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1 **Analysis of the Novel Cross Vane Expander-compressor: Mathematical** 2 **Modelling and Experimental Study**

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7 **Abstract**

8 One of the challenges in cooling science today is the development of vapour compression
9 system that is compact, scalable and highly energy-efficient. In order to achieve this goal, the
10 novel cross vane expander-compressor (CVEC) has been introduced. This device
11 amalgamates the working principle of the compressor and expander into a single unit,
12 permitting fluid compression and expansion energy recovery to be accomplished
13 simultaneously. In this paper, we describe theoretically the frictional losses of the CVEC and
14 predict its net power input per cycle. CO₂ is used as the working fluid for simulation purposes.
15 The mechanical efficiency of CVEC is found to be 95.9% where the largest loss is caused by
16 end-face friction which accounts for 81.2% of the total losses. The proposed CVEC system
17 improves the overall coefficient of performance (COP) by 36.6% as compared to that of the
18 basic vapour compression system. An experimental investigation is conducted for the
19 measurement of torque and speed of a CVEC prototype to verify its operational
20 characteristics. For initial testing purposes, air is used as working fluid in an open circuit. The
21 average discrepancy between the predicted and measured net power input was found to be
22 10.5%.

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