Considerations, customizations and efficiency: Choose the right mixer confidently.

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About this guide

The Industrial Mixers Handbook provides information and considerations for choosing an industrial mixer for food, pharmaceutical, chemical, biomass and mineral applications.

Given the cost and lifetime of industrial mixers, most manufacturers want to get a detailed education on their options before making a purchase. This guide is designed to walk you through the major considerations for choosing a mixer, first in general and then for each vertical.

We'll look at the major benefits of making the right choice as you consider the operational costs and implications on the quality of the output of the mixers. This guide also outlines the general considerations for choosing a mixer, as well as the considerations for each major vertical. Different applications have different requirements.

The second half of the Industrial Mixer Handbook goes into the specifics of the machines themselves. You'll learn about the categories for customization along with an illustration of the parts you can customize for each mixer. We'll then discuss how to think about the inflow and outflow for mixers and give an overview of continuous versus batch mixing.

Overall, this handbook offers a comprehensive overview of industrial mixers as a basis to start a conversation with potential vendors. After reading this guide, you'll be well equipped to ask the right questions and go deeper, so that you can make the right choice for your application.

Expanding or Replacing Industrial Mixers:

A Long-term Investment

As you dive into this handbook, it's important to remember that the time spent learning about industrial mixers is small compared to the amount of time you can waste by making the wrong choice. Industrial mixers can last 20 to 30 years on a factory floor, so by the time it comes around to replacing them, the knowledge that went into that initial choice may be outdated. Plus, if the mixer has been working well all those years, why make a change?

The answer should be obvious. If that next mixer is going to last you a few more decades, even a small improvement in efficiency will pay off tremendously. The kinds of improvements you should be looking for include:

- Power and throughput efficiency.
- Easier and lower cost maintenance.
- Lower sanitation costs for both the equipment itself and of the surroundings (replaceable gaskets, for example).
- Features that prevent waste due to incorrect mixtures, overheating and air pressure faults.
- Compliance and sanitation requirements.
- Customizable agitator paddles, fixed or replaceable.
- Factory floor footprint.
- Flexibility for changes over time—ability to adapt as the business grows and changes.

Customizing mixing equipment for your specific application may cost a bit more up front, but in the long term the efficiencies add up to lower operational costs as well as better quality product. Vendors who have been in business over the decades recognize the importance of continuous improvement of the equipment and will offer you a variety of custom options with different types of agitators, input and output options, gaskets, seals, etc. Precision selection of custom options lead to a more durable solution that serves your needs best.

Top Considerations for Choosing Industrial Mixers

When choosing a mixer, use the following as the baseline criteria to consider in making a choice. On top of that, add any specific requirements for your application:

- Feeders into and out of the machine. The speed and loading techniques of the inflow and outflow influence the type of machine and appropriate throughput.
- Composition of the materials being mixed: viscosity, density and granularity of materials.
- Changes in material characteristics during the process (chemical processes).
- Multi-purpose or dedicated production lines, that is, whether you'll be mixing different recipes and cleaning the machine frequently between batches.
- Site requirements. Safety, floor space, surrounding machines and other physical requirements and limitations influence the choice of mixing equipment.
- Sanitation of the machines, manual or automated cleaning, frequency, and level of sterility needed. Impact of dust or particles escaping or leaking: is it merely an inconvenience or will you be handling pharmaceuticals, explosive or other potentially harmful materials?
- Durability and precision. Accelerated wear and tear, short- and long-term maintenance requirements, and the potential for diminishing quality are all results of not having customized mixers appropriately from the outset.
- Future trajectory of your business. Manufacturers in many industries need to consider changes in formulation, chemical and materials technology advancement and company growth.

In addition to the general considerations described here, the next pages go deeper into specific verticals, and the considerations that apply to each of the major applications of industrial mixers.

Industry Verticals:
Major Considerations and Differences

FOOD

Consumers and regulators have upped the game when it comes to sanitary design and processing of foods. Manufacturers simply cannot afford the blow to their reputation associated with product recall or litigation.
Choosing 3-A authorized equipment is the right way to go. If it says "compliant" or "certified" you can be pretty sure it's not authorized. **Marion has the only 3-A authorized horizontal mixer on the market today**.

Going deeper into sanitation, the underlying questions are:

- How easy is it to clean the mixer?
- How easy is it to know that it's clean with a visual inspection?

People who do the cleaning shouldn't need mechanical or technical backgrounds to competently clean and inspect a machine. Anyone in the facility should be able to inspect the mixer without much training. Basically, that means the mixer shouldn't have any hidden niches or points where residue can accumulate unseen.

Mixers can include a variety of features that contribute to better sanitation, including:

- Ergonomic doors for easy access to the mixer with wands and brushes.
- Parts that can be removed for cleaning, such as gaskets, seals and valves.
- Welded paddles and parts (not bolted) to prevent residue and increase visibility of the paddles.
- Safety grate for inspection, protecting personnel as they bend over to investigate the mixer.
- Large doors for easy access.
- Weighted doors for easy opening and protection of personnel.
- Easy access to all surfaces for wipe-down access.

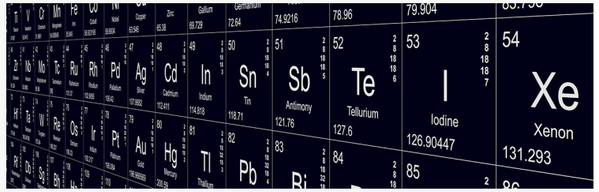
Options for Clean-in-Place and Rinse-in-Place.
When it comes to Clean-in-Place (CIP) options, most factory floors simply don't have the appropriate drainage and waste disposal facilities for the output of the detergent and residue. Rinse water with food residue can harbor bacteria, so for most locations, CIP is impractical or more expensive than manual cleaning. Typically, it's better to use manual cleaning, possibly with an option for rinse-in-place if the drainage is available.

PHARMACEUTICAL AND NUTRACEUTICAL

Precision is the name of the game when it comes to pharmaceuticals. Every single mix must be precisely the same with absolutely no room for error. Batch mixing is the only way to go for precision formulations. Experienced vendors can help with different techniques around the order of the batch mixing and ensuring the inflow, outflow and mixing times are optimized for the specific ingredients and materials being handled.

Furthermore, as with foods, sanitation is key to prevent any types of contamination and to allow manufacturers to use one mixer for different mixes. Anything consumable needs to adhere to 3-A Sanitary Standards, so you'll want to review the details in the Food section of this manual and make sure any mixer you choose has all of the appropriate options for sanitation.

CHEMICAL



Chemical mixes are varied and can require a variety of temperature and sanitation precautions. Similar to pharmaceuticals, working with the right vendor will allow you to achieve a high level of precision and accuracy in the mixes for the specific chemical materials being processed. With chemical reactions, it's important to have a high level of control around the temperature of the mix. For exothermic reactions, cooling jackets should be installed to control the temperature of the drum. Conversely heating jackets or mechanisms provide control in chemical reactions that need to stay within a warmer temperature range.

An important factor when handling chemicals is the safety of the environment around the mixer. Classified processes and materials require explosion-proof electrical parts, valves, motors and safety switches. It's extremely important to make sure the environment is safe and that there is no escape of fumes that could endanger people in the facility. Often, reactionary or classified materials require an isolated mixing room. Vendors with extensive experience in setting up safety rooms can help with the site specifications and installations, so that you ensure the highest level of safety at your facility.

PLASTICS

Plastics can include powders, pellets, flakes and coatings, and consistency is the key here. Considerations for plastics tend to vary depending on the applications, so consider different types of agitators depending on the need. For recycled plastics, a bolted agitator is best, but in medical applications, food-grade paddles are necessary. Anything that might be used for laboratories or medical procedures must adhere to all the sanitary requirements outlined in the Foods section of this handbook. Plastics today are used for everything from implants to surgical equipment, so anything that's going to be inside someone's body requires the same level of sterility as pharmaceuticals and consumables.

Because of the nature of plastics, they tend to leave residue in the mixing chamber, which can affect the consistency of the next batch in the line. Often there's a micro-dust that's hard to see with the naked eye but is quickly detectable with the white-glove test. For that reason, it's important to consider the ease of cleaning the mixers to prevent these types of problems. Delays in sanitation mean slower throughput. Easy sanitation increases the number of batches you can cycle per day.

BIOMASS

Biomass covers a huge range of applications, so customization is key here. Continuous mixers provide rapid throughput, so it's important to work through the specifications for the conveyers both for feeding the mixer and for the outflow. Applications such as colored mulch and waste recovery can use continuous mixers because the applications don't require high consistency of the output. If there is a variation tolerance of five percent or more for the output mixture, continuous mixing is probably the way to go.

On the other hand, with mixes that demand extremely consistent precision in the percentage of the mix, continuous mixing might not provide the best output. Finally, some biomass products are quite sensitive, or need both drying and mixing. Marion provides a large variety of machines to customize for this demanding market.

MINERAL

Abrasion tends to be a central issue in handling mineral mixes. It's important to choose a mixer that has features such as replaceable paddles and replaceable trough liners to extend the lifetime of the mixer. Any mixer without these kinds of replaceable parts will have to go out of service prematurely. Materials such as glass, sand, cement, concrete, aggregates, soil reclamation, pastes, epoxy, adhesives, gypsum, fiberglass and resins, and wood compounds can take their toll on machinery so make sure to choose a mixer that features easy replacement of any parts that come in contact with the mix. While some manufacturers may calculate that it's cheaper to replace the mixer every few years than purchase replacement parts, often these calculations neglect the cost of teardown and disposal of the machine, as well as transport, site preparation and installation of a new machine.

Customization:

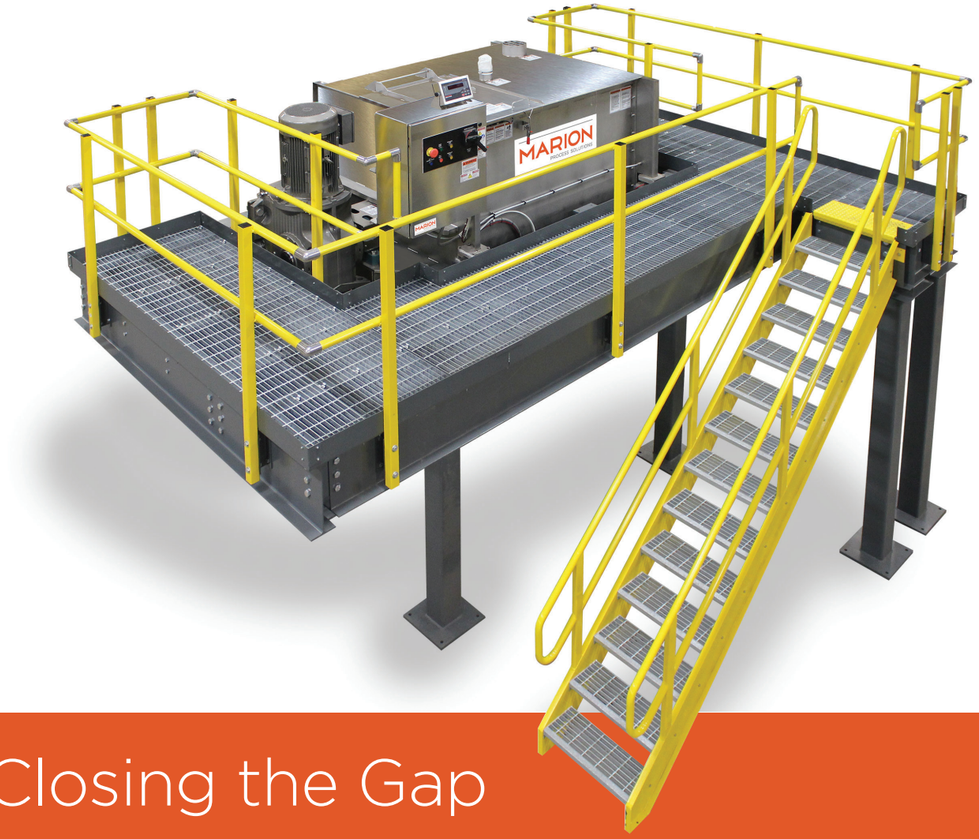
Top Three Benefits

Customization makes the difference when it comes to precision mixes, long-term equipment reliability and operational costs for production lines. Choose options that fit the sanitation, materials handling and durability requirements for your applications.

Sanitation: Depending on the application, cleanability is a major concern to prevent carryover and/or avoid contamination. Sanitation of the equipment involves a range of features, from replaceable gaskets to protect the environment from being dirtied with powders, through having easy-to-reach doors and internal mechanisms for your sanitation crew. If you are working in an environment where there's no room for error when it comes to the cleanliness of your mixers, choose a 3-A certified mixer, not a "compliant" or "compatible" mixer. To date, Marion Process Solutions is the only 3-A authorized manufacturer of horizontal mixers.

Materials Handling: Depending on the application, mixers can be customized for precise measurement, quality checks and appropriate mixing for the viscosity and granularity of the raw materials. Many manufacturers feature only one type of agitator, limiting the customization they can offer. Agitators vary in their abilities to handle different sizes, shapes, densities and potential viscosities of materials. Paddle agitators provide a gentler blending motion, while ribbons are needed to introduce shear or scrubbing action into the mix. Choppers are an option for applications where materials tend to agglomerate or where the material requires aggressive dispersion or size reduction.

Durability: A variety of options can compensate for accelerated wear and tear as well as address short and long-term maintenance requirements. Replaceable seals, gaskets and paddles can keep the machinery running at top performance over the years. One of the simple customizations is ensuring the air supply manifold is at eye level, to prevent unnecessary wear on seals and other components.



Closing the Gap

Mixers are all about moving parts, which puts a focus on how to ensure durability over a long machine lifetime. Marion Process Solutions puts a heavy focus on gaskets, seals and agitator shafts that stand out from the rest. One element of creating durability is determining the parts most likely to wear out and making it easy and cost effective to replace those parts. Acquiring a comprehensive maintenance plan takes the burden off of your staff and ensures a longer lifetime for the equipment.

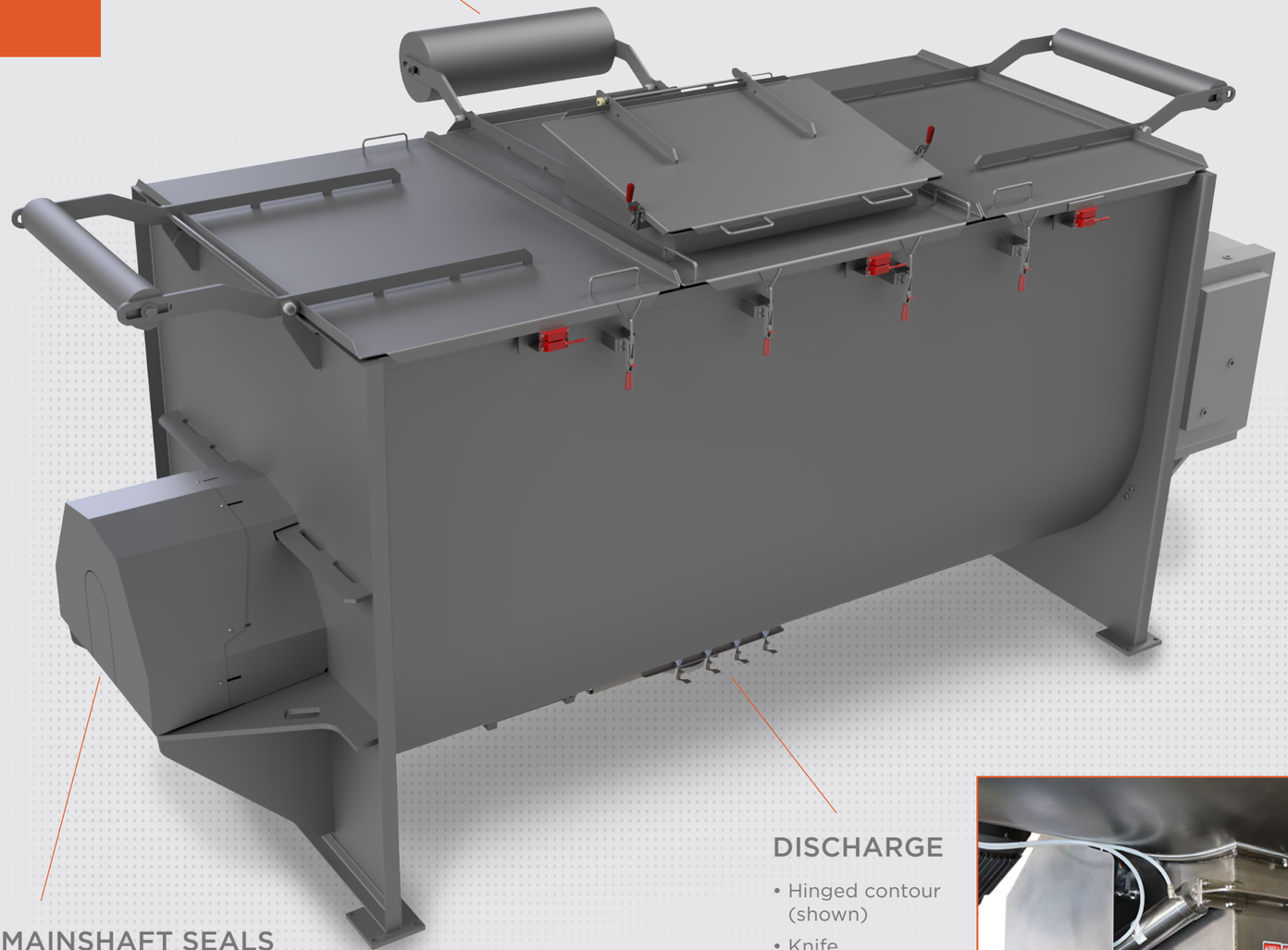
Marion has developed advanced lip seal technology that outperforms the typical stuffing box seals design, is more cost effective than mechanical seals and can rapidly be disassembled, cleaned and re-installed. For powder materials, the design is multiple double lip seals with air purge, while liquids, slurries and 3-A Sanitary authorized sanitary applications, utilize a single lip seal. The seals can operate for years with minimal maintenance required, and then be replaced for a fraction of the cost of traditional seals.

Gaskets maintain the hermetic seal on the doors of mixers. Anyone who has toured different facilities has seen production floors dusted with flour or other similar materials because of poorly fitting door seals or worn out gaskets that are the wrong material, haven't been properly maintained or have been removed altogether. Marion has developed a patented O-Ring technology that ensures a perfect seal for door gaskets and makes it simple to remove, clean and replace regularly to prevent such issues. Anywhere that leaks occur can be a source of health or compliance problems, so it's worthwhile to invest in customized gaskets, seals, doors and dust collection ventilation. Using the right seals and gaskets keeps your factory environment clean.

How to **Customize** Your Industrial Mixer

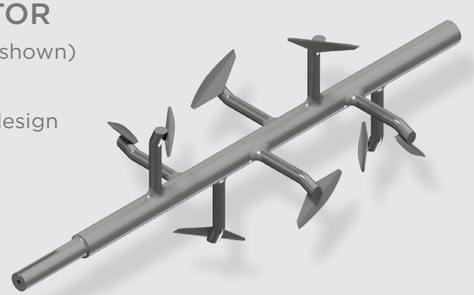
COUNTERWEIGHTED DOORS

- Ergonomic assist for easy access
- Solid weight (no hollow tubes)



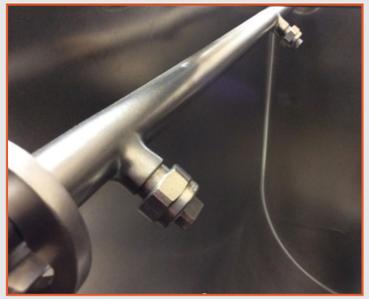
AGITATOR

- Paddle (shown)
- Ribbon
- Hybrid design



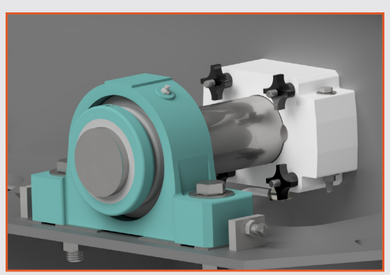
CHOPPER

- Intense cutting action to assist in blending
- 3600 rpm
- Tulip, knife blade or hybrid tulip/knife choices



SPRAY

- Spray or inject designs
- Sanitary and removable for cleaning available



MAINSHAFT SEALS

- Stuffing box
- Split design
- Mechanical

DISCHARGE

- Hinged contour (shown)
- Knife
- Roller gate
- Flush hinged
- Drop-bottom

ADDITIONAL FEATURES

- Drives specifically selected
- Controls
- Load cells
- Sifting
- Elevated work platforms
- Smart Air (mainshaft seals)
- 3-A authorized design
- Integral dimpled jackets
- Hoppers (stationary or agitated)

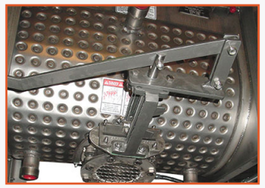
The **Ins** and **Outs**

Upstream and downstream flows are major factors in determining the types and configurations of mixers that are most appropriate for a company. Production lines have clear throughput goals, based on demand, and the mixers need to stand up to the demand. Careful assessment of the impact of the upstream and downstream flows leads to optimal choices in mixer configuration and quantity.

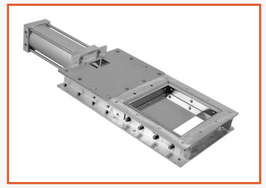
Loading of the mixers can end up as the limiting factor when it comes to determining cycle time. A mixer may need a 15-minute cycle for processing, resulting in four cycles per hour. However, if loading takes an extra 5 minutes, that limits the mixer to three cycles per hour. If a mixer is being hand loaded, mixers should be configured for easy loading to reduce the chance of injury. Bulk bag unloaders or feeders require headspace or conveyer space, so it's important to do a site survey and account for those needs.

Downstream, slow output may also be a choke point when it comes to the throughput of the mixer. Configurations for rapid discharge can choose options such as a knife gate or roller side gate. However, if the unloading is onto a conveyer, the system needs to use a control valve that meters out the mix at a rate dictated by the conveyer. A variety of metered valves are available, including ball valves, butterfly valves, knife gate valves, and iris valves.

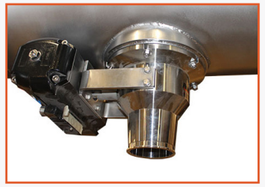
Finally, when considering the right discharge valve, some applications require removable valves for pristine sanitation. When working with degradable materials, pharmaceuticals or foods, manufacturers will want to be able to remove and thoroughly clean the valves on a daily basis or when switching from one mix to another.



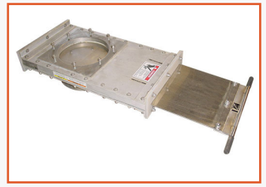
Knife Gate Valve



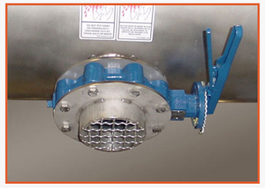
Roller Slide Gate Valve



Ball Valve



Orifice Slide Gate Valve



Butterfly Valve

Iris Valve

Continuous versus **Batch** Mixing

The choice between continuous and batch mixing is a key decision when choosing an industrial mixer. The three main factors are **throughput, precision and inflow/outflow** from the mixer. For some applications, manufacturers also need to take factors into consideration such as the need for thermal processing and coating or specific regulatory or sanitation requirements.

- **Continuous mixing is typically relevant when there are fewer than three ingredients and precision is not a priority. The benefits are high throughput and low energy use, as well as a smaller footprint.**
- **Batch mixing is appropriate for mixes with three or more ingredients, and where the precision of the mix determines the quality. Almost any type of consumable product falls into this category.**

While most manufacturers understand the difference between continuous and batch mixing, there can be some confusion when it comes to continuous process batch control mixing.

Continuous process batch control mixing is a batch process that improves the speed of batch mixers. In continuous process batch control, the hoppers are filled while the mix is in the mixer, and then as soon as the mixer is emptied, the next batch is immediately fed into the mixer. This process combines the precision of batch with some of the speed of continuous mixing. Continuous process batch control mixing is repeatable, consistent and maintains mix quality.

LIFECYCLE SUPPORT

Mixing isn't just about the mixer; it's the beginning of a long-term relationship with the equipment vendor. As you're vetting the equipment, you'll get a sense of how it is to work with that vendor. Are they trustworthy? How long have they been in business? Are they able to provide a test lab facility so you can try out different mixtures and configurations before making a purchase or changing a formula? Your needs will change over time, so make sure you are choosing a vendor that provides services such as:

- Engineering support during the pre-sales process for customization.
- Site inspection and specifications.
- Test labs for proving the effectiveness of their equipment.
- Configurations for your specific needs.
- Process improvement.
- On-site installation support.
- Routine maintenance schedules.
- Replacement parts, both new and refurbished.
- Engineering support for any issues that arise in the manufacturing process, inflow and outflow, energy and sanitation requirements, etc.
- Pre-scheduled site visits to assess and optimize performance.
- Needs assessments, configuration and optimization for growth, new products and line improvements.
- Processing expertise in similar fields, and the ability to apply that expertise to your production lines.
- Suggestions and updates, based on industry trends, laboratory tests, and knowledge gained from industry best practices.

AFTERMARKET SERVICE AND SUPPORT

Marion Performance Group (MPG) provides the aftermarket services that give our clients the best performance over the lifetime of their equipment. MPG relationship will begin before your mixer ships. Our team will reach out discuss recommendations as to what parts should kept on hand. We will discuss on site support. We will discuss maintenance plans. We will be here for your continued support.

Leveraging our experience ensures you'll receive far more than a solid return on your investment...you will create a competitive advantage in your industry. It's simple really: When you're proud of your work, you sign your name to it. You'll find it on everything we build.

CONNECT WITH US

Think of the last time you were delighted by a company. They asked the right questions, listened with eyes and ears, stayed engaged throughout the process, applied their unique expertise, provided you with a spot-on recommendation, and then delivered more than they promised—right? We call this experience "Full Engagement" and it's standard practice at Marion Process Solutions.

So let's engage, start the dialogue, and see where this goes.
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