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Threshold Sand Detection Limits for Acoustic Monitors in Multiphase Flow

Authors : Vinod Ponnagandla, Brenton McLaury, Siamack Shirazi

Abstract : Sand production can lead to deposition of particles or erosion. Low production rates resulting in deposition can partially clog systems and cause under deposit corrosion. Commercially available nonintrusive acoustic sand detectors are attractive as they claim to detect sand production. Acoustic sand detectors are used during oil and gas production; however, operators often do not know the threshold detection limits of these devices. It is imperative to know the detection limits to appropriately plan for cleaning of separation equipment or examine risk of erosion. These monitors are based on detecting the acoustic signature of sand as the particles impact the pipe walls. The objective of this work is to determine threshold detection limits for acoustic sand monitors that are commercially available. The minimum threshold sand concentration that can be detected in a pipe are determined as a function of flowing gas and liquid velocities. A large scale flow loop with a 4-inch test section is utilized. Commercially available sand monitors (ClampOn and Roxar) are evaluated for different flow regimes, sand sizes and pipe orientation (vertical and horizontal). The manufacturers' recommend that the monitors be placed on a bend to maximize the number of particle impacts, so results are shown for monitors placed at 45 and 90 degree positions in a bend. Acoustic sand monitors that clamp to the outside of pipe are passive and listen for solid particle impact noise. The threshold sand rate is calculated by eliminating the background noise created by the flow of gas and liquid in the pipe for various flow regimes that are generated in horizontal and vertical test sections. The average sand sizes examined are 150 and 300 microns. For stratified and bubbly flows the threshold sand rates are much higher than other flow regimes such as slug and annular flow regimes that are investigated. However, the background noise generated by slug flow regime is very high and cause a high uncertainty in detection limits. The threshold sand rates for annular flow and dry gas conditions are the lowest because of high gas velocities. The effects of monitor placement around elbows that are in vertical and horizontal pipes are also examined for 150 micron. The results show that the threshold sand rates that are detected in vertical orientation are generally lower for all various flow regimes that are investigated.

Keywords : acoustic monitor, sand, multiphase flow, threshold
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