PROCESS

BHR Group
EXPERTS IN FLUID ENGINEERING

Is mixing costing you dear?
OUR EXPERT OPINION

The design of your mixing equipment has a major impact on process efficiency and productivity.

With the pressures of daily production targets, product quality and on-time shipping, it's easy to push equipment auditing and opportunities for process improvement to the bottom of the list.

Mick Dawson, Engineering Director explains why an independent audit can be a win-win for your mixing operations.

How auditing your mixing equipment can stop you paying the price for poor mixing

Mixing is at the heart of practically all processes in the chemical and related (pharmaceutical, consumer care, food) industries. The controlling mechanisms can vary significantly depending on the product, but many of the key phenomena are common to a wide range of processes, and are crucially important in the design, operation and scaling of appropriate plant. If operations are running at an acceptable level, you may think “if it isn't broke don't fix it?”

But are you missing a trick?

If you invest in an independent audit you will be able to benchmark your mixing plant performance against best practice for your current processing requirements. You may reveal the potential for realising energy savings and highlight opportunities to avoid operational failures.

Increased productivity, higher yields and lower costs can all be achieved by having best in class mixing. Even if the audit findings shows your facility is running at optimum levels, you get peace of mind and a comprehensive audit of your current process mixing applications.

Independent, impartial advice

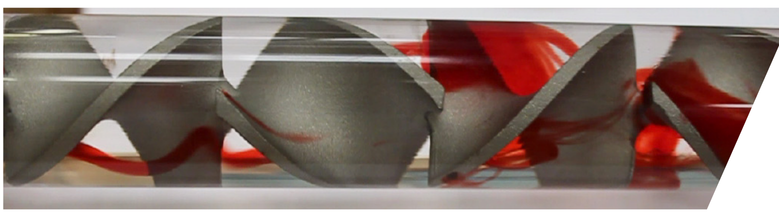
Commissioning an audit from an independent consultancy such as BHR, as opposed to an equipment manufacturer, means there should be no concern over impartiality. You should be confident that any recommendations made are unbiased as there is no incentive to sell you any new equipment.

When BHR undertakes an audit, a member of our specialist team visits the client site and reviews their key mixing equipment.

We typically spend a day auditing applications and providing the client with a straightforward document that records:

- Mixer characteristics (make, model, size, power).
- Mixer application (e.g. liquid blending, solids suspension, gas dispersion).
- Process fluids.
- A simple Red, Amber or Green rating on each mixers suitability for its application and adherence to best practice for energy efficiency etc.
- Adherence to best practice for energy efficiency.

For over 40 years BHR Group has designed, optimised and improved processes for the chemical and related industries. Overleaf, we explain how our expertise helped a leading global chemical manufacturer reduce batch times and batch-to-batch variation.



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Case Study

BHR Group worked with a leading global chemical manufacturer, assessing their current operations with the aim to compare reactor geometries and operating procedures, identifying limitations in equipment and suggesting improvements.

Important considerations affecting product quality in emulsion polymerisation reactor design include:

- Effective control of monomer drop size.
- Heat removal.
- Effective distribution of surfactants and catalyst.

Product quality and productivity depend strongly on these factors, and can vary significantly between plants employing different reactor geometries and scales. A key challenge was that the plant was understandably resistant to change and modifications rather than replacements were preferred so that other products manufactured in the same facility were not compromised. The batch polymerisation process can be summarised as follows:

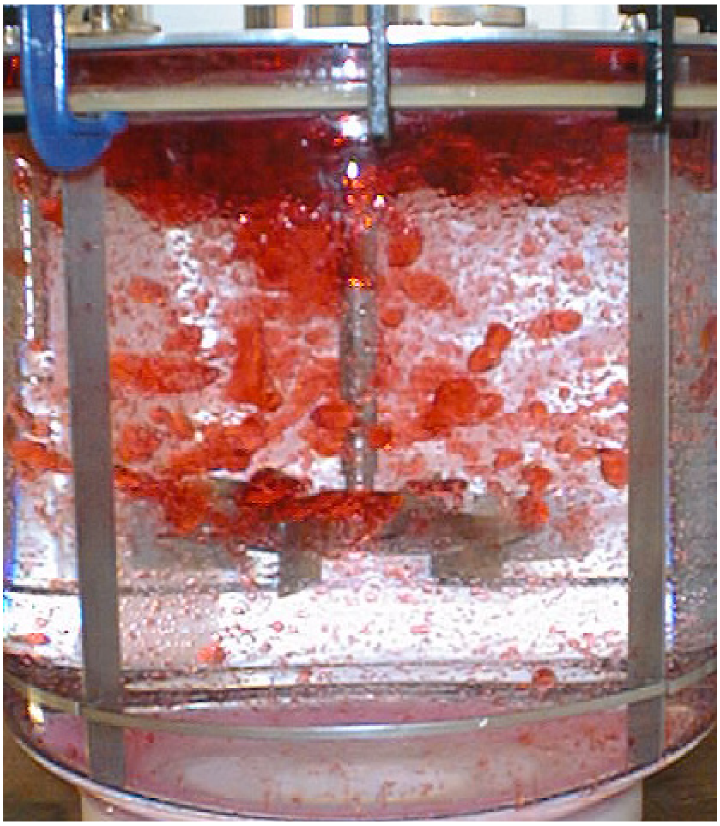
- An aqueous solution of surfactants and monomer were prepared in 10m3 and 20m3 reactors of different designs.
- Oil was then added and recirculated through a rotor-stator until the required droplet size was achieved.
- The surface addition of an aqueous solution of catalyst triggered the exothermic reaction, with heat being removed through a cooling jacket.

BHR mixing experts undertook a full review of the client's process, using our proprietary design guides and assessment protocols. These considered the suitability of the vessel geometries, agitator and rotor-stator designs as well as operating conditions and the method and location of catalyst injection. Careful consideration was paid to the developing rheology and its impact on blending and heat transfer performance.

OUR EXPERTISE

Our team played a key role in delivering these benefits to the client:

- **AGITATOR MODIFICATION**: Multiple impellers of a different design improved cooling and most significantly blending performance in the later, more viscous stages of the process, reducing batch times by 30%.
- **RECIRCULATION LOOP CHANGE**: Changing the in-line catalyst injection into the recirculation loop reduced batch-to-batch variability.
- **LOOP REACTOR IMPLEMENTATION**: Changing to the use of a loop reactor incorporating in-line static mixers could deliver further benefits in terms of temperature control and reduced energy usage, but this radical design change would require testing prior to implementation.



Our review provided the following insights:

- A low heat transfer rate caused by poor agitator design and a low surface area per unit volume limited cooling in the larger reactor.
- The variable nature of the addition of catalyst solution onto the liquid surface compromised blending performance, leading to variable product quality in both reactors.

Recommendations

The agitator in the larger vessel was modified to include multiple impellers of a different design, improving cooling and most significantly blending performance in the later, more viscous stages of the process. The revised geometry allowed operation using the existing drive and gearbox, helping reduce the cost of the upgrade. Simply increasing the impeller speed, the strategy initially considered by the client, was not recommended, as it would have been expensive to implement, and realised little benefit.

While similar changes would have improved the performance of the smaller reactor, these would have been less significant and so the agitator was not modified. A proposed change to an in-line catalyst injection into the recirculation loop was implemented. An "up pumping" agitator design was also suggested, which would have allowed the retention of the surface feed.

A more significant design change to the use of a loop reactor incorporating in-line static mixers was considered too radical to be implemented without testing, despite the benefits it would have afforded in terms of temperature control and reduced energy usage.