

# Chemical and thermal analysis of the sunflower oil used in a parabolic dish cooker for a sensible heat storage

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## ABSTRACT

This article mainly focused the storage system for the solar cooker to study the possibility to use the solar cooker during the night or cloudy time. There are many storage system are available to store the sensible heat energy for the fuel less system like this. Here mainly focus the storage of sensible heat in the sunflower oil. We made the experimental setup for a solar parabolic type with storage of heat addition to the sunflower oil. This articles explained about the performance improvement of the cooking during no or low radiation time as well as chemical and thermal analysis of the sunflower oil; we found there are no significant changes in the chemical edible properties of the sunflower oil because we have added the moderate quantity of temperature to the oil. Insulation also made for the detailed study of the experiment. Also, we compared the results without the insulation. This article deals the practical result of peak hour of solar radiation only.

**KEY WORDS:** Chemical analysis, Thermal Analysis, solar, parabolic dish, cooker, sensible heat, temperature, viscosity.

## 1. INTRODUCTION

Thermal storage unit provides the facility for indoor afternoon and evening cooking by stored solar energy. This unit consists of two coaxial cylindrical vessels having void space in between them. For enhancing heat transfer, steel balls are placed inside the outer container. The storage unit is made up of aluminium and three sunflower oil have been tested with insulation and without insulation. The outer surface of a thermal storage unit is painted black so that it can absorb a significant amount of heat. Figure 1- Block diagram of the process of cooking using thermal heat storage system.

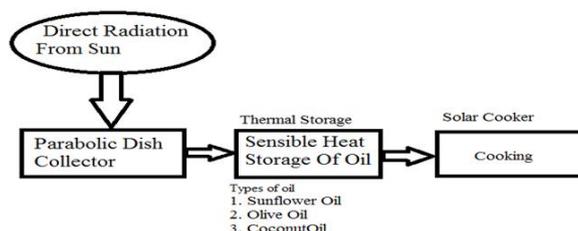


Figure.1. Block diagram of the process of cooking using thermal heat storage system

## 2. EXPERIMENTAL SETUP

The experimental setup is given in the following picture. This system consists of parabolic dish collector and solar cooker. The main components of experimental setup are parabolic dish collector, Thermal storage unit, Cooking pot and Insulator box. Water. Steel balls are used to increase the temperatures of oil and used for heat storage from one medium to another medium.



Figure.2. Parabolic dish collector

**Table 1: Design Specifications of Dish Collector**

Diameter of outer ring	0.9 m
Focal length of dish	0.42 m
Dish rim angle	56.14°
Aperture area of dish	0.636 m <sup>2</sup>
Concentration ratio of dish	20.254

**Table.2.Design Specifications of Thermal Storage Unit**

Diameter of inner vessel	0.22 m
Diameter of outer vessel	0.20 m
Height of inner vessel	0.12 m
Height of outer vessel	0.10 m
Mass of storage unit	1 kg
Volume of water	1 Litre
Volume of oil	1 Litre
Number of steel balls	40

Thermal storage unit provides the facility for indoor afternoon and evening cooking by stored solar energy. For enhancing heat transfer, steel balls are placed inside the outer container. The storage unit is made up of aluminium have been tested with insulation and without insulation. The outer surface of a thermal storage unit is painted black so that it can absorb a large amount of heat. It is the cylindrically shaped vessel made up of aluminium in which actual cooking occurs. It is included in the cavity of the thermal storage unit for cooking purpose. Aluminium is used on its lateral surface for enhancing cooking rate. The cooking pot is an essential component in the experimental setup. Insulator box is designed to prevent the heat loss from the thermal storage unit after charging for storing solar energy in the form of thermal energy. Thermocol used around which glass wool filled for insulation purpose. Sunflower oil is the non-volatile oil compressed from sunflower seeds. Refining losses are low, and the oil has good keeping qualities with the light tendency for flavor reversion. The maximum temperature achieved during charging process in the heat storage of sunflower oil without insulation and with insulation is 109.5°C and 118.2°C respectively. Sunflower oil is readily available, edible and food-grade. Sunflower oil is non-toxic, and its fumes are tolerated. Energy storage performance of sunflower oil varies significantly. Sunflower oil used for heat storage, heat retention, and heat utilization cycles. Sunflower oil is a non-volatile oil which is commonly used in food as a frying oil.

### 3. RESULTS AND ANALYSIS

The following results are obtained during experimental investigation

**Table.3.Water Heating Test with Respect to Time**

Time	Ib(W/m <sup>2</sup> )	T amb(°C)	T water(°C)	Tv, bottom(°C)	Treflector(°C)
11:00 am	489	30.8	32	43	47
11:15 am	526.737	31.6	44	60	53
11:30 am	571.8	31.9	58	74	64
11:45 am	581.02	33.4	74	82	64
12:00 pm	614.16	33.6	82	90	68
12:15 pm	621.422	34.8	90	97	61

**Table.4.Heat Storage of Sunflower Oil without Insulation**

Time	T <sub>1oil</sub> (°C)	T <sub>2oil</sub> (°C)	T <sub>3</sub> (°C)	T <sub>4bottom</sub> (°C)	T <sub>5reflector</sub> (°C)
11:00 am	34	32	26	54	40
11:15 am	37.2	40	42.6	61	41.7
11:30 am	39.5	41.2	46.5	65.5	42.5
11:45 am	55.2	50.2	59.3	71.2	44.3
12:00 pm	81.5	83.6	81.1	86.5	44.1
12:15 pm	96.5	95.2	86.5	89.5	45.9
12:30 pm	109.5	113.5	91.1	92.7	49

**Table.5.Discharge Cycle of Sunflower Oil with Insulation**

Time	T <sub>oil</sub> (°C)	T <sub>oil</sub> (°C)	T <sub>water</sub> (°C)
12:55 pm	97.5	98.5	46.5
1:05 pm	91.5	90.9	55.7
1:15 pm	81.5	80.8	56.2
1:25 pm	72.6	71.1	58.8
1:35 pm	66.3	66.7	60.1
1:45 pm	60.1	58.3	59.9

The maximum temperature variation shown from the graph is for the sunflower oil that is achieved at 15:00 pm at 119.2°C. The charging process of the system takes place from 13:00 pm to 16:00 pm respectively. After 16:00 pm the discharging process takes place where there is a slight variation of oil temperatures

#### 4. CONCLUSION

The purpose of doing this experiment is to preserve the heat and use it for another purpose we do the experiment during the noon time when the solar radiation is at its peak. The readings were taken from around 11 am to 3pm, The container was shifted to an insulated box and the heat produced was preserved. The heat generated in the water in the discharge cycle was up to 60 degrees. This heat can be used for various purposes. The heat generated this way could be more useful and with more energy than the heat generated directly. Hence this method of preserving heat during the day times and using the heat stored in the night times can be a useful and conservative source for energy. The maximum temperature of sunflower oil is observed and calculated. The ambient temperatures of oil with respect to time remains constant approximately.

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