Development of a thermo-gravity pumping mechanism for circulating the working fluids in a novel LiBr–H₂O vapour absorption refrigeration (VAR) system

A. Paurine, G.G. Maidment, I.W. Eames, J.F. Missenden

1. Introduction

The rising demand for use of vapour compression systems represents a growing fraction of overall energy consumption due to refrigeration and air conditioning systems. Such systems contribute significantly to emissions with both direct and indirect environmental impacts. Therefore, the use of alternative systems such as diffusion and vapour absorption refrigeration (DAR and VAR) that use sources of energy other than fossil fuels has the potential to reduce carbon emissions. Particularly, the use of DAR and VAR systems that operate without using electromechanical pumps as well as high capital cost hinder the extensive use of these systems. The development of a novel VAR system incorporating a thermo-gravity pump and with reduced cost is the subject of this paper. An experimental apparatus consisting of a single stage LiBr–H₂O VAR system is described. The apparatus incorporates two novel thermally activated valves for aiding circulation of system working fluids and a novel regenerative heat exchanger for improving the generator’s and absorber’s effectiveness. This paper describes the design and operation of a thermo-gravity pump also referred to as thermally activated pumping mechanism for circulating the refrigerant H₂O(l), water vapour H₂O(v), weak and strong LiBr–H₂O solutions inside a novel VAR system.

2. Operational description of a novel VAR system

The novel VAR system shown in Fig. 1 below is similar to other VAR and DAR systems listed in Table 1 above; in that, it consists of four main components i.e. generator, evaporator, condenser and absorber. However, the generator and absorber include special valves V1 and V2 that are fundamental for circulating the working fluids. In addition, a packed bed regenerative heat exchanger...