

Optimal Design of 3-Way Reversing Valve Considering Cavitation Effect

Authors : Myeong-Gon Lee, Yang-Gyun Kim, Tae-Young Kim, Seung-Ho Han

Abstract : The high-pressure valve uses one set of 2-way valves for the purpose of reversing fluid direction. If there is no accurate control device for the 2-way valves, lots of surging can be generated. The surging is a kind of pressure ripple that occurs in rapid changes of fluid motions under inaccurate valve control. To reduce the surging effect, a 3-way reversing valve can be applied which provides a rapid and precise change of water flow directions without any accurate valve control system. However, a cavitation occurs due to a complicated internal trim shape of the 3-way reversing valve. The cavitation causes not only noise and vibration but also decreasing the efficiency of valve-operation, in which the bubbles generated below the saturated vapor pressure are collapsed rapidly at higher pressure zone. The shape optimization of the 3-way reversing valve to minimize the cavitation effect is necessary. In this study, the cavitation index according to the international standard ISA was introduced to estimate macroscopically the occurrence of the cavitation effect. Computational fluid dynamic analysis was carried out, and the cavitation effect was quantified by means of the percent of cavitation converted from calculated results of vapor volume fraction. In addition, the shape optimization of the 3-way reversing valve was performed by taking into account of the percent of cavitation.

Keywords : 3-Way reversing valve, cavitation, shape optimization, vapor volume fraction

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