

Static Mixers and Heat Exchangers in Polyester Production

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The application of “motionless” or “static” mixers and heat exchangers to various problem areas in PET production lines has proven to offer great benefits. Two critical factors always come to the forefront with the production of polyester: product residence time and potential product stagnation, or “dead flow,” regions.

BENEFITS OF UNIFORM RESIDENCE TIME

Product residence time is the interval of time between the entrance of a given component of polyester flow in a section of pipe or pressure vessel and

its exit. Typically in polyester production, the pipe section/vessel is heated at least to the temperature needed to keep the PET above the product melt point. Since PET has the ability to accumulate a “thermal history,” the longer PET experiences heat exposure, the greater the possibility it will break-

down and “degrade” into an unacceptable product.

With “open” process piping, this situation is complicated further by the variation in product velocities if measured from the boundary layer of the inside of the pipe to the centerline of the pipe itself. (The typical “parabolic” velocity profile shows the fastest flow regime along the centerline of the pipe and the slowest flow velocity along the region in contact with the pipe wall.) With open piping, some flow components are exposed to heat longer than others, to the extent that the product begins to breakdown and degrade before exiting the piping, resulting in large amounts of off-spec unacceptable product.

By inserting motionless mixer elements into this open process piping, the velocity profile of the product can be modified to “plug flow,” approximating the flow of a solid plug of product through

the pipe where all flow components have the same velocity. In this manner, all components of the flow have approximately the same residence time, and thus the same thermal history – optimizing the process with time/temperature sensitive products.

A continuation of this one step is to incorporate the motionless mixer element concept into multiple tube heat exchangers. An added benefit of these static mixer elements is that they improve the overall heat transfer to or from a product (three to five times), thus providing a considerably shorter product residence time inside the heat exchanger as well as providing a much more uniform product residence time due to the plug flow characteristics inside the tube bundle in the shell of the heat exchanger.

Elimination of potential product stagnation (degradation) areas in process piping is another reason to install motionless mixer elements in a polyester plant. Typically, open piping runs in a PET plant with numerous elbows, bends, and other changes in direction as the product moves downstream. All of these are potential flow stagnation areas where the PET product can “hang up” and degrade unless some method is used to reintroduce the slow and non-circulating product flow back into the flowing region of the process. Static mixer elements have proven to be very effective.

Normally in applications involving PET, the mixer elements must be metal sealed (edge sealed) into location inside the piping so that no gap exists between the outside edge of the mixer element and the inside wall of the process piping that could serve as a location of polyester degradation. This is normally accomplished by welding or brazing the outside edges of the mixer elements to the inside wall of the pipe. As in all polyester “wetted” surfaces, the inside wall and the mixer element surfaces are highly polished, also to minimize potential product degradation.

Static mixers are an economical way to improve the PET producers, existing or new process lines. 

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Alternate helical twist mixer element



High shear mixer element