



WHITE PAPER

Driving Performance in Chemical Mixing

Achieving Greater Efficiency, Consistency, Repeatability
and Sustainability in Chemical Mixing



Digital Controls & Automation Drive Performance

Predictable homogeneity across a given batch (consistency), batch after batch (repeatability), is obviously the goal. Active ingredients may be just a few percent of a total load, but if even a tiny imprecision sneaks into the mix, the entire load is wasted. One of the key advantages of automation is to remove operator error from contributing to those imprecisions while improving accountability and record-keeping. Data logging alone makes it easier to compare batch to batch for consistency.

At the same time, external market pressures—supply chain and labor shortage issues—demand attention be paid to improving yields from a given process, even as we strive for greater consistency. Given that mixers are expected to run decades in place, a “good enough” mixer design simply isn’t good enough anymore. Available digital controls and automation replace flashing red and green buttons with touchscreen user interfaces that can inform as well as monitor and control, keep operators focused on actions and reduce manpower requirements by supporting operators with various experience levels.

The application of digital process management controls, automation and thoughtful customization of equipment (new or used) are a path to more consistent quality. Now a manufacturer has:

- more control and repeatability of product
- extended performance
- reduced operational costs
- avoids material losses
- more efficient cleaning/maintenance
- improved safety
- less downtime

More specifically, as the costs of active ingredients rise, the need for automation—and the payback for installing it—rises in proportion. Automation can reduce headcounts without impacting throughput or quality as experienced operators leave the industry or are harder to find. As other automated equipment comes online, process step integration becomes a reality up and down the line.

Continuous Process with Batch Control

A variety of Marion Process Solution mixers incorporate digital process management controls to achieve better throughput, enabling “Continuous Process with Batch Control.” Traditional continuous mixing may be appropriate for some basic products but cannot provide the precise control required for fully homogenous mixes that require longer reaction times.

Batch mixing delivers that precision but has the logistical drawback of loading/unloading/stopping/starting each batch. With Marion’s “Continuous Process with Batch Control,” digital process controls enable automated load preparation, injection, residence time and unloading, all synchronized to minimize downtime. The result is batch quality control in a near-continuous process.

Introduction

Chemical mixing is a wide-ranging topic, incorporating various specific raw materials, temperatures, reactions and necessary precautions. However, one central question comes up whenever discussing new mixing equipment:

“What are the key factors I need to consider when deciding what new mixing equipment to buy or how to optimize the mixing process in my production line?”

Proper management of the mixing process comes down to driving performance in efficiency, consistency, repeatability and sustainability. These are the watchwords throughout the entire chemical processing sector.

While that may seem like a tall order, the right chemical mixer will not only address each of these issues but bring productivity solutions for all of them. Every chemical manufacturer, chemical plant engineer and quality manager would recognize that when these four core considerations have been optimized with an efficient and effective mixer, other “sub-issues” are addressed at the same time, including capacity, throughput, safety, total cost of ownership and ROI.

Let’s break down how mixing technology can be applied to drive higher performance for chemical processors.

Load Cells

Load cells alone make a big difference. Even though many chemical ingredients are highly reactive, the industry has traditionally relied on manually graded measurements and simple, manually controlled feed valves. Pesticides, for example, require very precise mixes of active ingredients and concentrations that must be validated. The ability to measure precisely the amount of a very expensive reagent added to a given batch equals the ability to salvage that batch—and the time it would take to run—if there is a misfeed or operator error.

NOTE: Updated load cells, like many modern digital controls, can be retrofitted on any Marion ribbon or paddle blender. In fact, in terms of process, Marion can meet you at any point with the appropriate blending technology: continuous, batch or continuous with batch control.

Hazardous Environments

Advances on the automation side, combined with the correct mixer design and appropriate customization, prove essential when dealing with classified processes and materials which require explosion-proof electrical parts, valves, motors, safety switches and, in some cases, isolated mixing rooms.

Safety being a top priority across the board, and the cost of mishaps being so high, operators need to rely on the accuracy of automation monitoring when working with volatile chemicals to break the “combustion triangle.” Since they may not be physically present throughout the run (and may even be working behind solid concrete walls separating the mixer and control bank), sensors provide the feedback they need. O2 sensors, capacity and load sensors, as well as automated feedback to controls and safety switches, join XP motors and electronics in the front-line role of reducing the probability of an accident.



How? Automation helps cut through the confusion and reduce time to troubleshoot. It replaces the need to walk around, check all the fault lights and see which safety device tripped. Instead, all that relevant information is clearly presented wherever the control panel is.

Current digital controls from Marion that can be updated remotely include:

- start-ups and shutdowns
- weight and balance alarms
- temperature notifications
- mixing speed motor current draw
- pressure measurements

Moreover, automation can help reduce the number of interlock safety-related shutdowns and emergency stops. Operators can monitor temperature/amperage readings, find abnormalities inside the mixer and respond in ways that prevent more serious accidents. And digital control can make it much more difficult to bypass safeties or suffer other damaging operator “shortcuts.”

Remote Support

Another significant advantage is the availability of real-time remote support. Operators equipped with a headset/camera can log in to Marion Technical Support (via VPN-protected industrial router) to an experienced technician to view and monitor the entire process control system for immediate remote support.

Regarding Sustainability

As so many vertical markets have discovered, addressing sustainability issues—whether related to product recycling, reduced waste generation, process efficiency, etc.—is a growing concern. The chemical industry, complex as it is, faces the same imperative to meet the market where it’s at today in terms of improving processes for environmental and human benefit. For example, think plastic: recycling/eliminating disposable plastics from everyday life is already dramatically changing the business climate.

How do OEMs like Marion make chemical processing equipment more sustainable? Obviously, by making it more efficient, consistent and repeatable: using less energy to produce better yield per batch or run and producing less waste. And by offering solutions that help address the problems directly.

A good example is the Marion Core Series Horizontal Continuous Mixer jacketed with a double-arm agitator. PET is shredded, then mixed with a caustic solution to soften glues and solvents, and condition the plastic for re-use after drying further down the line.

Customization For Demanding Applications

Customization makes the difference in precision mixes, long-term equipment reliability and operational costs for production lines. Loading/unloading, access, cleanability and more are critical to maintain uptime and avoid cross-contamination. Custom agitator design can address ingredients’ different sizes, shapes, densities and viscosities to provide appropriate blending and shearing. And a host of customizable features—replaceable seals and gaskets, controls like air supply manifolds, etc.—offer extended life, faster maintenance and troubleshooting and better overall performance with specific applications. While one manufacturer may need customized options on one unit, others may choose different customizable features across different lines that work on specific mixes.

Equally important is the ability to have a high level of control around the temperature of the mix. For exothermic reactions, cooling jackets installed to control the temperature of the trough must be monitored and adjusted. The same is true of heating jackets or

mechanisms: customized thermal jacketing and modern digital controls enable more autonomous mixing operations without endangering product quality or operator safety.

In either event, inconsistent starting temperatures, for example, can result in inconsistent fluid viscosity, reaction rates, etc. And, given that so many chemical ingredients are temperature-sensitive, more precise temperature control is also intrinsic to optimal yield calculations. Marion Process Solutions has experience working with applications that require temperatures ranging from +600°F to -20°F.

Consider this example: a manufacturer of advanced proprietary polymers operations utilized a mixer that included vacuum processing of a slurry to drive off moisture, which delivered roughly 86% dry yield. But facing supply chain issues and operator manpower shortages, they sought a straight-line solution to remain competitive in that market. That solution: an upgraded mixer featuring automated controls that produced more consistent product more repetitively, resulting in a jump in yield from the aforementioned 86% to as much as 94%. That improvement in yield more than compensated for the capital expenditure in short order and positioned the company for better profitability as oil prices rose.

Pre-Installation Test Runs

A wise person once observed that in order to make product and money on a large scale, failures should happen on a small scale first. While mixer designs are fairly standardized and well-understood, accommodating any specific chemical process – in particular, a novel or proprietary blending – in a specific factory setting demands a solutions-based approach. Given that mixers are generally found towards the middle of a processing line, and their performance will have a distinct impact up and down that line for years to come, having confidence in the solution is critical.

Marion Process Solutions' engineering teams share more than 80 years of experience assisting customers in navigating their specific challenges across every major vertical market. Their expertise includes evaluating feeding, abrasive resistance, viscosity/density of materials and changes during processing, site requirements, cleaning and maintenance. All impact choices in terms of blender design, necessary automation, customization and ultimate productivity.

The Marion Advantage lives here: we can verify and optimize your mixing, drying and heating processes before you commit to an installation in your facility. Thorough testing is at the heart of our ability to deliver the best-in-class performance that translates into efficiency, consistency, repeatability and sustainability.

Again, the Marion Test Center plays a vital role as companies explore new products and processes. With our vast established customer base across so many verticals – “been there, done that” – chemical companies attempting to pioneer a process can be assured of the quality of support they receive.

Summary

Regardless of end product or process complexity, addressing the core concerns in chemical mixing may be viewed most productively as a function of new mixer design, with emphasis on digital control/automation, customization and engineering support before and after sale/installation. In all these critical areas, Marion offers specific advantages: from proprietary controls and advanced remote sensing capabilities to the simple fact that process automation requires deep knowledge to avoid spending big money on counterproductive results.

Or, as a simple formula:

Baseline criteria + Specific application requirements + Marion = Maximum value + Lower total cost of ownership

Depending on the specific chemical compounds being produced in any facility, operators will follow this checklist of considerations when making their equipment selection and how we begin a customer discussion to identify the best mixer architecture for a specific application:

1. Measurement precision
2. Sustainability
3. Consistency
4. Yield calculation
5. Repeatability
6. Maintenance/operations/TCO
7. Abrasion and corrosion resistant
8. Automation
9. Capacity throughput
10. Safety

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