

Adsorption technology have been widely used for various applications, differs from the absorption technique as it's a surface phenomenon whereas absorption is a volumetric phenomenon. Adsorption cooling has been used now-a-days in vehicle cooling [4] due to its vibration free and corrosive resistant properties when powered by high temperature vehicle exhaust unlike absorption which vibrate for its absorbent and corrode above 200⁰C [6]

In the thermo-mechanical solar cooling system, the thermal energy is converted to the mechanical energy. Then the mechanical energy is utilized to produce the refrigeration effect. When the steam ejector cycle is integrated with a parabolic solar collector, then it's a solar operated steam ejector cycle. The steam produced by the solar collector is passing through the steam ejector. Steam ejector replaces electrically driven compressor of conventional AC systems but the cycle is operated in VCRCs cycle only [24].

VI. SOLAR COMBINED COOLING

Hybrid solar air conditioner which couples the use of Photovoltaic/thermal collector along with Vapour compression system has been a state of the art technique. By the experimental investigation, it has been observed that the efficiency and indoor comfort condition improves in hybrid AC as compared to conventional standalone Vapour compression AC system and in some condition, COP is more than unity. When desiccant is incorporated in an AC, then it takes care of the moisture part and it reduces the load of an AC significantly in hot and humid parts [25]. In hybrid system, Sun acts as an additional heat source to assist the energy needed to drive the cooling process of a conventional air conditioning system which in turn reduces the electrical consumption required to run the compressor. The difference between the standalone and hybrid system is the technique by which gas is changed back in to a liquid so that it may be used again. Usual air conditioning system uses a compressor to increase the pressure of the gas, forcing it to become a liquid again through the use of the condenser coil while in Solar hybrid Air Conditioning System, it uses solar heat from the sun to superheat the refrigerant which enables the refrigerant to begin changing state at the top 2/3rd's of the condenser coil.

The improvement in effectiveness of heat exchanger of solar thermal collector may further reduce the dependency and share of electrical compressor which, in turn will lower down the operating cost of the system [Centre of Energy and Environment setup, MNIT].

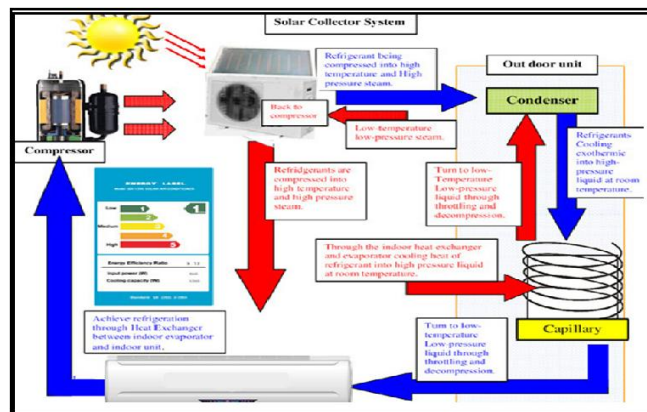


Figure 5: Solar Hybrid cooling

VII. CONCLUSION

Solar cooling has been regarded as a very promising application for solar thermal energy in countries with high insolation and high cooling loads. This solution has been demonstrated in different configurations and applications, but currently it's not that prevalent in Indian market. A lot of research needs to be done on cost reduction, system quality improvement, energy performance enhancement, and better building and process integration to make it easily adoptable by common people [20]-[23]. With these objectives in mind, R&D should aim at improving thermally driven cooling components and enhancing system performance, integration and reducing material costs of each component present in VARS. In Europe, solar thermal assisted cooling systems are getting widespread over the last two decades [27]. A few years ago, market development and commercialization started in the residential sector in Mediterranean countries (e.g. Spain, Hong Kong) [28] and in the office building sector in Asia (India, Singapore, China) [29]. The analysis of the first commercial market development phase highlights a substantial potential to accelerate this development with further R&D work. Solar thermal driven air-conditioning and refrigeration systems have high capital costs due to multiple system components, i.e. cooling equipment, solar collectors and heat storage appliances, and have not been cost-competitive with conventional electrically-driven cooling systems. But the best part of it is that it employ refrigerants with no ozone depleting potential and no, or very small, global warming potential. Most systems use water as refrigerant.

So far, mainly pilot plants and a few commercial plants have been in operation, limited know-how is one of the major barriers for widespread installation of solar air-conditioning and refrigeration systems. Only a small number of professionals are well informed on both solar thermal and air-conditioning in buildings. Due to this limited experience with solar cooling-refrigeration systems, steps are taken to encourage the dissemination of existing know-how and improve system quality. Places in north-western part like Rajasthan and Gujarat has high solar intensity which makes it a worthy option for solar powered devices and systems [29]. The awareness of global warming has been intensified in recent times and has reinvigorated the quest for alternative energy sources that are independent of fossil fuels and contribute less to global warming [26].

VIII. ABBREVIATIONS

COP	Coefficient of Performance
CFC	Chloro Fluoro Carbon
DC	Direct Current
HVAC	Heating, Ventilation and Air Conditioning
TEWI	Total Equivalent Warming Impact
VARS	Vapour Absorption Refrigeration System
VCRS	Vapour Compression Refrigeration System

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