Comprehensive Parameter for Analyzing Condensation in Pneumatic System

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Abstract: The condensation in pneumatic system is a complex physical phenomenon dependant upon status variation and phase transitions, which are related to the parameters of the compressed air, atmospheric conditions and the dimensions of the pneumatic components. Up to now, general research method for this problem is to calculate the status variation and movement quantity by numerical simulation and experiment directly. The comprehensive parameters composed of several different effect factors are rarely used to study the condensation. The composed components and the working conditions of each cylinder are different, a large number of experiments and complex calculations are necessary to determine the condensation. Additionally, the transferability of the determined results is poor. In this paper, the charging and discharging systems of serials cylinder with different structure parameters are studied. The condensation of the systems is observed and the effects of the structure parameters on condensation are analyzed. The changing trends of relative humidity, natural frequency and average speed against the structural parameters of the components during discharge of the pneumatic systems are analyzed. Three comprehensive parameters used to analyze and determine condensation composed by structure parameters of components are proposed, namely, the ratio of the effective area of the discharge tube and the container volume, the square root of the effective area of the discharge tube divided by the product of the container volume and the length of the discharge tube, and the discharge dimensionless tube-volume. The experimental results show that these comprehensive parameters can be used to quantitatively determine whether internal, external or zero condensation occurs in a pneumatic system, and can be also used to quantitatively analyze the experimental data of condensation in pneumatic systems directly. At the same time, the effect factors are too much and the effect relationships are very complex, which causes that the conclusions can't be put forward by using single effect factor in experimental data processing individually. The three obtained comprehensive parameters can be used to resolve the above problem. The proposed parameters can also resolve the problem of poor transferability in determining the state of condensation in pneumatic systems, and provide a novel method for the further study of condensation theory.

Key words: pneumatic system, condensation, comprehensive parameter, structure parameter

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