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A REVIEW ON ADSORPTION COOLING SYSTEM

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Abstract – *The paper aims to introduce an adsorption cooling system by using traditional working pair silica gel/ water and newly searching metal organic framework(MOF's) material phthalic acid/water pair by doing experiment with the optimize system give the comparative study about specific cooling system(SCP) and coefficient of performance(COP). This paper clearly shows the information about experimental calculations regarding both the working pairs.*

Key Words: **Adsorption cooling, Adsorbate and Adsorbent, Adsorbent material, Low grade thermal energy, Adsorptivity, Adsorbent bed, Desorption phenomena, Adsorption phenomena.**

1. INTRODUCTION

Now a days the use of traditional vapor compression cooling and heating system increase in various applications; hence in last three decades there is need to coordinate to balance between energy utilization, economy development and environment protection in the world. For the purpose of sustainable development Adsorption cooling system plays an important role. Therefore the purpose of this paper is to introduce an adsorption cooling system by using environment friendly, ecofriendly and long working life with zero ozone depletion layer(ODP) and zero global warming potential(GWP), easily available in the market with fair cost and does not having any moving part with zero maintenance requirement adsorbent material.

1.1 Schematic of adsorption cooling system

Fig.1 shows the Schematic diagram for adsorption cooling system with reference to the Clapeyron diagram.

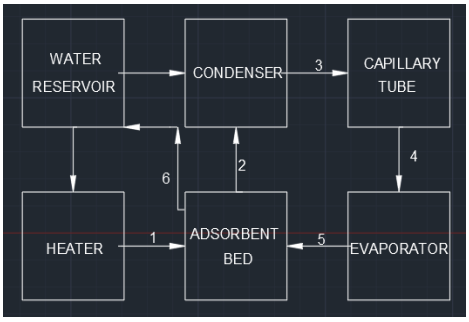

Fig.1 Schematic Diagram for adsorption cooling system

Fig.1 shows the following processes as per cycle set-up in the equipment arrangement.

1. Heating of water
2. Desorption
3. Condensation
4. Expansion
5. Cooling of water
6. Adsorption

Construction and working of adsorption cooling system:

1. First of all process of heating a refrigerant i.e. water is done by using induction heater and pump it through the adsorbent bed to the condenser; then it pass through the capillary tube. After capillary tube it is passed to the evaporator in which cooling effect is found in terms of cold air inside the evaporator.

2. At the Induction heater heating of water take place; after reaching a certain temperature i.e. 50^0C it pass through the adsorbent bed where desorption take place and then it pass to the condenser.

3. In the condenser where cooling fan is placed for increasing rate of heat transfer condensation will occurs. After that it flows through the capillary where pressure will drop from condenser pressure to evaporator pressure.

4. Then this water is flowing through the evaporator and it get evaporated by the adsorbing heat in the adsorbent bed by recycling the water through adsorbent bed by using submersible pump into the reservoir.

In this way, cooling effect is happens at the evaporator in the adsorption cooling system.

2. LITERATURE REVIEW

Q. Gao et al. [1] First experimentally shows that the Metal organic frameworks (MOF's) have excellent adsorptive capacity than the traditional adsorbent material such as silica gel.

Biplap Chaudhary et al. [2] introduced about all the cycles that can be employed to produce cooling effect without making load on the extra use of electrical energy as like traditional vapor compression cooling system and appropriate selection of working pairs with increasing adsorptive capacity of adsorbent material.

Ahmed Rezk Masoud Rezk [3] shows theoretical and experimental model of two-bed adsorption cooling system by using silica gel/water and HKUST-I/water working pair. By comparative study it could find that HKUST-I/water pair has 25% more cooling capacity and coefficient of performance than silica gel /water pair.

K. Sumathy et al. [4] states and explained the various types of adsorption cooling cycles and derived the formulas related to adsorption cooling systems for finding the total Heat input and output delivered by the system.

A. Rezk et al. [5] performed experimentally the Metal organic Frameworks (MOF's) material HKUST-I/water has 26.8% highest adsorptive capacity than silica gel/water pair. It also introduced the various types of Metal organic frameworks (MOF's) with characteristics when water is used as adsorbate material analytically.

Qiang Gao et al. [6] study on the physical and chemical properties of the Metal organic frameworks (MOFs) with the help of various active researchable material available in the form of journals, websites, papers, etc.

Rakhi M S et al. [7] Introduced about various types of Metal organic frameworks (MOF's) include in the waste water treatment.

Ahmed Rezk and Masoud Rezk [8] investigated on adsorption cooling systems theoretically and experimentally with silica gel/water working pair. It also gives the information about various solid adsorbent such as Metal organic frameworks (MOF's) materials having effective adsorptive capacity and gives higher cooling effect than others traditional working pairs when water is used as adsorbate.

Baosheng Shi [9] studied on design and development of adsorption cooling system for Automobile applications based on the Metal organic frameworks (MOF's) material when water is used as adsorbate.

Wang RZ et al. [10] worked on the adsorption cooling system where solar energy act as heat input and design the adsorption cooling system with construction and working of a system.

3. CONCLUSIONS

1. Adsorption cooling system is worked on the waste heat and low grade temperature as compare to any other vapor compression cooling system and vapor absorption cooling system; therefore this system has no limitation for low temperature reservoir.

2. In this system there is no use of any moving parts therefore, it does not required any type of maintenance and bears very long life as compare to the other vapor compression cooling system and absorption cooling system.

3. Only drawback is that the adsorption cooling system has loss of heat due the process of adsorption and desorption as well as condensation and evaporation.

4. Also it is difficult to maintained vacuum state at each process such as desorption, condensation, evaporation and adsorption during running of cycle.

5. Another drawback is that the adsorption cooling system take more time for giving the required cooling effect than any other type of cooling system.

4. FUTURE SCOPE

Researchers have more opportunities to improve the performance of adsorption cooling system by enhancing rate of heat transfer during adsorption and desorption process take place. Also, ratio of proportion quantity of adsorbent/adsorbate pairs plays an important role in improving the cooling capacity of the system. As well as design and selecting the proper material of adsorbent bed is another key element for improving the performance of adsorption cooling system.

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