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THE USE OF HEAT PIPES FOR ENERGY EFFICENCY IN BUILDINGS

BY

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Abstract. Energy efficiency of buildings in our days is in full development, so the research in this domain brings useful solutions to reduce the energy consumption in buildings. Using heat pipes as heat exchangers to obtain a better energy efficiency has many advantages. The purpose of the paper is to present different heat exchangers with heat pipes used in our days, using as primary and secondary fluid water or air. Heat exchangers are used to prepare domestic hot water and to maintain climatic comfort parameters in the rooms of buildings. Also this study will show the feasibility of using heat exchangers with heat pipes used for energy efficiency in buildings. The necessity of energy efficiency is needed because of the major problems of the environment and climate change. Due that in the construction domain buildings should be built with a big energetic performance with a low or even zero impact over environment.

Keywords: heat exchangers; heat pipes; energy efficiency; heat transfer; working fluid.

1. Introduction

The main problem in our days is to reduce the energy consume and for that researchers are trying to develop new technologies with low cost of

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production. Energy efficiency would be possible if the technologies developed would be used for new buildings and eventually rehabilitate the old ones.

Using heat pipes for energy efficiency in building it gives the opportunity for researchers and companies to create and to produce new heat exchangers. Heat pipes used as heat exchangers have many advantages comparing them with the classic heat exchangers, can be easily manufactured with a low cost for production. The properties of heat exchangers used are improved and can be used to create energy efficient buildings. In our days many researchers are studying the use of heat pipes for energy efficiency. The heat exchangers used are using as working fluid water, air or even exhaust flue gases

2. Heat Pipes Working Fluids, Operating Temperatures and Materials

Heat pipes used in our days have various working fluids, the most common working fluid being water (Ramos, 2016; Burlacu, 2017). The heat pipes also use as working fluid Nano fluids (Hussein, 2017; Mohanraj, 2017). Nano fluids are used in cryogenic applications, low temperature applications but also in high temperature heat pipes. Every working fluid it operates at a different range of temperatures. In Figs. 1 and 2 are shown working fluid and temperature useful range criteria for cryogenic applications and for low temperature applications.

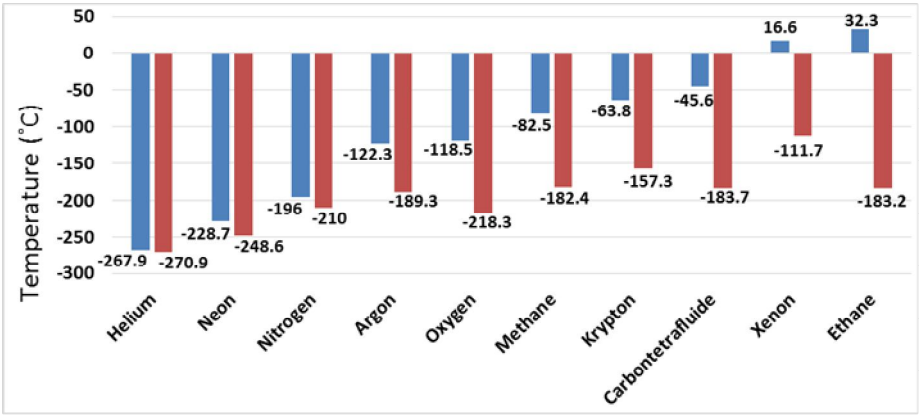


Fig. 1 – Cryogenic application of heat pipe working fluids.

Cryogenic heat pipes can be considered for operating temperatures below –70ºC (Jouhara, 2017).

Low temperature applications refers to food processing, chemical, medical, pharmaceutical and biotechnology industries and heat pipes can preserve their materials under extremely low temperatures.

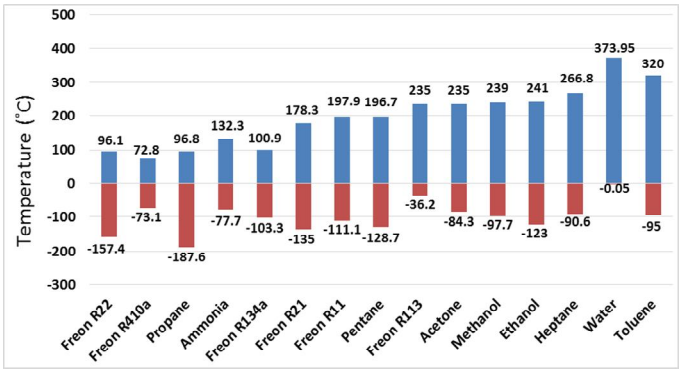


Fig. 2 – Low temperature applications of heat pipe working fluids.

The materials used to manufacture the heat pipes can be metals, polymers and elastomers. The most common used materials are generally from metals like: Aluminum, Copper and Stainless steel. Heat pipe working fluids are compatible with almost all materials used to manufacture heat pipes.

3. Heat Pipes Heat Exchangers, Application in Buildings

Some of researchers have designed heat exchangers which can be used for energy efficient buildings. Using solar radiation (Burlacu, 2016 a, b, Burlacu, 2014 a, b,) realized a study to improve energy performance of buildings with glazed façades and CFD analysis for integration of heat pipes into buildings with glazed façades. (Zhang, 2017) studied numerical simulation on thermal performance of heat pipe flat-plate solar collector.

In Fig. 3 is presented the constructive principle of the glazed façade with heat pipes integrated, with main components being: 1. Cavity façade; 2. Autoclaved Aerated Concrete Wall; 3. Room; 4. Glass layer; 5. Symmetry plan; HP. Heat pipes.

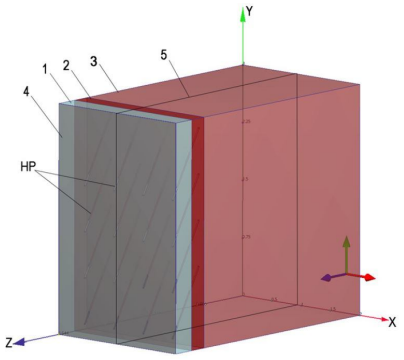
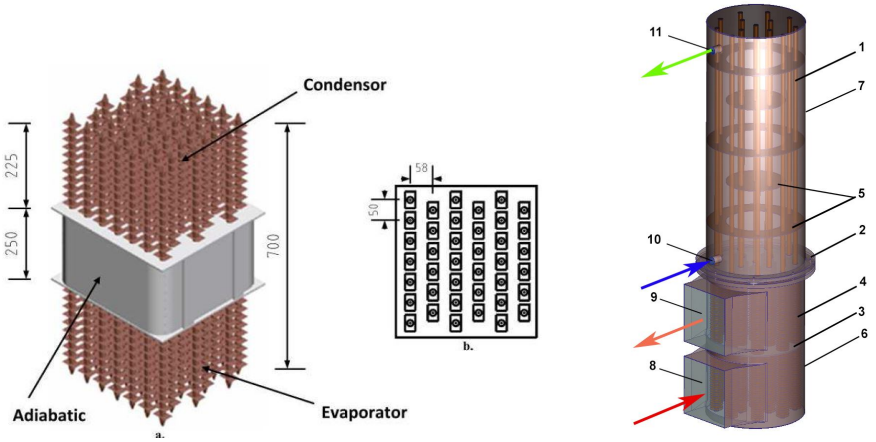


Fig. 3 – The constructive principle of the glazed façade with heat pipes integrated (Burlacu, 2016 b).

Heat pipes heat exchangers can also transfer heat from hot air or from exhaust flue gases. (Putra, 2017,) made an experimental study of heat pipe heat exchanger in hospital heating ventilation and air conditioning (HVAC), which can reuse the temperature of evacuated air to heat the fresh air before it is inserted in rooms. (Burlacu, 2017 a, b; Burlacu, 2009; Burlacu, 2007) realized a study with a heat pipe heat exchanger which can be used in industrial areas. Heat pipe heat exchanger uses the temperature from exhaust flue gases to heat the interior of buildings and to prepare domestic hot water. In Fig. 4a and Fig 4b are presented operating principles of heat pipe heat exchanger for hot air and for exhaust flue gases.



a *b*

Fig. 4 – *a* – Heat pipe heat exchanger components for hot air (Putra, 2017); *b* – Heat pipe heat exchanger for exhaust flue gases (Burlacu, 2017).

The Main Component For Heat Pipe Heat Exchanger For Exhaust Flue Gases Are: 1. Heat Pipe; 2. Separation Flange; 3. Air Directional Plate; 4. Heat Transfer Rings For Air; 5. Heat Transfer Rings For Water; 6. Shell; 7. Water Tank; 8. Exhaust Flue Gases Inlet; 9. Exhaust Flue Gases Outlet; 10. Cold Water Inlet; 11. Heated Water Outlet.

Bhullar, (2016), Studied The Temporal Performance Of Heat Pipe Using Surfactant Free Ionized Water Nano Fluids In Order To Measure The Temperature Of The Working Fluid Inside Heat Pipe And Also To See If The Heat Exchanger Can Be Applied For Heating The Air With Natural Convection And To Observe If It Can Be Applied On Buildings. In Fig. 5 Is Presented A Schematic Diagram Of Thermocouple Layout.

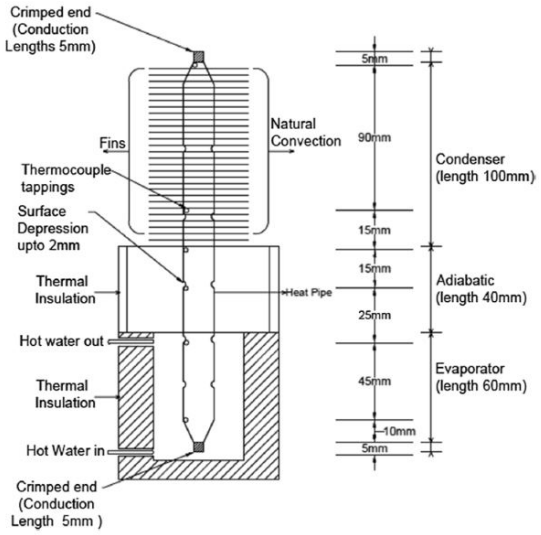


Fig. 5 – Schematic diagram of thermocouple layout (Buhllar, 2016).

4. Conclusions

The use of heat pipes in buildings integrated as heat exchangers can realize great energy performance and due that the energy costs are dropping and the CO_2 emissions it is reduced with very good impact for the environment.

Heat pipe heat exchangers can be applied on a large scale and not only in industrial area but also can be applied to commercial, public or residential areas.

The most important advantage of the heat pipe is that it can operate for recovering heat from hot water, solar radiation, exhaust flue gases, hot air and even from cryogenic applications.

The costs for manufacturing heat pipe heat exchangers are very low and the maintenance can be realized very easily.

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UTILIZAREA TUBURILOR TERMICE PENTRU EFICIENTIZAREA CONSUMULUI DE ENERGIE ÎN CLĂDIRI

(Rezumat)

Eficiența energetică a clădirilor din zilele noastre este în continua dezvoltare, astfel că cercetările în acest domeniu vin mereu cu soluții pentru a reduce consumul de energie. Folosirea tuburilor termice ca schimbătoare de căldură pentru a creşte eficiența energetică are multe avantaje. Scopul acestei lucrări este de a prezenta diferite schimbătoare de căldură cu tuburi termice folosite în zilele noastre, având ca agent termic primar şi secundar apă sau aerul. Schimbătoarele de căldură sunt folosite pentru a prepara apa caldă menajeră şi pentru a menține un climat interior confortabil în clădiri. Necesitatea eficienței energetice decurge din faptul că există schimbări climate cu un efect distructiv asupra mediului înconjurător. Datorită faptului că piața construcțiilor este în creştere, acesta ar trebui să integreze în clădirile ridicate echipamente cu performanțe energetice, cu un consum zero de energie şi impact redus asupra mediului.