

A Numerical Study on the Fluid Flow inside a Cage-Guided Globe Valve to Evaluate the Operability of Air-Operability Valve

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Abstract

Air-operated valve (AOV) is widely used to control the flow and pressure of piping system for various industrial fields. For the flow interruption as a major function of AOV, the AOV is operated by using the air pressure against the stem and plug weight, the packing and seal friction force, the differential pressure force and so on. To evaluate the operability of AOV, the functional test is generally performed by using the test facility. However, the test conditions applying to the test valve have some limitations with the specification of test facility. Although the analytical method is proposed and used to evaluate the operability, it is not easy to know the required stem thrust considering the differential pressure force acting on the plug. In the present study, the fluid flow inside a valve was numerically investigated to obtain the stem thrust required for the operation of valve. As a test valve focused in the present study, the cage-guide globe valve with the balanced plug was selected with the air-operated actuator. For the computational domain, the geometry of valve was modeled with the extension of piping system from the inlet and outlet of valve. The flow and pressure conditions of piping system were applied to the inflow and outflow boundary faces of computational domain. With the operation of actuator, the motion of plug and stem was considered by using the morphing technique for the re-meshing of modified computational domain. These numerical methodologies were verified by comparing the numerical results of flow rate for various positions of plug with the experimental data. From the results, the maximum differential pressure force acting on the plug was observed in the beginning of the movement of plug from the seat and the end of the movement of plug to the seat, and the differential pressure force linearly increased with the increase of operating pressure of piping system. With the differential pressure force for various positions of plug, the required stem thrust was obtained to evaluate the operability of valve. The present results can be useful to evaluate the operability of valve to interrupt the flow through the piping system.

Keywords: Air-Operated Valve, Globe Valve, Operability, Computational Fluid Dynamics, Morphing Technique