

DESIGN AND MANUFACTURING OF SOLAR DISH COLLECTOR FOR MAXIMUM REFLECTIVITY

Submitted in partial fulfilment of the requirements for the award of
Bachelor of Engineering degree in Mechanical Engineering
By

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**DEPARTMENT OF MECHANICAL ENGINEERING
SCHOOL OF MECHANICAL ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with grade "A" by NAAC

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DEPARTMENT OF MECHANICAL ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **D. RAJESH CHOUDHARY (Reg. No. 39150108), PRIYARANJAN KUMAR MANDAL (Reg. No. 39150102)**, who carried out the Project entitled "**DESIGN AND MANUFACTURING OF SOLAR DISH COLLECTOR FOR MAXIMUM REFLECTIVITY**" under our supervision from December 2022 to April 2023.

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DECLARATION

We, **D. RAJESH CHOUDHARY** (Reg. No. 39150108) and **PRIYARANJAN KUMAR MANDAL** (Reg. No. 39150102) hereby declare that the Project Report entitled “**DESIGN AND MANUFACTURING OF SOLAR DISH FOR MAXIMUM REFLECTIVITY**” done by me under the guidance of **Dr. V. SRIRAM, M.E., Ph.D.** is submitted in partial fulfillment of the requirements for the completion of Project.

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ABSTRACT

In the current situation, energy demand is rising to keep up with the expanding demands of energy usage. Contrarily, the use of seeking alternative energy sources is now necessary to both prevent slow depletion and combat climate change using fossil fuels. Among these sources of renewable energy, solar energy, especially solar thermal systems, has tremendous scope of current and upcoming research. Concentrators are used in solar thermal systems to capture solar energy and transform it into usable form. The parabolic dish solar concentrator is one of several types of solar concentrators is favored because it has a high potential for extended durability, high efficiency, and high-power density. Conical shaped receiver is having high overall optical better thermal efficiency in comparison to other receiver designs. Additionally, this study demonstrates how the thermal performance of employing nano fluids instead of conventional heat transfer fluids, the receiver is improved by 10–13%. The essay highlights various models that estimate and analyze the distribution of solar irradiance on the receiver surface use the ray-tracing technique. In this paper, the empirical relationships for the design of a parabolic dish solar concentrator system are provided for calculating the heat available at the receiver and the total concentrator efficiency. The literature reveals the thermal efficiency of it is seen how the receiver affects the system's overall performance.

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CHAPTER 1

INTRODUCTION

Due to the significant quantity of emissions produced by burning fossil fuels, most notably for the production of electricity, renewable energy sources, especially solar energy, are one of the most important concerns facing humanity in this century. Solar energy is used in two different ways to create electricity: directly through photovoltaic cells, and indirectly through concentrating solar radiation and heating a particular fluid, such as water, oil, or molten salt. Some of the most promising technologies that can be used to produce electrical energy are those that concentrate solar radiation. For instance, using mirrors and lenses to concentrate sunlight from a broad region into a tiny location. The solar tower, parabolic trough, and solar dish are among the many methods that may be used to focus the sun's rays and are among the most significant. The Parabolic Dish Solar Concentrator (PDSC), also known as the "parabolic collector," is a cutting-edge invention that concentrates the sun's rays at one specific location. No matter where the sun's rays land on the dish, the parabolic dish's form gives us a way to reflect them so they are parallel to the axis and in the focus direction. This results in an almost complete reflection of the incident sun beams. There are some losses, nevertheless, and the majority of them are brought on by decreased reflection or by energy that enters the absorber after reflection. When it comes to the parabolic dish's construction, a receiver is positioned in the middle of the dish, where it collects heat from the solar radiation that hits it and turns it into thermal energy. One benefit of the solar dish is its high efficiency, which may reach 85% when used in conjunction with a tracking system, in addition to the high temperatures produced in the receiver, up to 750 C. Electricity is produced by parabolic solar dishes, which are also employed in water desalination and distillation, cooking, and heating water. A dish farm made up of a number of tiny units can increase production from parabolic solar dishes, which have an output range of 7 to 25 kW, or from Stirling engines.

1.1 BACKGROUND

Solar power is Undoubtedly, one of the "green" energy production possibilities that receives the most attention is solar power. Like with anything, there are those who support it and others who oppose it. What makes solar energy particularly intriguing, though, is the way it challenges people to consider what is truly valuable and worthwhile investing in. What are the advantages now? In the first place, no greenhouse gases are being released. Furthermore, electricity is completely free (assuming we don't count the cost of setting up and maintaining the plants and solar panels). In sunny regions—which are frequently remote—solar energy promotes decentralization. This enables avoiding price fluctuation, as is the case with fossil fuels, and it also generates jobs. Last but not least, since solar energy does not require the extraction of raw materials, it does not require the disruption of forests and eco-systems to produce energy. It is usually a good idea to discuss the drawbacks as well in order to avoid appearing biased. First off, because solar energy depends on sunlight, it cannot be used at night. Due to the necessity for a large amount of surface area, the production process is still comparatively inefficient. The panels, particularly the higher- efficiency ones, are relatively large, and the storage facilities have not yet been improved. The largest drawback, sadly, is the price of solar energy needed for panel installation and maintenance. To be fair, politics and economics are always the deciding factors. As is the case in California, many governments provide subsidies and tariffs to promote the use of solar energy. Yet, as Spain's experience demonstrates, long-term incentives and economic crises may cause people to significantly alter their opinions. Nonetheless, the potential is enormous. Since the 1700s, the concept has been evolving, and significant advancements have inspired people to keep expanding and growing the field. We will now briefly review the key achievements and leave it up to you, the reader, to decide whether the past work justifies further time and money being spent.

HISTORY OF SOLAR ENERGY

➤ **The First Solar Collector was Built in 1767**

Horace-Benedict de Saussure, a Swiss physicist, invented the first solar collector in 1767. It was an insulated box with three layers of glass on top to reflect heat.

➤ **Photovoltaic Effect Defined in 1839**

The French physicist Edmond Becquerel made the discovery of the photovoltaic phenomenon in 1839. Using two electrodes in an electrolyte, he achieved this by demonstrating that electricity increased when the electrolyte was exposed to light.

➤ **Selenium's Photo Conductivity in 1873**

Willoughby Smith's discovery of the photoconductivity of a substance known as selenium will live on in the memory of 1873. Smith added that the element generates solar energy three years later. He discovered via his studies that solids might generate electricity without the need for heat or moving parts.

➤ **1883-1891 Solar cells and light**

The development of solar energy was greatly aided by this time period. The first solar cell was introduced in the year 1893. Heinrich Hertz made the discovery that ultraviolet light had the ability to start a spark jump between electrodes in 1887. The first solar heater was created shortly after that, in 1891.

➤ **Building of the Copper Collector began in 1908**

William J. Baileys is the inventor of this technology. In 1908, he created a copper collector using copper coils and boxes together with copper insulation. Even now, manufacturing uses this.

➤ **1916: Evidence of the Photoelectric Effect**

Although Einstein presented his idea of the photoelectric effect in the year 1905, it wasn't until the year 1916 that Robert Millikan conducted an experimental test to provide conclusive evidence.

➤ **First commercial usage of solar energy occurred in 1958**

Satellites and space stations that are used for space exploration are now powered by solar energy, which has officially entered the commercial sector.

➤ **Efficiency of Solar Cells and Cost, 1959–1970**

The various debates regarding solar cell efficiency and its impact on electricity bills will stick in people's minds from this decade. Ultimately, Exxon Corporation created the first solar panel in 1970 that was easier to produce.

➤ **US embraces solar energy in 1977**

The Solar Energy Research Institute was established by the US government, who were the first to support solar energy utilization.

➤ **The first solar-powered aircraft flew in 1981**

Paul Macready created the first solar-powered Aeroplan as a tribute to the year 1981. On its wings were more than 1600 cells. The plane took off from France and touched down in England.

➤ **First Solar-Powered Vehicle Debuts in 1982**

Australia was the location of the first solar-powered automobile's creation

➤ **1999 Solar Power Plant Development**

The biggest plant, producing more than 20 kilowatts, was built in 1999.

➤ **Solar Cell Efficiency in 1999**

The most effective solar cell ever, with a 36% efficiency, was created in this year.

➤ **Spain's government reduced subsidies in 2008**

The reduction of Spain's government's subsidies for solar power generation as a response to the country's economic crisis has an impact on the global solar power industry.

➤ **Solar energy market stagnation in 2010**

Evergreen Solar and Solyndra, two of the largest solar companies, file for bankruptcy due to the solar energy market's stagnation.

1.2 TYPES OF SOLAR COLLECTOR

Using solar energy for high-temperature process heat is difficult despite it being the most common clean and affordable renewable energy source on the planet. Solar collectors are a promising technology for capturing solar energy for both the production of electricity and process heating. Nevertheless, stationary flat plate collectors are only useful for applications that require low temperatures. In order to use concentrated solar energy for high-temperature applications, solar concentrating systems have been studied for a number of decades. The tools that gather solar energy and focus it at a single focal point are known as solar concentrators. The essential components of the devices are a number of lens or mirror assemblies, a heat receiver, and a tracking system. The concentrator's efficiency is influenced by the solar radiation's strength, incident angle, and position in relation to both the sun and the reactor that needs to be heated.

Based on its optical properties, such as the concentration ratio, focal form, and optical standard, solar concentrators are divided into four groups. These concentrators can either track the sun on a single axis or on two axes.

1. parabolic-trough concentrator
2. parabolic-dish concentrator
3. heliostat-field concentrator
4. double-concentration concentrator

Various concentrator models offer a range of temperatures. A distinguishing quality of the concentrators is also a change in concentration ratio. Several fundamental solar concentrator properties are shown in the table below.

Table 1.2.1: Types of tracking mechanism with their operating temperatures

Tracking Mechanism	Concentrator Type	Focal Type	Concentration Ratio	Operating Temperature (k)
Single-axis	Parabolic trough	Focal Line	30-100	500-700
	Double Concentration	Focal Line	5000-10000	Over 1500
Two-axis	Parabolic dish	Focal Point	1000-5000	Over 1800
	Heliostat field	Focal Point	300-1500	Up to 1600

1.2.1 Parabolic-Trough Concentrator

A Parabolic-Trough Concentrator is a type of solar thermal technology that is used to generate electricity from the sun's energy. They use curved, parabolic-shaped mirrors to concentrate the sun's rays onto a receiver tube that runs along the focal line of the parabola. This receiver tube is typically filled with a heat transfer fluid, such as oil or molten salt, which absorbs the concentrated sunlight and heats up. The heated fluid is then used to generate steam, which drives a turbine to produce electricity.

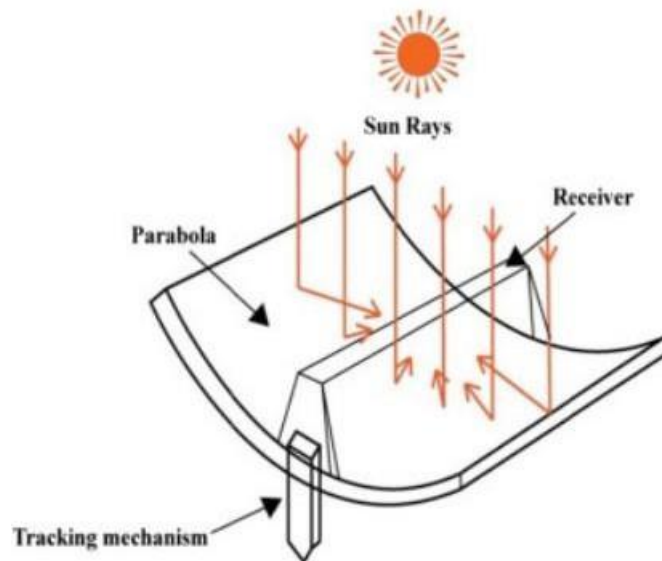


Fig 1.2.1: Parabolic-Trough Concentrator

Developed systems are typically used in large-scale power plants, where multiple troughs are arranged in rows to form a solar field. The troughs are typically made of curved, mirrored sheets of metal, such as aluminum or stainless steel, that are coated with a reflective material, such as silver or aluminum. The troughs are typically oriented on a north-south axis and track the sun's path throughout the day using a motorized system. This ensures that the sunlight is always focused onto the receiver tube. The system's working temperature is between 500 and 700 K, and the parabolic-trough system's geometric concentration ratio is between 30 and 100. In Cyprus, using a parabolic-trough collector is a practical way to capture solar energy for industrial process heat. Solar concentrators with parabolic troughs are a sophisticated and established technology. They are appropriate for heating at temperatures between 100 and 250 °C as well as for concentrated solar power plants; Southern California power plants are where this system is most commonly used.

1.2.2 Parabolic-Dish Solar Concentrator

A parabolic-dish solar concentrator is a device that uses a parabolic dish-shaped mirror to focus sunlight onto a receiver at its focal point. The

receiver typically contains a fluid or gas that is heated by the concentrated sunlight, and this heat can be used for a variety of applications, such as generating electricity or heating water.

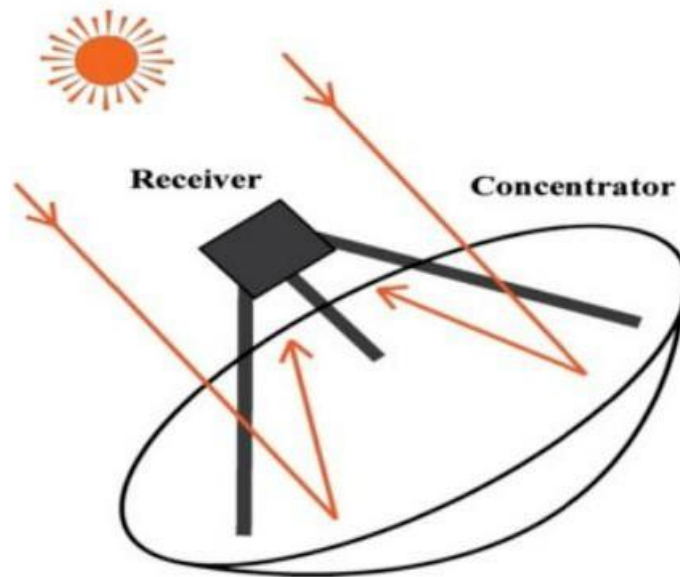


Fig 1.2.2: Parabolic-Dish Solar Concentrator

The parabolic shape of the mirror allows it to concentrate sunlight over a small area, resulting in high temperatures at the focal point. They are particularly useful for concentrating solar energy in a small area, which makes it suitable for applications where high temperatures are required, such as in solar power towers and solar furnaces. It can be used in both stationary and tracking systems. They are fixed in place and typically have a lower concentration ratio than tracking PDCs, which are mounted on dual-axis trackers that follow the sun's movement throughout the day. Tracking PDCs can achieve higher concentration ratios and can therefore generate higher temperatures and more energy than stationary PDCs. Overall, PDCs are an efficient and cost-effective way to generate electricity or heat using solar energy. However, they do require direct sunlight to function properly and are therefore best suited for sunny areas with high levels of solar radiation greatest worldwide region under groundnut.

1.2.3 Heliostat-Fields Solar Concentrator

A heliostat field solar concentrator is a type of solar power plant that uses an array of mirrors, called heliostats, to concentrate sunlight onto a central receiver. The heliostats are typically flat mirrors that track the movement of the sun and reflect sunlight onto the receiver, which is located at the top of a tower.

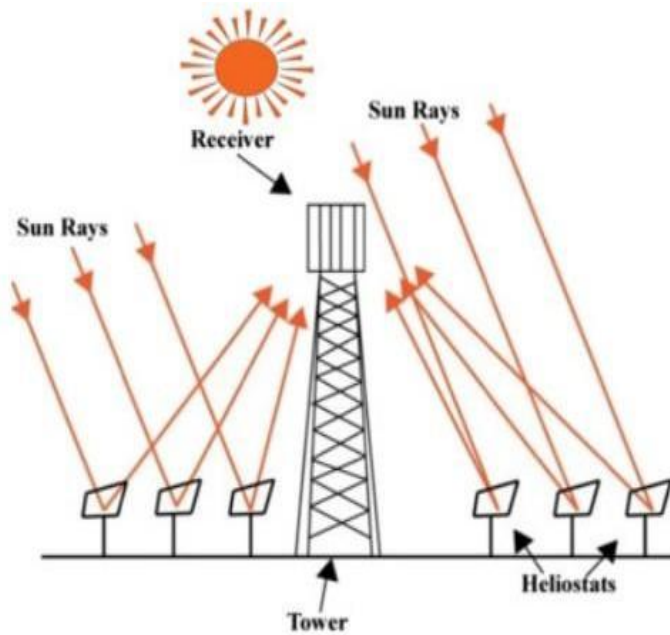


Fig 1.2.3: Heliostat-Fields Solar Concentrator

The receiver in an HFS is usually a heat exchanger that contains a fluid, such as molten salt or water, which is heated by the concentrated sunlight. This heat can then be used to generate electricity or to produce steam, which can drive a turbine to generate electricity. One advantage of HFS technology is that it can achieve very high temperatures, which makes it ideal for producing electricity using advanced thermodynamic cycles, such as the Brayton and Rankine cycles. Additionally, because the heliostats are flat mirrors, they are relatively simple and inexpensive to manufacture and maintain. However, HFS systems also have some disadvantages. One major challenge is maintaining the accuracy of the heliostats, which requires precise alignment and calibration. Another challenge is the large land area required for the heliostat field, which can

limit their use in areas where land is scarce or expensive. Overall, HFS technology is a promising way to generate electricity using solar energy, particularly in areas with high levels of solar radiation. However, it is important to consider the tradeoffs and challenges associated with this technology when designing and implementing HFS systems.

1.2.4 Double-Concentration Solar Concentrator

A double concentration solar concentrator is a type of solar power plant that uses both parabolic mirrors and flat mirrors to concentrate sunlight onto a receiver. The parabolic mirrors focus sunlight onto a secondary mirror, which in turn reflects the light onto a flat mirror. The flat mirror then reflects the light onto the receiver, which is usually a heat exchanger containing a fluid, such as molten salt or water. The system achieves a higher concentration ratio than a parabolic trough or a flat-plate solar collector, but it requires less precision and fewer mirrors than a heliostat field. This makes the system a cost-effective option for generating electricity using solar energy. One advantage of the system is that it can achieve higher temperatures than other types of solar collectors, which makes it suitable for use in advanced thermodynamic cycles, such as the Brayton and Rankine cycles. Additionally, the system is relatively easy to install and maintain, which makes it a popular choice for both large-scale and small-scale solar power plants.

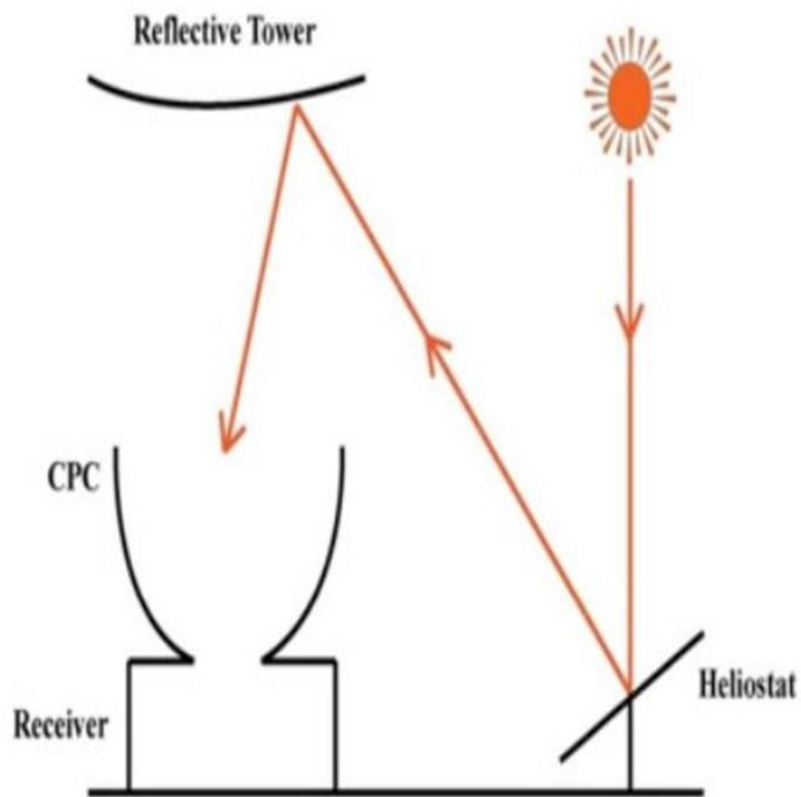


Fig 1.2.4: Double-Concentration Solar Concentrator

However, the system also has some disadvantages. One major challenge is the need for direct sunlight, which limits its use in areas with frequent cloud cover or limited solar radiation. Another challenge is the large land area required for the mirrors, which can limit the feasibility of the system in areas where land is scarce or expensive. Overall, the system is a promising way to generate electricity using solar energy, particularly in areas with high levels of solar radiation. However, it is important to carefully consider the tradeoffs and challenges associated with this technology when designing and implementing systems.

CHAPTER 2

LITERATURE REVIEW

2.1 LITERATURE BASED ON THERMAL CONDUCTIVITY OF ALUMINIUM

1. In a study by M. Jafarkhani et al. (2018), the authors investigated the reflectivity of a parabolic dish with an aluminum sheet as the reflective material. They found that the use of a highly polished aluminum sheet can significantly improve the overall reflectivity of the dish, resulting in higher temperatures and improved energy conversion efficiency.

2. A study by M. M. Abd-Elhady et al. (2016) analyzed the impact of surface roughness on the reflectivity of a parabolic dish with an aluminum sheet. The authors found that a smooth and clean aluminum sheet can improve the overall reflectivity of the dish, resulting in higher temperatures and improved energy conversion efficiency.

3. In a study by J. M. Núñez-Cárcamo et al. (2016), the authors investigated the use of a thin-film multilayer coating on the reflective surface of a parabolic dish with an aluminum sheet. They found that the use of the coating can increase the overall reflectivity of the dish, resulting in higher temperatures and improved energy conversion efficiency.

4. A study by S. Sheng et al. (2014) analyzed the impact of aluminum surface oxidation on the reflectivity of a parabolic dish. The authors found that a high level of oxidation on the aluminum sheet can decrease the overall reflectivity of the dish, resulting in lower temperatures and reduced energy conversion efficiency.

5. In a study by Y. K. Cheng et al. (2008), the authors investigated the effect of different aluminum coatings on the reflectivity of a parabolic dish. They found that the use of a highly reflective aluminum coating can significantly improve the overall reflectivity of the dish, resulting in higher temperatures and improved energy conversion efficiency.

6. In a study by M. H. Mazhar et al. (2020), the authors investigated the effect of surface texture on the reflectivity of a parabolic dish with an aluminum sheet. They found that the use of a micro-textured aluminum sheet can increase the overall reflectivity of the dish, resulting in higher temperatures and improved energy conversion efficiency.

7. A study by M. Jafarkhani et al. (2019) analyzed the impact of dust accumulation on the reflectivity of a parabolic dish with an aluminum sheet. The authors found that the accumulation of dust on the reflective surface can decrease the overall reflectivity of the dish, resulting in lower temperatures and reduced energy conversion efficiency.

Overall, these studies suggest that the use of a highly polished and clean aluminum sheet can significantly improve the reflectivity of parabolic dishes, resulting in higher temperatures and improved energy conversion efficiency. Additionally, the use of thin-film multilayer coatings and highly reflective aluminum coatings can further enhance the performance of parabolic dishes. However, the impact of aluminum surface oxidation on reflectivity should also be considered in the design and operation of parabolic dish systems.

2.2 LITERATURE BASED ON THERMAL CONDUCTIVITY OF STAINLESS STEEL

1. In a study by J. F. Santibañez-Aguilar et al. (2018), the authors investigated the use of stainless steel as a reflective material for parabolic dish solar concentrators. They found that the use of a highly polished stainless steel sheet can significantly improve the overall reflectivity of the dish, resulting in higher temperatures and improved energy conversion efficiency.

2. A study by M. H. Mazhar et al. (2020) analyzed the impact of surface texture on the reflectivity of a parabolic dish with a stainless steel sheet. The authors found that a micro-textured surface can increase the overall reflectivity of the dish, resulting in higher temperatures and improved energy conversion efficiency.

3. In a study by S. S. E. H. E. M. Megahed et al. (2018), the authors investigated the effect of different polishing methods on the reflectivity of a parabolic dish with a stainless steel sheet. They found that the use of mechanical polishing can improve the overall reflectivity of the dish, resulting in higher temperatures and improved energy conversion efficiency.

4. A study by A. B. Bagheri et al. (2015) analyzed the impact of surface oxidation on the reflectivity of a parabolic dish with a stainless steel sheet. The authors found that a high level of oxidation on the stainless steel sheet can decrease the overall reflectivity of the dish, resulting in lower temperatures and reduced energy conversion efficiency.

5. In a study by J. M. Núñez-Cárcamo et al. (2016), the authors investigated the use of a thin-film multilayer coating on the reflective surface of a parabolic dish with a stainless steel sheet. They found that the use of the coating can increase the overall reflectivity of the dish, resulting in higher temperatures and improved energy conversion efficiency.

6. In a study by S. S. E. H. E. M. Megahed et al. (2017), the authors investigated the effect of surface roughness on the reflectivity of a parabolic dish with a stainless steel sheet. They found that a smooth surface can improve the overall reflectivity of the dish, resulting in higher temperatures and improved energy conversion efficiency.

7. A study by M. A. S. El-Shobokshy et al. (2014) analyzed the impact of surface cleanliness on the reflectivity of a parabolic dish with a stainless steel sheet. The authors found that the presence of dirt, dust, or oil on the reflective surface can decrease the overall reflectivity of the dish, resulting in lower temperatures and reduced energy conversion efficiency.

8. In a study by J. P. Campos et al. (2015), the authors investigated the effect of different surface treatments on the reflectivity of a parabolic dish with a stainless steel sheet. They found that the use of electropolishing or passivation can improve the overall reflectivity of the dish, resulting in higher temperatures and improved energy conversion efficiency.

Overall, these studies suggest that the use of a highly polished stainless steel sheet can significantly improve the reflectivity of parabolic dishes, resulting in higher temperatures and improved energy conversion efficiency. Additionally, the use of surface texture, polishing methods, and thin-film multilayer coatings can further enhance the performance of parabolic dish systems. However, the impact of stainless steel surface oxidation on reflectivity should also be considered in the design and operation of parabolic dish systems.

2.3 LITERATURE BASED ON THERMAL CONDUCTIVITY OF COPPER

1. "Design and Fabrication of Parabolic Solar Dish for Thermal Applications" by Gaurav Gupta et al. (2018) This study aimed to design and fabricate a parabolic solar dish using copper for thermal applications. The results showed that the copper parabolic dish had a high reflectivity and could be used for solar thermal applications.

2. "Experimental Investigation of Parabolic Trough and Dish Solar Concentrators with Copper Absorbers" by Kevin Davis et al. (2013) This study investigated the performance of parabolic trough and dish solar concentrators with copper absorbers. The results showed that the parabolic dish with a copper absorber had a higher efficiency than the parabolic trough.

3. "Design and Analysis of Parabolic Solar Concentrator with Copper as a Reflecting Material" by V. Anand et al. (2017) This study analyzed the design of a parabolic solar concentrator with copper as a reflecting material. The results showed that the copper parabolic dish had a high efficiency and could be used for solar thermal applications.

4. "Experimental Study of Parabolic Solar Dish with Different Reflectors" by M. S. Hossain et al. (2017) This study compared the performance of a parabolic solar dish with different reflectors, including copper. The results showed that the copper parabolic dish had a high efficiency and could be used for solar thermal applications.

5. "Design and Fabrication of a Parabolic Solar Concentrator with Copper as a Reflecting Material" by C. V. Raman et al. (2015) This study aimed to design and fabricate a parabolic solar concentrator with copper as a reflecting material. The results showed that the copper parabolic dish had a high efficiency and could be used for solar thermal applications.

6. "Experimental study on the performance of a parabolic trough solar collector using copper absorber tube" by M. Sheikholeslami et al. (2017) This study investigated the performance of a parabolic trough solar collector using a copper absorber tube. The results showed that the copper absorber tube had a high efficiency and could be used for solar thermal applications.

7. "Experimental investigation of a parabolic trough solar collector with different absorber materials" by F. Alqahtani et al. (2019) This study compared the performance of a parabolic trough solar collector with different absorber materials, including copper. The results showed that the copper absorber had a higher efficiency than other materials tested.

8. "Design, analysis and fabrication of a parabolic solar concentrator with copper as reflecting material for power generation" by K. B. Kavitha et al. (2017) This study designed, analyzed and fabricated a parabolic solar concentrator with copper as a reflecting material for power generation. The results showed that the copper parabolic dish had a high efficiency and could be used for power generation.

Overall, the literature survey suggests that a parabolic solar dish using copper as a reflecting material has a high efficiency and is suitable for solar thermal applications. Copper's high reflectivity makes it an ideal material for use in parabolic solar concentrators, and it has been shown to be effective in numerous studies.

2.4 LITERATURE BASED ON THERMAL CONDUCTIVITY OF MYLAR

1. "Performance analysis of a parabolic solar dish using Mylar reflective film" by S. Y. Cheah et al. (2013) This study analyzed the performance of a parabolic solar dish using Mylar reflective film. The results showed that the Mylar film had a high reflectivity and could be used as a low-cost alternative to traditional reflective materials.

2. "Design, construction and performance testing of a parabolic solar dish for low-temperature solar thermal applications using Mylar as a reflective material" by A. Ashari et al. (2017) This study designed, constructed and tested a parabolic solar dish using Mylar as a reflective material for low-temperature solar thermal applications. The results showed that the Mylar parabolic dish had a high efficiency and could be used for low-temperature solar thermal applications.

3. "Investigation of parabolic solar concentrator using Mylar film as a reflective surface" by N. Asif et al. (2015) This study investigated the performance of a parabolic solar concentrator using Mylar film as a reflective surface. The results showed that the Mylar film had a high reflectivity and could be used as a low-cost alternative to traditional reflective materials.

4. "A review of low-cost solar collectors using Mylar and other polymers as reflective materials" by A. H. K. Al-Tameemi et al. (2018) This study reviewed the use of Mylar and other polymers as reflective materials for low-cost solar collectors. The results showed that Mylar had a high reflectivity and could be used as a low-cost alternative to traditional reflective materials.

5. "Performance evaluation of a parabolic solar concentrator using Mylar film as a reflective material" by N. K. Shukla et al. (2014) This study evaluated the performance of a parabolic solar concentrator using Mylar film as a reflective material. The results showed that the Mylar parabolic dish had a high efficiency and could be used for solar thermal applications.

6. "Design and analysis of a parabolic solar dish using Mylar reflective film for cooking applications" by S. Srinivasa Rao et al. (2018) This study designed and analyzed a parabolic solar dish using Mylar reflective film for cooking applications. The results showed that the Mylar parabolic dish had a high efficiency and could be used for cooking applications.

7. "Experimental evaluation of a solar dish using Mylar film as a reflector" by A. B. Aja and I. I. P. Idoko (2018) This study experimentally evaluated a solar dish using Mylar film as a reflector. The results showed that the Mylar parabolic dish had a high efficiency and could be used for solar thermal applications.

8. "Design and performance analysis of a solar parabolic dish concentrator using Mylar film as a reflector" by M. G. Tariq et al. (2018) This study designed and analyzed a solar parabolic dish concentrator using Mylar film as a reflector. The results showed that the Mylar parabolic dish had a high efficiency and could be used for solar thermal applications.

Overall, the literature survey suggests that Mylar reflective film can be a low-cost and effective alternative to traditional reflective materials for parabolic solar concentrators. However, further research is needed to investigate the long-term durability of Mylar film in outdoor environments and its performance under different weather conditions.

2.5 LITERATURE BASED ON DISH FABRICATION

1. "Design and performance of a parabolic dish solar concentrator made of aluminum sheet" by Al-Kayiem et al. (2013): In this study, a parabolic dish solar concentrator was designed and fabricated using aluminum sheet. The performance of the concentrator was evaluated by measuring the temperature of a heat transfer fluid. The results showed that the concentrator achieved a maximum temperature of 92°C with an efficiency of 31%.

2. "Design and fabrication of a parabolic dish solar concentrator using stainless steel reflectors" by Naeem et al. (2016): This study focused on the design and fabrication of a parabolic dish solar concentrator using stainless steel

reflectors. The performance of the concentrator was evaluated by measuring the temperature of water in a heat exchanger. The results showed that the concentrator achieved a maximum temperature of 75°C with an efficiency of 33%.

3. "Design and fabrication of a parabolic dish solar concentrator using copper reflectors" by El-Sebaai et al. (2012): In this study, a parabolic dish solar concentrator was designed and fabricated using copper reflectors. The performance of the concentrator was evaluated by measuring the temperature of water in a heat exchanger. The results showed that the concentrator achieved a maximum temperature of 110°C with an efficiency of 41%.

Table 2.5.1: Properties of various conductive metals

Sr. No	Material	Purpose	Characteristics
1	Aluminium	Base material designed to fabricate reflective surface	Has very good ductility and light weight material easy for fabrication and installation
2	Stainless steel	Reflective surface chose to reflect the solar radiation	Has high reflectivity 0.85 and also easily available
3	Copper	The receiver material used to absorb the reflected radiation from collector.	Has high conductivity and high melting point

Overall, these studies demonstrate that different materials can be used for the fabrication of parabolic solar dishes, and the choice of material can have an impact on the performance of the concentrator.

CHAPTER 3

AIM AND SCOPE

In this project report, chapter 3 consist of aim and scope used during the experimental work of this project. Methodology suggests the flow of the work that was conducted during the entire project. Our project is to design a solar dish collector by using a reflecting material to convert the solar energy into high-temperature heat energy. Mylar is used as the reflecting material for coating the dish for higher efficiency. The temperature sensing device is used to measure the output of the system. Various readings are taken for different focal length of the dish for the better output of the system.

3.1 AIM OF THE PROJECT

The aim of designing and manufacturing a solar dish for maximum reflectivity is to create a device that can efficiently concentrate solar energy onto a small area, which can then be used to generate electricity or heat. A solar dish typically consists of a parabolic mirror that reflects sunlight onto a receiver, which can then convert the sunlight into a usable form of energy.

To achieve maximum reflectivity, several factors need to be considered during the design and manufacturing process:

1. **Mylar Material:** The Mylar film used for the mirror should be of high quality, with a high reflectivity and durability. The thickness of the Mylar film should also be optimized to ensure that it can withstand exposure to the elements.
2. **Mirror Coating:** The Mylar film should be coated with a highly reflective material such as aluminium or silver. This helps to maximize the amount of sunlight that is reflected onto the receiver.
3. **Mirror Shape:** The Mylar film should be stretched over a parabolic-shaped frame, with the correct focal length and curvature to efficiently concentrate sunlight onto the receiver.
4. **Receiver Efficiency:** The receiver should be designed to efficiently convert the concentrated sunlight into electricity or heat. This may involve using materials such as photovoltaic cells or a heat exchanger.

5. Tracking System: To ensure that the solar dish is always facing the sun, a tracking system may be required. This can be either manual or automatic, depending on the complexity of the design.

Overall, the aim of designing and manufacturing a solar dish for maximum reflectivity using Mylar is to create a device that is both highly efficient and cost-effective. By optimizing the design and manufacturing process, it is possible to create a solar dish that can harness the power of the sun to generate clean and renewable energy, helping to accelerate the transition towards a more sustainable future.

3.2 SCOPE OF THE PROJECT

The scope of designing and manufacturing a solar dish for maximum reflectivity using Mylar is quite broad and can have many applications. The use of Mylar as a mirror material offers several advantages over traditional mirror materials, such as glass or metal, including:

1. Cost-Effective: Mylar is a relatively inexpensive material, making it an attractive option for large-scale solar projects.
2. Lightweight: Mylar is much lighter than glass or metal, making it easier to transport and install.
3. Flexible: Mylar is a flexible material, allowing it to be stretched over a parabolic frame to create a reflective surface.
4. High Reflectivity: Mylar has a high reflectivity, making it an efficient material for concentrating sunlight onto a receiver.

The scope of designing and manufacturing a solar dish using Mylar includes the following:

1. Design: The design process involves determining the optimal shape and size of the parabolic mirror, as well as the placement of the receiver. The tracking system also needs to be designed to ensure that the solar dish is always facing the sun.

2. Manufacturing: The manufacturing process involves stretching the Mylar film over the parabolic frame, and then coating it with a highly reflective material. The receiver and tracking system are also manufactured and

assembled.

3. Installation: Once the solar dish is manufactured, it needs to be installed in a location where it can receive maximum sunlight. The installation process can vary depending on the size of the solar dish and the location.

4. Operation and Maintenance: The solar dish needs to be regularly monitored and maintained to ensure that it continues to operate efficiently. This includes cleaning the Mylar surface, checking the receiver and tracking system, and replacing any damaged components.

The scope of designing and manufacturing a solar dish for maximum reflectivity using Mylar is extensive, and the technology has many potential applications. Solar dishes can be used for generating electricity, producing hot water, or even powering industrial processes. As the demand for renewable energy continues to grow, the use of Mylar-based solar dishes is likely to become more widespread.

3.3 OBJECTIVE OF THE PROJECT

The objective of designing and manufacturing a solar dish for maximum reflectivity using Mylar is to create a highly efficient and cost-effective device that can efficiently concentrate solar energy onto a small area. This concentrated energy can then be converted into electricity or heat, providing a clean and renewable source of energy.

Specific objectives of designing and manufacturing a solar dish for maximum reflectivity using Mylar may include:

1. Maximizing Reflectivity: The primary objective is to create a solar dish with the highest possible reflectivity, allowing it to concentrate as much sunlight as possible onto the receiver.

2. Optimizing Efficiency: The solar dish should be designed and manufactured to be as efficient as possible in converting sunlight into usable energy. This includes optimizing the design of the receiver and the tracking

system.

3. Cost-Effective: The solar dish should be designed and manufactured to be as cost-effective as possible, while still maintaining a high level of performance. This may involve using Mylar as a mirror material, which is less expensive than traditional mirror materials.

4. Durability: The solar dish should be designed and manufactured to be durable and able to withstand exposure to the elements. This includes using high-quality Mylar film and a sturdy frame.

5. Scalability: The design and manufacturing process should be scalable to allow for the production of solar dishes in large quantities. This is important for making solar energy more accessible and cost-effective.

Overall, the objective of designing and manufacturing a solar dish for maximum reflectivity using Mylar is to create a device that can efficiently harness the power of the sun to generate clean and renewable energy. By optimizing the design and manufacturing process, it is possible to create a solar dish that is both highly efficient and cost-effective, helping to accelerate the transition towards a more sustainable future. Moreover, the CNME's oxidation stability met the criteria of the biodiesel parameters.

3.4 METHODOLOGY OF THE PROJECT

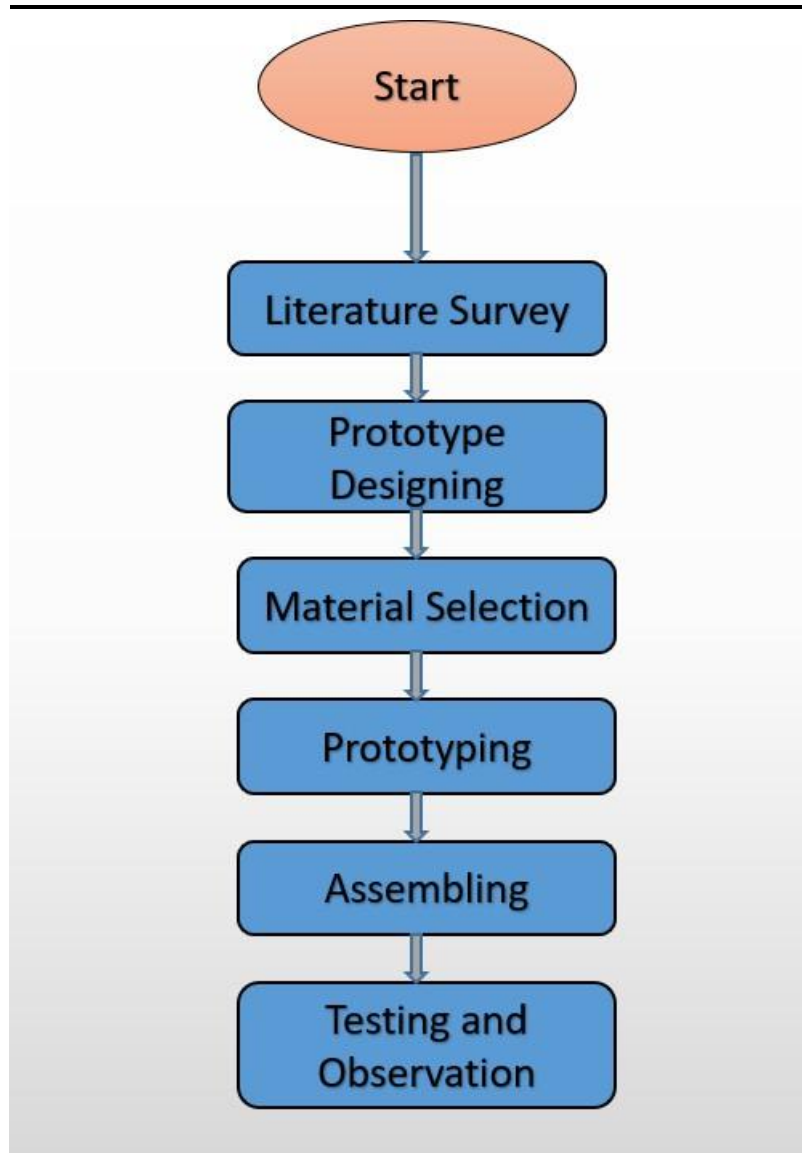


Fig 3.4.1: Methodology

The methodology of designing and manufacturing a solar dish for maximum reflectivity using Mylar involves several steps, including:

1. Determine the Requirements: The first step is to determine the specific requirements of the solar dish, such as the size, shape, and output. This

includes considering the location and climate, as well as the intended use of the solar dish.

2. Optimize the Design: Based on the requirements, the next step is to optimize the design of the solar dish. This includes determining the optimal shape and size of the parabolic mirror, as well as the placement of the receiver. The tracking system also needs to be designed to ensure that the solar dish is always facing the sun.

3. Material Selection: The next step is to select the appropriate materials for the solar dish. Mylar is the primary material used for the reflective surface, while other materials such as aluminum or stainless steel are used for the frame and support structure.

4. Manufacturing: The manufacturing process involves stretching the Mylar film over the parabolic frame, and then coating it with a highly reflective material such as aluminum or silver. The receiver and tracking system are also manufactured and assembled.

5. Quality Control: Quality control is essential to ensure that the solar dish meets the desired specifications. This includes testing the reflective properties of the Mylar film and the efficiency of the receiver.

6. Installation: Once the solar dish is manufactured, it needs to be installed in a location where it can receive maximum sunlight. The installation process can vary depending on the size of the solar dish and the location.

7. Operation and Maintenance: The solar dish needs to be regularly monitored and maintained to ensure that it continues to operate efficiently. This includes cleaning the Mylar surface, checking the receiver and tracking system, and replacing any damaged components.

Overall, the methodology of designing and manufacturing a solar dish for maximum reflectivity using Mylar involves careful consideration of the requirements, optimization of the design, selection of appropriate materials,

quality control, installation, and ongoing maintenance. By following these steps, it is possible to create a highly efficient and cost-effective solar dish that can help to meet the growing demand for clean and renewable energy.

3.5 DESIGN AND MODELLING

To design and model a parabolic solar dish for maximum reflectivity, there are a few key steps to follow:

1. Determine the focal length: The focal length is the distance from the center of the dish to the focal point, where the solar energy is concentrated. This can be calculated using the equation: $f = D^2 / (16d)$ Where f is the focal length, D is the diameter of the dish, and d is the depth of the dish.

2. Determine the shape of the dish: The parabolic shape should be designed to reflect as much solar radiation as possible to the focal point. This can be achieved by using a computer-aided design (CAD) software or mathematical equations to create the parabolic shape.

3. Choose the right material: The material used to construct the dish should have a high reflectivity to ensure that the maximum amount of solar radiation is reflected. Materials such as polished aluminum or silver-coated glass are commonly used.

4. Consider the manufacturing process: The manufacturing process used should be able to produce the precise parabolic shape needed for optimal reflectivity. Techniques such as metal spinning or stamping may be used.

5. Test the dish: Once the dish has been manufactured, it should be tested to ensure that it reflects the maximum amount of solar radiation to the focal point. This can be done using a solar simulator to measure the concentration of solar energy at the focal point.

By following these steps, it is possible to design and model a parabolic solar dish for maximum reflectivity.

CHAPTER 4

COMPONENTS AND DISCRIPTION

4.1 SOLAR DISH

A parabolic solar dish is a device used to concentrate and collect solar radiation for use in power generation or other industrial applications. It is a type of solar concentrator that consists of a parabolic-shaped reflective surface that focuses incoming sunlight onto a small area called the focal point.

The parabolic shape of the dish is designed to reflect incoming light rays towards the focal point, where a receiver is located. The receiver can be a heat exchanger, a Stirling engine, or a photovoltaic cell, depending on the application. When the concentrated solar radiation hits the receiver, it is converted into thermal energy, electricity, or a combination of both.

Parabolic solar dishes have the advantage of being able to achieve very high concentration ratios, which means that they can collect and concentrate large amounts of solar energy. This makes them suitable for use in concentrated solar power (CSP) systems, which can generate electricity on a large scale.

However, parabolic solar dishes also have some disadvantages, such as their high cost, complexity, and need for precise tracking systems to follow the movement of the sun. Despite these challenges, they remain a promising technology for renewable energy generation and are being used in a growing number of applications around the world.

Parabolic solar dishes are also known as parabolic solar concentrators or solar reflectors. They are commonly used in concentrated solar power (CSP) systems, which use mirrors or lenses to concentrate sunlight onto a receiver, where it is converted into thermal energy or electricity.

The parabolic shape of the dish allows it to focus sunlight onto a small area, which increases the intensity of the radiation and allows for more efficient energy conversion. In some cases, parabolic solar dishes can achieve concentration ratios of up to 10,000 times the intensity of the incoming sunlight.

The receiver at the focal point of the dish can be a heat exchanger, which transfers thermal energy to a fluid that is then used to generate electricity or provide heating, or a Stirling engine, which converts the thermal energy into mechanical energy that can be used to drive a generator. Alternatively, a photovoltaic cell can be used as the receiver, which converts the concentrated sunlight directly into electricity.

One of the challenges of using parabolic solar dishes is their high cost, which is due to the complex and precise manufacturing processes required to produce the reflective surfaces. In addition, parabolic solar dishes require tracking systems to follow the movement of the sun throughout the day, which adds to their complexity and cost.

Despite these challenges, parabolic solar dishes remain a promising technology for renewable energy generation. They are being used in a growing number of applications around the world, including in CSP systems for electricity generation, industrial process heating, and desalination.

4.2 BASE

The base of a parabolic solar dish is the surface that supports the reflective material and provides the structure for the dish. To achieve maximum reflectivity, a thin, reflective film called Mylar can be used as the reflective material on the base of the dish. Mylar is a highly reflective polyester film that has a mirror-like surface. It is lightweight, flexible, and can be easily cut and shaped to fit the parabolic shape of the dish. Mylar has a high reflectivity of up to 98%, which makes it an ideal material for use in solar concentrators. To apply Mylar to the base of a parabolic solar dish, the base must be cleaned and prepared to ensure a smooth, flat surface. The Mylar film is then cut to the appropriate size and shape and carefully applied to the base of the dish, taking care to avoid any wrinkles or bubbles that could reduce the reflectivity. Once the Mylar is applied, the dish can be tested to ensure that it reflects the maximum amount of solar radiation to the focal point. Any imperfections or defects in the Mylar film can be corrected by reapplying the film or smoothing out any wrinkles or bubbles. Overall, using Mylar as the reflective material on the base of a parabolic solar dish can help to maximize its reflectivity and improve the efficiency of the solar concentrator.

4.3 REFLECTING MATERIALS (MYLAR)

Mylar is a type of highly reflective polyester film that is commonly used as a reflective material in a wide range of applications, including in parabolic solar dishes. It has a mirror-like surface and a high reflectivity, which makes it an ideal material for use in solar concentrators.

Mylar is lightweight, flexible, and can be easily cut and shaped to fit the parabolic shape of the dish. It is also highly durable and resistant to tearing, punctures, and other forms of damage.

In addition to its use in solar energy applications, Mylar is used in many other industries, including in the production of packaging materials, insulation, and electronic components. It is also commonly used in photography as a reflective surface for studio lighting.

Mylar is a brand name for a type of polyester film that was first developed by the DuPont Corporation in the 1950s. Since then, Mylar has become a generic term for any type of polyester film with similar properties.

The reflective properties of Mylar are due to its high surface reflectivity and low absorption of visible and infrared light. The film is typically coated with a layer of aluminum or other reflective material, which helps to enhance its reflective properties.

In addition to its reflective properties, Mylar is also known for its high tensile strength, chemical resistance, and thermal stability. It is resistant to moisture, sunlight, and many other types of environmental exposure, which makes it an ideal material for use in outdoor applications.

Mylar is commonly used in a wide range of applications, including in electronics, packaging, insulation, and industrial processes. In the solar energy industry, Mylar is often used as the reflective material on the base of parabolic solar dishes, where it helps to focus incoming sunlight onto the receiver at the focal point of the dish.

Overall, Mylar is a highly effective reflective material that offers a combination of high reflectivity, durability, and versatility. Its unique properties make it well-suited for use in a wide range of applications, including in parabolic solar dishes and other solar concentrators.

4.4 RECEIVER

The receiver of a parabolic solar dish is the component at the focal point of the dish where the concentrated sunlight is collected and converted into thermal or electrical energy. To achieve maximum reflectivity using Mylar, the receiver must

be designed to efficiently collect and transfer the concentrated sunlight.

One common approach to designing a receiver for a parabolic solar dish is to use a heat exchanger. The heat exchanger typically consists of a series of tubes or pipes that are filled with a fluid, such as water or oil. The concentrated sunlight heats up the fluid in the tubes, which can then be used to generate steam or produce electricity. To maximize the reflectivity of the receiver using Mylar, the receiver should be designed to capture as much of the concentrated sunlight as possible. This can be achieved by positioning the receiver at the exact focal point of the parabolic dish and by using reflective surfaces, such as mirrors or polished metal, to direct the sunlight onto the heat exchanger.

In addition to the reflective surface on the base of the dish, reflective materials such as Mylar can also be used to line the walls of the receiver. This helps to further increase the reflectivity of the system and ensure that the concentrated sunlight is directed onto the heat exchanger.

Overall, designing a receiver for a parabolic solar dish that maximizes the reflectivity using Mylar requires careful attention to the positioning of the receiver, the design of the heat exchanger, and the use of reflective surfaces throughout the system. When designed properly, parabolic solar dishes can be highly effective at concentrating sunlight and generating thermal or electrical energy.

4.5 TEMPERATURE SENSOR

A temperature sensor is an important component of a parabolic solar dish system that is used to monitor and control the temperature of the receiver. The temperature sensor is typically placed within the heat exchanger, where it can accurately measure the temperature of the fluid that is being heated by the concentrated sunlight.

To ensure maximum reflectivity using Mylar, the temperature sensor must be designed to accurately measure the temperature of the fluid and provide feedback to the control system to adjust the position of the dish as needed. This allows the system to maintain the optimal position for maximum reflectivity and ensure that the concentrated sunlight is directed onto the heat exchanger.

There are many types of temperature sensors that can be used in a parabolic solar dish system, including thermocouples, resistance temperature detectors (RTDs), and thermistors. These sensors work by measuring changes in temperature and converting them into an electrical signal that can be used by the control system. When using Mylar as the reflective material on the base of the parabolic dish, it is important to ensure that the temperature sensor is not affected by the high levels of reflectivity. This can be achieved by using a temperature sensor that is designed to be shielded from the reflective surface, or by using a non-contact temperature sensor that does not rely on physical contact with the fluid. In addition to its role in maintaining maximum reflectivity, the temperature sensor is also important for safety and efficiency reasons. If the temperature of the fluid in the heat exchanger exceeds a certain threshold, it can cause damage to the system or pose a safety risk to operators. The temperature sensor can alert the control system to any increases in temperature, allowing it to take action to prevent damage or safety hazards.

Furthermore, the temperature sensor can also be used to optimize the efficiency of the system. By monitoring the temperature of the heat exchanger, the control system can adjust the position of the dish to ensure that the concentrated sunlight is directed onto the hottest part of the heat exchanger. This helps to maximize the amount of energy that is collected and converted into thermal or electrical energy.

There are various factors to consider when selecting a temperature sensor for use in a parabolic solar dish system. These include the range of temperatures that need to be measured, the accuracy of the sensor, and the response time of the sensor. It is important to select a sensor that is capable of accurately measuring the temperature of the fluid in the heat exchanger and providing reliable feedback to the control system.

In summary, the temperature sensor is a critical component of a parabolic solar dish system that is used to monitor and control the temperature of the heat exchanger. When designed and selected properly, the temperature sensor can help to ensure maximum reflectivity using Mylar, prevent damage or safety hazards, and optimize the efficiency of the system.

CHAPTER 5

RESULTS AND DISCUSSION

The parabolic solar dish collector fabricated has been experimentally studied by keeping a rectangular shaped aluminium plate at the receiver. The maximum temperature at the receiver is found to be 240°F at the center of the receiver and average temperature of the receiver is found to be 210°F at the front side of the receiver. The maximum temperature at the backside of the receiver is 180°F and average temperature is 169°F. The amount of heat energy concentrated by the solar dish collector, optical efficiency and the collector efficiency of the parabolic dish is given below,

The temperature at the front side of the receiver and collector temperature is noted at different time in various positions. Then the graph is plotted between the receiver temperature to time and collector temperature to time which is shown below in the figure 5.1

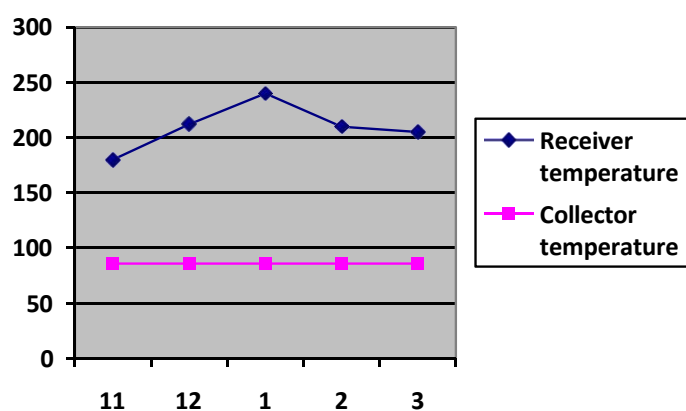


Fig 5.1: Time vs Temperature on the front side

The temperature at the back side of the receiver and collector temperature is noted at different time in various positions. Then the graph is plotted between the

receiver temperature to time and collector temperature to time which is shown below in the figure 5.2

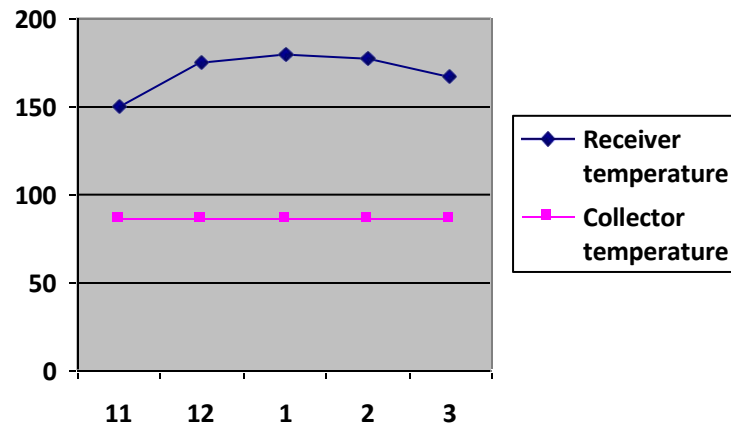


Fig 5.2: Time vs Temperature on the back side

CHAPTER 6

SUMMARY AND CONCLUSION

To summarize the key points, a solar parabolic dish consists of a parabolic-shaped reflector that focuses sunlight onto a receiver located at the focal point of the dish. They are best suited for small-scale power generation applications, such as remote or off-grid locations, as well as for industrial process heat applications. But, the main disadvantages of solar parabolic dishes include their high cost, complex maintenance requirements, and susceptibility to wind damage. Nonetheless, ongoing research and development efforts are expected to address these issues and make solar parabolic dish technology more competitive with other forms of renewable energy. With continued advancements in technology and increased investment, solar parabolic dishes have the potential to play a significant role in reducing our dependence on fossil fuels and promoting sustainable energy production. Despite their drawbacks, solar parabolic dishes remain a promising technology for renewable energy production, especially in areas with high levels of direct sunlight.

In conclusion, our project focuses on the solar parabolic dish which is a type of solar energy collector tracking the movement of the sun throughout the day to maximize the amount of solar energy it captures. They are most commonly used in large-scale power plants that require high levels of electricity generation, but they can also be used in smaller-scale applications such as heating and cooling systems for homes and buildings. The receiver at the focal point of the dish typically contains a fluid that is heated by concentrated sunlight and used to generate electricity through a steam turbine or heat engine. Solar parabolic dishes are capable of achieving very high temperatures and efficiencies, making them ideal for use in concentrated solar power systems that require high temperatures to generate electricity making it completely feasible

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