MIXER MIXING INFORMATION

STATIC MIXER vs. CONTINUOUS STIR FLOW MIXERS

It is agreed that there are numerous suitable applications, such as high viscosity mixing, for static or plug flow mixing devices. What is not understood so well is that there are ramifications and consideration when applying static mixers to all continuous flow applications. In short, the process results of many mixing applications can be directly dependent upon a Residence Time Distribution (RTD). For example, in consideration of processing water, Plug Flow or Static Mixers have RTD's that range from fractions of a second to just a few seconds, whereas Continuous Stir Flow Reactors (CSFR), generally associated with the use of Top Entering Mixers, have controllable RTD's, that typically range from 40 seconds to 2 minutes or longer (the latter occurs when operating at maximum flow turndown). In other words, unless the reaction is instantaneous and immediate, using a Static Mixer may result in uncontrollable process problems.

Static Mixers claim to be the most innovative cost savings designs introduced over the last 20 years, where numerous unit operations have been enhanced through the use of this technology. The problems result when a static mixer is used as the primary mixer for a unit operation instead of to enhance the process results of the unit operation. There are many claims that are made in regard to static mixing devices, where benefits such as "low power consumption", "no moving parts", and "low initial cost" become overwhelming arguments in favor of replacing or using static mixers instead of Top Entering Mixing designs, with the promise of equivalent results. However, you cannot change the laws of chemistry and physics. In short, once a static mixer is installed, you have to live with either poor mixing or process results, or high chemical dosing, or both, or you will need to change to expensive designer coagulants (expect the unexpected). The following is a discussion of today's most common Static-Mixing Applications.

COMMON STATIC MIXING APPLICATIONS:

1. FLASH MIXING WITH FILTERALUM (ALUMINUM SULFATE HYDRATE):

To understand the application we must first take a look at the chemistry. Filteralum, the most common (cost effective) coagulant added to process water, wants to immediately react with the small amount of hardness (lime) that is found in water. On its own, the filteralum will drop the pH of the process water as it reacts (some say like a stone). The efficiency of the floc is directly dependent upon the chemistry as the development of filter alum into pin-floc is very pH sensitive. It is for this reason that lime is added to the process water to increase the waters hardness. Hydrated or slaked lime ($Ca(OH)_2$), the most common lime used for this application, has almost a 0% solubility in water. Said another way, lime doesn't readily dissolve in water. In short, it takes time to dissolve the lime in water so that it can then immediately react with filteralum. The efficiency of the coagulant (chemical usage) is dependent upon the pin-floc's immediate development followed by its discharge to a high flow "floc-chamber", where the process waters turbidity, and other related factors such as color units, can then adhere itself to the pin-floc, where the floc is then is allowed to grow in size. Since the Residence Time Distribution (RTD) in a static mixer is limited, the result is to rely on its mixing and its continued reaction somewhere downstream. It is of fact that if the pin-floc development is not immediate, and is not controlled, it's efficiency suffers. The result of poor performance is increased chemical usage, and downstream reactions occur (in some cases, beyond filtration).

2. POLYELECTROLYTE DILUTION:

It is understandable why this would be listed as a common static mixer application. Since there is no way to compensate the efficiency of the pin-floc while using a static mixer, you have no choice but to enhance the chemistry by adding polyelectrolytes or polymers, although it must be stated that the influence of polyelectrolytes will also enhance floc efficiency for both designs.

3. RAW WATER BLENDING:

Static mixers have been used to pre-treat raw water with chemicals, such as for pH adjustment, eliminating the need for large mechanically agitated holding tanks. Since there is further downstream processing, using a static mixer is good idea as long as you can eliminate the need for holding the raw process water.

4. CHLORINATION and OZONATION:

Chlorination and ozonation involve instantaneous chemical reactions, to a point, and are suitable applications for static mixing.

5. CONTROL and pH ADJUSTMENT:

The suitability of using static mixers for pH adjustment is again dependent upon the characteristics of the chemical reaction. If its instantaneous, static mixers are acceptable, but if your reaction is time dependent or is complex such as using lime for example as discussed above, considerations should be given for using a CSFR. In some instances, two (2) stage control is incorporated, where static mixers are used in conjuction with a CSFR to the either to pre-mix or polish the effluent of a CSFR. The benefit is lower energy consumption of a smaller top entering mixer used in the CSFR.