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REVIEW OF SOLAR HEATING FURNACE DEVELOPMENT

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Abstract- *This paper deals with a detailed literature survey related to solar heating furnace. It also incorporates its applications and temperature and stress analysis of furnaces. A solar heating furnace is a structure that uses concentrated solar power to produce high temperature, usually for industry where the high temperature required for the processes. Parabolic surface which is covered by the aluminium foil or mirror,which is Fresnel lens, concentrates light onto a focal point. The temperature at the focal point may reach maximum 2000°C, and this heat can be used to boiling water, melt steel, nanomaterial, generating electricity or hydrogen fuel.*

Keywords: -*Concave surface, mirror, reflectors, solar heating furnace*

1. INTRODUCTION

The Concave surface used for the solar heating furnace is made from mild steel which has approximately thickness of 2mm, diameter of 914mm. This is also known as “Solar Concentrator”. The main aim of the solar heating furnace is the curve surface which is covered by the mirror, when the sun rays comes on the mirror at that time this ray reflected by the mirror. The mirror concentrates the sun rays on the single focal point. The focal point contains very high degree of temperature. This high temperature used for metallic receivers producing hot air for the next generation solar towers, produces hydrogen by cracking methane molecules, nuclear reactors, produce nanomaterials.The solar heating furnace principle is being used to make inexpensive solar cookers and solar water pasteurization.

2. LITERATURE SURVEY

European Research on Concentrated Solar Thermal Energy [1] et.al. The central tower system is somewhat different in that the solar collector field is composed of several hundred individual, large sun tracking flat plane mirrors, called heliostats. These heliostats track the path of the sun throughout the day and focus the rays on to the solar receiver, the solar receiver can be an area of a few metres square which is located on the tower at a height of between 50 to 100 m according to the level of concentrated radiation to be collected. In these systems, a working fluid, either high temperature synthetic oil or molten salt is pumped through the receiver where it is heated to 550°C. The heated fluid can then be used to generate steam to produce electricity.The CESA-1 test facility is the only one of its kind in Europe and is located at the Platform Solar de Almeria, Spain. It consists of a solar collector field of 300.

Each heliostat is made up of 12 mechanically curved glass mirror facets. This installation is used to demonstrate the feasibility of central tower systems and their components, such as the heliostats, solar receivers, thermal storage and control systems. It does not produce electricity, but instead is used for other applications that require high temperatures, such as the production of methane and materials testing, for example, the testing of thermal shields of space vehicles simulating re-entry into the atmosphere.M. Ouannene, B. Chaouachi, S.Gabsi[2] et.al. Solar cooking is a simple and own technology. Nichols [1993] has shown that the concept of solar cooking began over 220 years ago and was used by the French Foreign Legion starting in the 1870's. It makes possible to reduce the costs of cooking and does not employ any raw material expensive or polluting. Moreover, it has a slow cooking; the food is not degraded and preserves all their nutritional and gustatory qualities.The guiding principle of a standard box solar cooker is to concentrate heat while letting pass the sunlight through a pane in one limps closed well-insulated. The light is 'imprisoned' in the box and is transformed into heat when it is absorbed by the pot. The parabolic solar cooker rests on the principle of the concentration of the rays. The parallel beam of ray of the sun is reflected on the parabolic mirror and the rays converge in the same point, the hearth of the parabola. While running up against a dark container placed in this point, the rays are released their energy in the form of heat. It is obvious that when the parabola is larger, the cooker will be powerful.

B.Sri Hari Priya, R.Santoshi Kumari, M.Tukaram Bai, V.Sridevi [3] et.al. A water distiller captures the process of evaporation and condensation in a chamber, leaving behind all impurities, such as inorganic materials and chemicals. It can even purify seawater. Distillation is one of the mankind ‘s earliest forms of water treatment, and it is still a popular treatment solution throughout the world today. In ancient times, the Greeks used this process in their ships to convert sea water to drinking water and also to treat water in other area that are fouled by natural and unnatural contaminants. Solar still having the advantage of low capacity and self-reliance is best suited as; they can produce pure water by using solar energy only, and do not need other expensive energy sources such as fuel or electricity.

A solar powered distillation device will contain three basic components: a basin in which the contaminated water is contained, a surface above the said feed water for the water vapour to condense onto (i.e. a glass pane), and a catch basin for the distilled water to drain into. During operation of the distiller, solar energy is collected by the feed water. When enough energy is absorbed by the water, the water undergoes a phase change. The water vapour then rises and come into contact with the cooler transparent, inclined surface. Here the vapour once again goes through a phase change from vapour back to liquid. The water then condenses and runs off the transparent inclined surface into a collection bin.

Harendra Kumar Yadav, Vijay Kumar, Vinay Kumar Yadav[4] et.al. world the fastest growing thing is the energy requirement by world, with the reduction in the conventional resource. The most challenging thing in front of the world is how fulfill the requirement of energy. Due to the limitation of the conventional resources, the world has to think about the alternate source of energy. Now a day's most of the countries are emphasizing on the development of renewable energy resources. In the renewable energy resources, solar energy plays important role and it is a tremendous source of energy. The sun is the planet's most powerful source of energy and also the most unused source of energy by humans. Solar energy is abundant and offers a solution to fossil fuel emissions and global climate change. The rate of energy received by the earth from solar energy is approximately 1,20,000 TW (1 TW = 1012W or 1 trillion watt).Mr. S. D. Kulal, Prof. S. R. Patil[5] et.al. The Parabolic Dish Solar Collector technology is very useful as it is used for approximately all solar energy applications such as steam and power generation, water heating, air heating etc. In this paper work the performance analysis of parabolic solar dish collector is done with the use of different reflecting materials. In this work a Parabolic Dish Solar Collector system is fabricated for hot water production. Water is used as a working fluid and is recirculates from the storage tank to the absorber tank with the help of a pump. The main aim in the work is to increase the temperature of water in the storage tank to a maximum value.The values of useful heat gain, overall thermal efficiency, instantaneous efficiency and hourly thermal efficiency are calculated and their variation with time and solar intensity are represented graphically. To begin with stainless steel sheet is used as reflector and performance is compared with using aluminium sheet and silver foil as reflector.

John Harrison [6] et.al. To identify the reflector materials that would be both suitable for the application as well as economical. FSEC has conducted an extensive search for available reflective materials. This has included contacting reflective materials manufacturers as well as national laboratories that are currently working with private industry in developing reflector that can be used primarily on large concentrating solar energy devices.3M VM2000 radiant mirror film, 3M SA-85 solar film, 3M Silver Flux material, Acrylic Mirror, Alanod Aluminium, Aluminium foil, Aluminium foil emergency blankets, Aluminized polyester, Anocoil aluminium sheet, 0.3mm thick, Astro-Foil, Clear Dome Solar – Solar Flex material, Heat shield (R+Heatshield), Mirror flex, Polyester based reflective materials. These materials are also used as the reflective materials in solar heating furnace.Sambeet Mishra, Pratyasha Tripathy [7] et.al. We generate the thermal energy by concentrating and converting the direct solar radiation at medium/high temperature (300ºC – 800ºC). All solar thermal systems capture the energy of the sun by absorbing light as heat. Solar thermal power systems focus sunlight, usually with mirrors, to heat a fluid to high temperatures and drive an engine. With their high efficiency and the lowest power production costs of all solar technologies, the technologically mature parabolic trough power plants in particular have outstanding prospects for the future.The modern era of large scale solar power generation was born in California's Mojave Desert in the 1980s, when Luz Industries built a total of 354 MW of Solar Electric Generating System, or SEGS, power plants. The SEGS plants use long parabolic mirrors with pipes at the focus point, where circulating oil is heated to 700 F (350 C). Computer systems manage the mirror positions, tracking the motion of the sun throughout the day to maintain the focus point on the absorber.Rosnani Affandi, Mohd Ruddin Ab Ghani, Chin Kim Ghan, Liaw Geok Pheng[8] et.al. Parabolic Dish (PD) is one of Concentrating Solar Power (CSP) technologies that convert sunlight to electricity. PD has shown the highest efficiency by converting nearly 31.25% of solar radiation into electricity and PD has emerged as one of reliable and efficient Renewable Energy (RE) technology. Collector and receiver to the value of heat transfer to the receiver; solar power intercept by a receiver as well as the receiver loses in 25kW PD system.The aluminium and silver were used as the reflective material and the intercepted factor used for the simulation is in the range of 0.9 to 1.0. The losses of solar radiation that transferred from the concentrator to the receiver will increase. Therefore, to increase the fraction of solar power entering the receiver, the intercept factor must be increased. Thus, the losses of solar radiation are transferred.

Mathias B. Michael, Esther T. Akinlabi, Member, IAENG and Tien-Chien Jen[9] et.al. Parabolic trough solar thermal system (PTSTS) consists of large fields of parabolic trough collectors and receivers, a heat transfer fluid, thermal energy storage (TES). The field consists of large modular arrays of single-axis-tracking solar collectors arranged in parallel rows. Each collector has a reflector with linear parabolic shape that directs the incident solar radiation out a linear receiver located at the focal line of the parabola. The sun is tracked from east to west during day by the collectors and the heat transfer fluid is heated within the receiver tubes to a temperature of about 390C. The heated HTF then flows through a heat exchanger, heat up the molten salt in the TES. In the case of electricity generation application, the heat exchanger generates steam which is fed to a conventional steam turbine generator for electricity production.Heliostat field or central receiver collector. By using slightly concave mirror segments on the heliostats, large amounts of thermal energy can be directed into the cavity of a steam generator to produce steam at high temperature and pressure. The concentrated heat energy absorbed by the receiver is transferred to a circulating fluid that can be stored and later used to produce

power.Vanita Thakkar[10] et.al. Solar Energy Technology has an important role to play in the present Energy and Environment crises. Solar Concentrator Technology has good potential for various applications. Parabolic Solar Dish Concentrators can be very useful in Industrial Process Heat applications, which use about 20% of total oil consumption in India. If only 25 to 30% of this can be saved by putting up Solar Concentrators, it will save import of 4.5 MT oil per year, which is about 6% of our oil imports.Parabolic Dish Solar Concentrators have shown high conversion efficiencies and operating temperatures (around 750oC at annual efficiency of 23%-29% peak)Gaurav A. Madhugiri, S.R.Karale[11] et.al. The effective way of utilizing sunlight with solar energy concentration technology and recent developments of its applications using Fresnel lens is reviewed in this paper. The present status of application, the on-going research and development works suggest that Fresnel lens solar concentrators will bring a breakthrough of commercial solar energy concentration application technology in the near future. The paper was focused on the Solar Energy high temperatures using parabolic solar concentrator, Fresnel lens, reflecting materials and solar tracking the use of Fresnel lenses will raise more temperature than conventional one and can be used in furnace heating. Solar energy concentrated by Fresnel lenses is a cheap and environmentally friendly energy source suitable for surface materials treatment.The current investigation introduced that with two axes sun tracking to resolve the problem of frequent tracking and standing in the sun, which are the main drawbacks of most concentrating solar cookers with manual tracking. The provision of two-way tracking mechanism for a parabolic type solar concentrator permits accurate and effortless focusing of solar radiation on the receiving surface of the utensil.

Philippe SCHILD [12] et.al. Concentrated solar power systems can be used for a range of applications depending upon the energy conversion utilised, electricity or heat. However, at present, most systems focus on electricity generation. The different types of CSP system, discussed above, are suitable for different applications. The parabolic trough collector is the best solution for applications in the low temperature ranges such as detoxification, liquid waste recycling and heating water. All three systems are suitable for the midtemperature range applications, and the central tower is the most suitable system because temperatures of more than 1 000°C can be easily sustained. Join Dascomb al. [13] et.al. Concentrating solar power is a unique renewable energy technology. Which have the ability to provide electricity, refrigeration & water purification in one unit. The concentrator was coated with a highly reflective polymer film. The cavity type receiver was filled with sodium nitrate to act as a heat storage & transfer medium. The concentrator, mirror, receiver was all used in this. A cavity type absorber was used instead of flat plate. This not only increased absorption but the greatly decreased radiation & convection losses. Berin Aniesh N.B, S.Lionel Beneston[14] et.al. The abundance of solar energy has urged mankind to use it as a substitute for many prevalent sources of energy. One of the most efficient ways of utilizing solar energy is by harnessing the heat in the sun light and using it instead of the heat obtained by fossil fuels, as photovoltaic cells are costly and less efficient. Most common way of concentrating solar power is using parabolic reflectors, which has many disadvantages. Solar energy concentration technology using Fresnel lens is an effective way to make full use of sunlight. The on-going research and development involves imaging systems and non-imaging systems. Compared with imaging systems, non-imaging systems have the merits of larger accept angles, higher concentration ratios with less volume and shorter focal length, higher optical efficiency, etc. Concentrated photo voltaic is a major application and the highest solar-to-electric conversion efficiency based on imaging Fresnel lens and non-imaging Fresnel lens are reported as over 30% and 31.5 ± 1.7%,respectively. Moreover, both kinds of systems are widely used in other fields such as hydrogen generation, photo bio reactors as well as photochemical reactions, surface modification of metallic materials, solar lighting and solar pumped laser. During the recent two decades, such applications have been built and tested successfully to validate the practicality of Fresnel lens solar concentration systems. Although the present application scale is small, the on-going research and development works suggest that Fresnel lens solar concentrators, especially non-imaging Fresnel lenses, will bring a breakthrough of commercial solar energy concentration application technology in the near future. This paper attempts to state the advantages of the use of Fresnel Collectors in concentrating solar power.

3. CONCLUSION:

We can conclude that there is a lot of scope of further research and development in solar heating furnace. Solar heating furnace technology has existed for many years but never has been fully explored or used on widespread commercial basis. Present innovation utilizes sun-based energy for the era of high temperature with the assistance of reflector; reflectors are encased in an explanatory lodging to focus the sun powered radiations on a required zone. The requirement for the development of an allegorical dish as a contrasting option to explain the warm energy needs of the people. In concentrated close planetary system, fixation by reflection or refraction through reflecting components. The reflectivity of the surface materials is an imperative factor in the optical productivity.

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