Abstract

Sameh S Shaaban

Optimization of orifice meter’s energy consumption

Orifice meters are commonly used in many industrial facilities and pipelines. However, they increase the annual energy consumption and cost due to their high pressure loss. The present research introduces a new design that reduces this high pressure loss by ing a ring downstream the standard orifice meter. Maximum reduction of pressure loss is achieved by optimizing the downstream ring geometry. Numerical optimization is implemented using CFD simulation together with a genetic algorithm. Accurate CFD simulation is performed to solve the flow field at different downstream ring geometries while the genetic algorithm is used to estimate the optimum ring geometry. Optimization results show 29.8–33.5% reduction of orifice meter pressure loss for a Reynolds number Re = 1.84 × 104 to 8.69 × 104. An increase of the discharge coefficient by 17.7–22% is also obtained within the investigated operating range. Both the effect of upstream distance and inlet flow disturbance and distortion are investigated. This investigation shows that the downstream ring reduces the pressure loss of standard orifice meters by 31–33.2% even under high flow disturbance and short upstream length. The proposed design adds many new advantages to the well known standard orifice meters.