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Optimization of a Four-Lobed Swirl Pipe for Clean-In-Place Procedures

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Abstract : This paper presents a numerical investigation of two horizontally mounted four-lobed swirl pipes in terms of swirl induction effectiveness into flows passing through them. The swirl flows induced by the two swirl pipes have the potential to improve the efficiency of Clean-In-Place procedures in a closed processing system by local intensification of hydrodynamic impact on the internal pipe surface. Pressure losses, swirl development within the two swirl pipe, swirl induction effectiveness, swirl decay and wall shear stress variation downstream of two swirl pipes are analyzed and compared. It was found that a shorter length of swirl inducing pipe used in joint with transition pipes is more effective in swirl induction than when a longer one is used, in that it has a less constraint to the induced swirl and results in slightly higher swirl intensity just downstream of it with the expense of a smaller pressure loss. The wall shear stress downstream of the shorter swirl pipe is also slightly larger than that downstream of the longer swirl pipe due to the slightly higher swirl intensity induced by the shorter swirl pipe. The advantage of the shorter swirl pipe in terms of swirl induction is more significant in flows with a larger Reynolds Number.

Keywords : swirl pipe, swirl effectiveness, CFD, wall shear stress, swirl intensity
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