Kinematic flowrate characteristics of external spur gear pumps using an exact closed solution

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Abstract

This paper investigates flow characteristics of external spur gear pumps using a flowrate formula derived in closed form. Non dimensional flowrates and fluctuation coefficients of gear pumps are discussed. By using the formula, flowrates can be calculated accurately and efficiently. Firstly, using the involute equation in polar form, an analytic solution of the arc area enveloped by the involute curve is derived. Then, the formula representing pump flowrate is deduced using a control volume approach. During the process, the volume exiting the control region is divided into two parts which respectively belong to involutes and to the line of contact resulting from movement of the meshing point with the rotation of gear pairs. Next, flowrates and fluctuation coefficients of spur gear pumps both with and without relief grooves are calculated and compared. Results show the essential role of relief grooves in reducing flowrate fluctuation. Finally, influences of design parameters which include tooth number, module, pressure angle, and addendum coefficient on pump flowrate behavior are discussed.

Keyword：Flowrate, external gear pump, involute, flowrate fluctuation coefficient, volume displacement.