A Review onSolar Biogas hybrid Refrigerator

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Abstract: Refrigeration systems are necessary unit for dairy farmers. Energy is one of the crucial input for producing refrigeration effect. Refrigeration process is usually affected in remote places or villages due to uninterrupted supply of electricity. In this regard, an idea is proposed in this article that ultimately uses energy from solar as well as organic waste available at dairy centers (i.e. cattle dug, kitchen waste, agricultural waste etc.)

Introduction:

In a tropical country, like India, refrigeration is most widely used and generally the most energy consuming process. In general, refrigeration is defined as any process of heat removal from a place for preserving foods and medicines by enhancing their shelf life. In the current situation the energy demand is increasing with increasing in the population. Energy is the crucial input to the development of any country. The International Institute of Refrigeration in Paris (IIF/IIR) has estimated that approximately 15% of all the electricity produced in the whole world is employed for refrigeration and air-conditioning processes.

At the time of independence milk production in India was only 17 million tons per annum. Today India has become number one in milk production, producing 127 million tons per annum with approx. 20% of the total milk production is handled by the organized sectors. Farmers mostly dairy farmers who sell their products to export markets, refrigeration could play an important role to increase their annual income. Without cooling capabilities the dairy products have to be sold immediately after taking form animals. This reduces the chance of negotiating good prices, because the buyer is in a better bargaining position. Particularly in these sectors, farmers have the potential to produce a lot of biogas through available cattle dung. Solar- Biogas Hybrid based cold Storage technology would be a good opportunity for such farmers to take maxi mum benefits.

System Features:

Hybrid Solar-Biogas thermal systems use solar energy in day time and biogas for night time as a heat source to produce refrigeration effect. Solar heating system consisting flat-plate solar collectors including a metallic absorber and an insulated casing topped with glass plate(s). Evacuated collectors may also perform better at high temperatures. Evacuated collectors are typically made in a glass tube design, i.e. a metallic absorber inserted in an evacuated glass tube, to withstand the pressure difference between the vacuum and the atmosphere. Figure 1 shows schematic diagrams of these two collectors.

Hybrid Solar-Biogas thermal sorption refrigeration system uses physical or chemical attraction between a pair of substances to produce refrigeration effect. A sorption system has a unique capability of transforming thermal energy directly into cooling power. Among the pair of substances, the substance with lower boiling temperature is called sorbate and the other is called sorbent. The sorbate plays the role of refrigerant. Fig. 2. And Fig.3 shows schematic diagram of solar powered and biogas power closed sorption system respectively. Working of a sorption refrigeration system is described as under:

- In the evaporator, the fluid refrigerant evaporates by extracting heat from the product or room being refrigerated.
- The evaporated refrigerant flows into the absorber where it mixes with the secondary fluid.
- The resulting solution is then driven into the generator, where it is heated. This heat causes the refrigerant to vaporise.
- The resulting vapour passes into the condenser, where it returns to liquid state and is ready to start a new cycle.

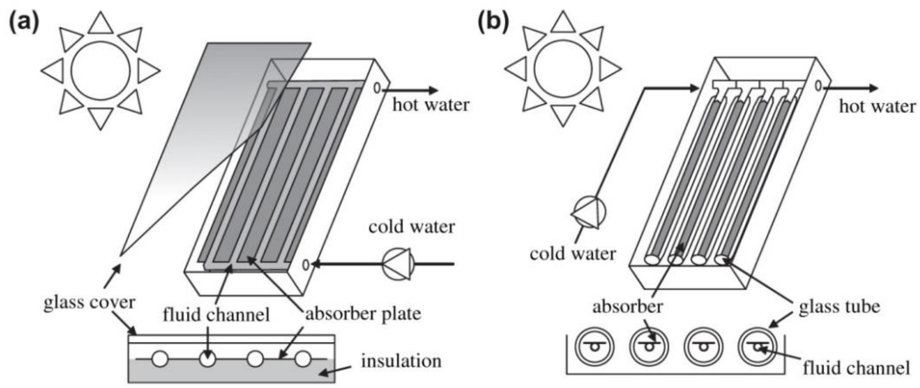

Fig. 1 Schematic diagrams of non concentrating solar collectors (a) flat plate type and (b) evacuated type

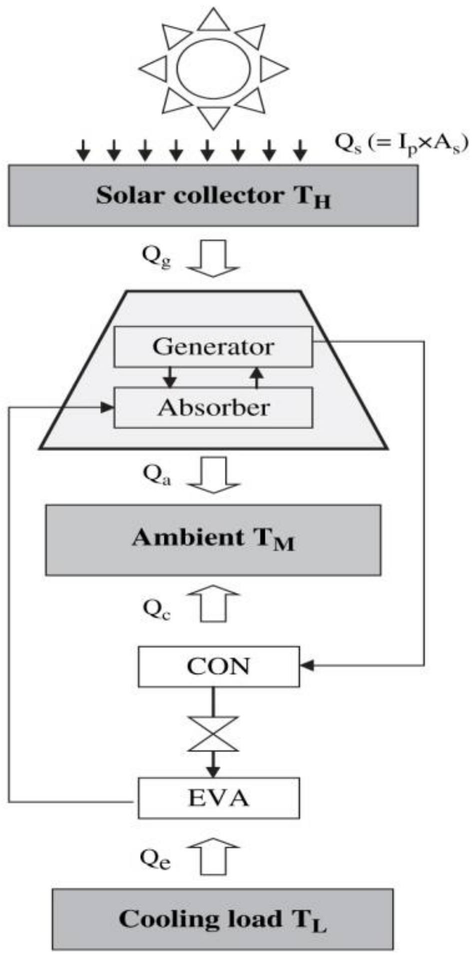

Fig. 2. Solar absorption refrigeration system

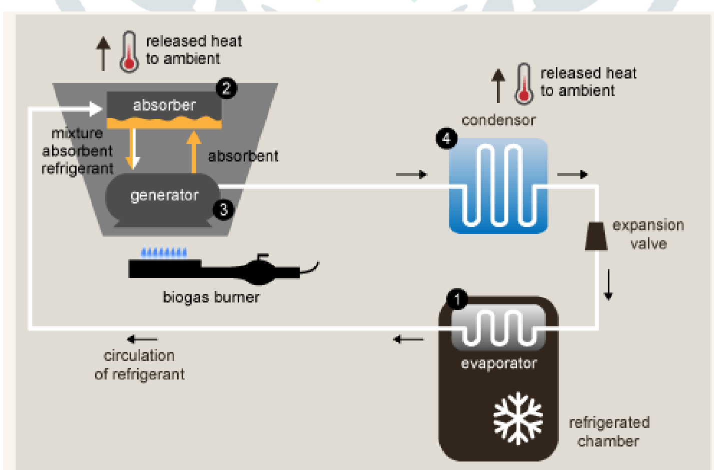

Fig.3 Schematic view of biogas based absorption refrigeration system.

Biogas:

Biogas is produced by decomposition of any organic matter in the absence of oxygen/air. Biogas comprises of 60-65 percent methane (CH_4), 35- 40 percent carbon dioxide (CO_2), 0.5-1.0 per cent hydrogen sulphide (H_2S) and traces of water vapours. It is almost 20 percent lighter than air. Biogas cannot be converted into liquid like liquefied petroleum gas (LPG) under normal temperature and pressure. The slurry coming from digester is rich in nitrogen which is an essential nutrient for plant growth.

Biogas is an easy and healthy cooking fuel since methane emissions from untreated cattle dung and biomass wastes can also be avoided. Since there is no pollution from biogas plants, these are one of the most potent tools for mitigating climatic change and being earth.

Properties

- Biogas is a non-toxic, colourless and flammable gas.
- It has an ignition temperature of 650 – 750 °C.
- Its density is 1.214 kg/ m^3
- About 60 percent methane and 40 percent CO_2 content
- Calorific value is 20 MJ/m^3 (4700 kcal).
- Almost 20 percent lighter than air
- It liquefies at a pressure of about 47.4 kg/cm^2 at a critical temperature of - 82.1°C.

Purified biogas (bio-methane) has a higher calorific value in comparison to raw biogas.

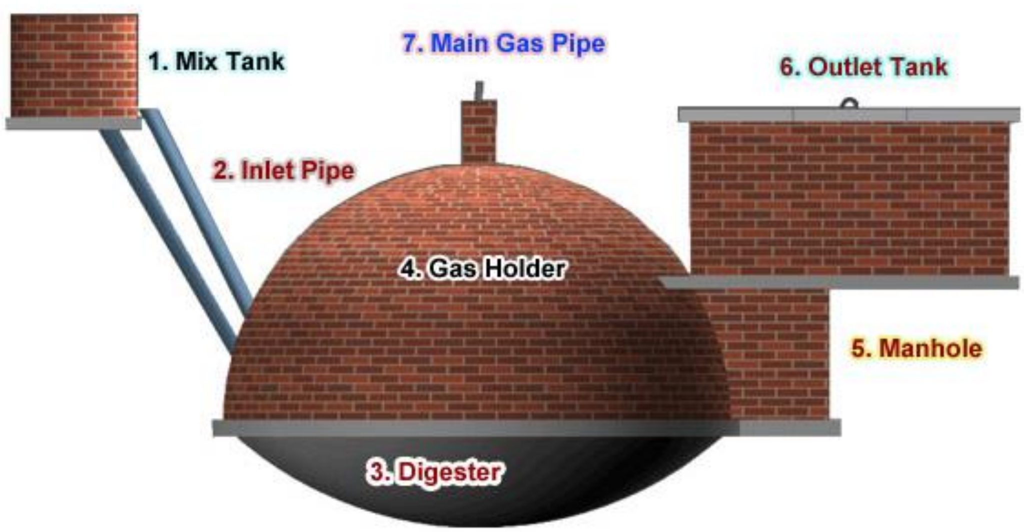

Fig.4. Biogas Plant

Conclusion: Dairy and food industries are fast growing industries and day-by-day newer technologies are being introduced to get better quality of foods. Use of conventional energy is common practice for major processing of milk. At present all most all dairy operations are performed using grid supply with diesel gen-set as backup. Milk procurement system has changed in India and now milk is being procured by maintaining cold chain to improve its microbial quality. In this article, an idea is proposed by which it is possible to use solar energy and biogas energy to operate vapour sorption refrigeration systems.

16. References

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