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HYBRID SINGLE-STAGE TRIPLE PRESSURE LEVEL ABSORPTION/COMPRESSION CYCLE OPERATED BY LOW GRADE HEAT SOURCES

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Abstract: The performance of the triple-pressure level (TPL) single stage absorption cycle operated with organic refrigerants and absorbents showed many advantages over the common double pressure level (DPL) absorption cycle. In order to enhance these advantages (increased COP) a mechanical compressor and a mixing device were inserted in the super heated refrigerant line between the evaporator and the absorber. The influence of the elevated pressure on the performance of the TPL absorption cycle with the working fluid pentafluoroethane (R125) and N,N'-dimethylethylurea (DMEU) was predicted by a computerized simulation program. The performances of two configurations of the TPL absorption cycle operated with mechanical compressor were compared; a) with common solution heat exchanger (HS) and b) divided solution heat exchanger (pApG). Based on the analysis, in the first configuration a significant reduction of the required generator temperature with increased coefficient of performance (COP), reduction in the circulation ratio (*f*) and reduction of the actual size of the solution heat exchanger was found. In the second configuration a significant increasing of the COP with less reduction of the required generator temperature but with increased actual size of the solution heat exchanger was found. The disadvantage of inserting the compressor is the increased electrical consumption.

Key words

Hybrid absorption system, triple pressure absorption system, absorption/compression hybrid cycle.

1. Introduction

Among various heat sources, the range of low grade temperature sources, preferably up to 130°C, such as solar energy, waste heat etc., is an important and difficult range for utilization and recovery. The utilization of these low grade heat sources for cooling and refrigeration by means of absorption systems with different working fluids usually leads to the necessity of a cooling tower. Various configurations of absorption systems are practically utilized.

The basic DPL absorption cycle includes two sub cycles; the solution and the refrigerant sub cycles. The solution sub cycle includes an absorber (where the cold refrigerant vapor from the evaporator is absorbed at low pressure), a generator (where the hot refrigerant vapor is generated at high pressure), a solution heat exchanger (an economizer where heat is transformed from the hot weak solution to the cold strong solution), a solution pump and a pressure reduction device. The refrigerant sub cycle includes the condenser, evaporator, refrigerant heat exchanger (an economizer where the hot condensate is sub-cooled by the cold refrigerant vapor) and expansion valve. In the basic DPL absorption cycle, the pressure of the absorber and the evaporator is the same and similarly the pressure of the generator and the condenser is the same (pressure drop is neglected).

An advanced single-stage triple pressure level (TPL) absorption cycle that utilizes a low potential heat source for cooling, by integrating a specially designed jet ejector at the absorber inlet, as presented by Levy et al. [1-2] and Jelinek et al. [3] is shown in Fig 1a. The major functions of the jet ejector are the ability to facilitate mixing and pressure recovery i.e. higher absorber pressure relative to the evaporator