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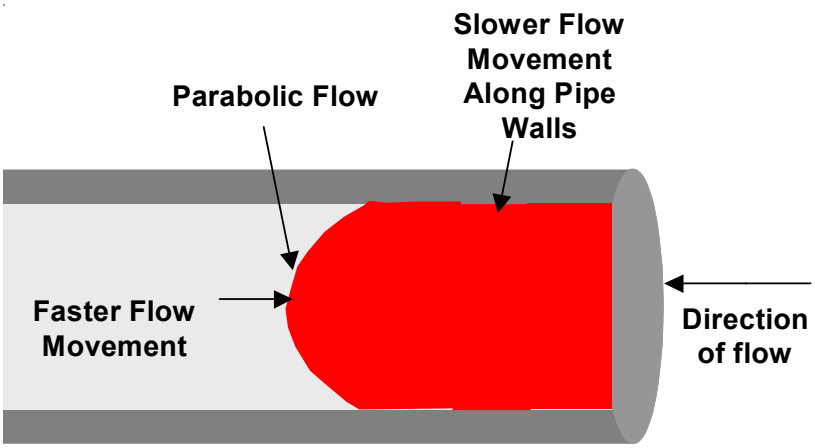
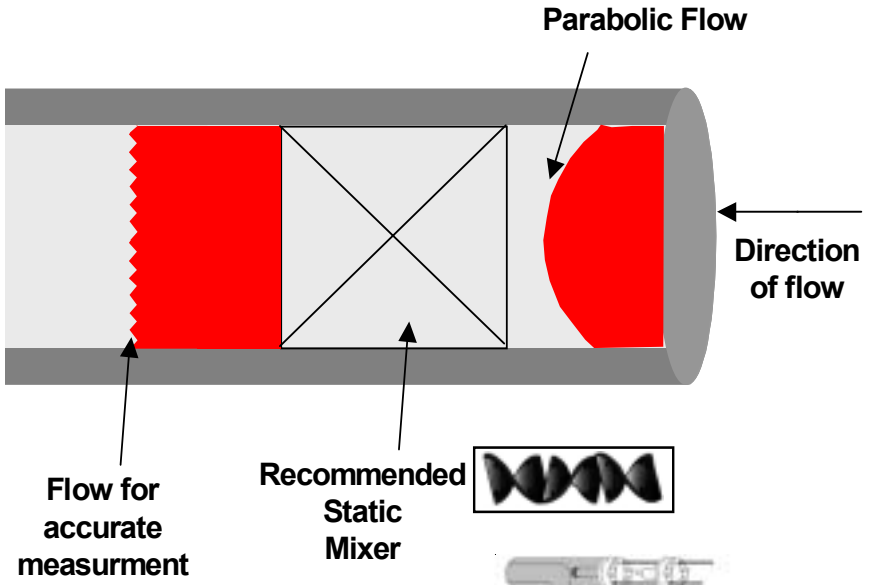
Engineering Paper

Topic: Static Mixers

It is well known in the field of fluid mechanics that the "wave front" of a flowing viscous fluid is parabolic. The fluid near the wall of a closed channel is moving at a slower speed than the material in the middle of the pipe. For flowing molten polymers undergoing polymerization, this is very undesirable because of the time-temperature relationship of the polymer, which, unless corrected, will adversely affect the quality of the final product. Early attempts to correct this phenomenon led to the development of so-called flow inverters, which if placed periodically down a pipe would allow wall material to pass to the center of the pipe and vice versa. The purpose was hopefully to allow all material to have the same time temperature history at the end of the line, whether making a fiber, film or particle. The reason why more than one inverter was required in a line is that the material will reestablish parabolic flow a relatively short distance down the pipe.



It was recognized a short time later that this parabolic profile would also adversely affect certain measurements placed directly in the pipe: These are in-line viscosity, process temperature, and any sampling point used for off- line work. The problem with all of these other measurements is that if not made just downstream of a static mixer, a change in flow would alter the shape of the parabola, and give rise to faulty measurements. (The original flow inverters were subsequently commercialized by several vendors and became known as static mixers.) In fact a patent memorandum was written to cover the application of mixers in conjunction with either viscous or temperature measurements. It was not pursued as it was considered a greater competitive advantage to remain silent. The magnitude of the temperature change, for example, from the wall to the core of a channel can easily be 4-5 deg C. A static mixer of 6 elements would result in 64 "slices" across the pipe, as determine by the relationship: Number of slices is 2^n.



For these reasons it is always recommended by Mansco Products that every installation of a TOV (Torsional Oscillatory Viscometer) include the appropriate static mixer coupled as closely as possible to the probe in the pipeline (upstream of the probe location). If the installation is within a few feet of a melt pump or filter device, consult with Mansco Products, Inc. for proper installation requirements. Typically the static mixer should be within 1 to 1 ½ pipe diameters from the adaptor inlet (manufacturer's recommendations).

In summary, proper installation and design of the mixer will change the pipeline flow characteristic from parabolic to plug flow thereby providing the best measurement possible made in the stream, that is viscosity and temperature. The use of static mixers for accurate measurements in a polymer pipeline is accepted good design practice. The mixer will also benefit other measurements such as pressure made in close proximity to the mixer while eliminating problems associated with throughput changes.

Over Mansco Products, Inc. 30+ years of operation, we have worked with and gained experience with a product made by the Chemineer Corp., Kenics Division and we recommend their model KMS6, which, when properly specified, is enclosed in the same pipe size, schedule, and material as the core pipe. Of course a product manufactured by another vendor that would provide the same striation mixing would be satisfactory.