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Abstract:

A new modeling scheme for refrigerating compressors is proposed. It uses real gas equation, considers the mass flow through the suction or discharge valves as when it occurs and calculates the required work and heat transfer between the refrigerant and the ambient. The performance behaviour of an actual compressor running on R-12, R-22 and R-502 is generated and compared for various operating conditions.

In the proposed model the friction between piston and cylinder walls, gas pulsations during suction and discharge, and thermal inertia of the walls of the compressor cylinder are neglected. A simplified approach is used for the operation of compressor valves while the detailed analysis of the valve dynamics is avoided.

The mathematical model reported incorporates the following:

(1) The suction valve opens fully when the pressure difference across it exceeds a specified value. The discharge valve opens when a specified minimum pressure drop is exceeded and the opening is proportional to the pressure difference acting across the valve. The opening is limited to a maximum design value.

(2) If a valve is open, the velocity of flow through the valve is calculated on the basis of the enthalpy drop across it. The mass flow rate is determined by multiplying the velocity with the effective area of the valve and the density of the refrigerant vapor.

(3) Work done by the vapor against the piston is computed by $p\Delta V$.

The resulting mathematical equations are solved numerically on a computer. The thermodynamic properties of refrigerants are calculated with the help of accurate Martin-Hou equation of state.

The effects of several operating variables, viz. evaporating and condensing temperatures, clearance factor, minimum pressure differences required to open suction and discharge valves, suction gas temperature and that of air temperature have been studied for different refrigerants.

The proposed program is likely to prove useful to the compressor designers. Such studies identify the major influencing variables and the ones which have little effect for different compressors, working fluids, etc.