„THE POSSIBILITY OF USING SELECTED REFRIGERANTS IN A COMPACT, SOLAR-POWERED EJECTOR AIR CONDITIONER"

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Abstract:

Refrigeration and air conditioning plays a vital role in the life of every human being. Providing energy to drive these systems is crucial from the point of view of many industries and the use of residential, office and commercial premises. Yearly increase in electricity consumption to power air-conditioning systems and requirements for Poland by the European Union in the field of energy generation from renewable sources lead to search for new technical solutions. In the field of refrigeration and air conditioning, systems that may be an attractive alternative to conventional vapor compression devices seem to be heat-driven ejector cooling system. They are characterized by a number of advantages, among which the most important is the lack of moving parts, and thus high reliability. The disadvantage of these systems, however, is low cooling efficiency. A high efficiency of energy conversion in presented device depends on the type of refrigerant used. Indication of substances, which optimally matched to this device enable to achieve high performance with simultaneous low amount of refrigerant in the circuit.

The aim of the work is theoretical and experimental analysis of the possibility of using higher hydrocarbons and organic solvents as working fluids in ejector cooling systems. In pursuit of doctoral thesis the concept of building low-powered compact chiller with ejector refrigerant circuit has been proposed. On the basis of the above concept and a one-dimensional model of the ejector, efficiency curves for various refrigerants and cooling capacity of the considered system have been developed.

The next stage of work was to determine heat transfer coefficients of the analyzed substances. The research was conducted sequentially using a flat surface and the falling film of refrigerant on the outer surface of the horizontal pipes. The result of the experiments was to determine the heat transfer coefficient value for a given geometry of the heat exchangers. High added-value of the experiments was also a comparison of the experimental results with other work available in the world literature and to determine their level of compliance.

The final step was to analyze the possibility of building proposed air conditioning ejector system using flammable refrigerants. Four variants of cycle construction were considered. The analysis was performed in the light of the safety regulations governed by the PN-EN 378-1:2008+A2:2012: Refrigeration systems and heat pumps – Safety and environmental protection.

On the basis of the analysis and experimental studies it was demonstrated that it is possible to build ejector air-conditioning system using flammable, environmentally safe, alternative refrigerants, provided optimal selection of operating point and implementing the system in intermediate variant of refrigerant evaporating.

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