International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2019): 7.583

Performance Evaluation and Utilization on the Solar Steam Generation System for the Cooking Process in the Composite Climate

Deepak Sharma[1], Ravindra Kumar Jain[2], Mukesh Kumar Gupta[3], Hemant Sharma[4]

[1]Master Degree Energy Engineer Suresh GyanVihar University, Jaipur – India, PH-9785144331. E-mail: *deepakranu1[at]mail.com*

[2, 3]Centre of Excellence-Renewable & Sustainable Energy Studies, Suresh GyanVihar University, Jaipur – India

[4]Malaviya National Institute of Technology -India

Abstract: ***In this present paper, an experimental investigation has been performed to analyze the thermal performance of a solar steam cooker in the composite climate. It is a household type solar steam cooker and has performed in the climate condition of Rajasthan, India. A parabolic type of solar concentrator is used in this setup. It collects the solar radiation and reflected on the bottom of a black-painted copper cylinder work as an absorber. It is Quarterly filled water this water heats up on a high grows up high-pressure steam and this steam utilizes in various cooking applications. In this paper, an experimental setup testing and reporting solar Steam cooker performance. Solar steam energy is used as a solar cooker, but solar cookers are used outside the kitchen while the steam cooker can be used in the kitchen. In this setup, Steam generates high temperatures and high pressure into the absorber (copper cylinder) and supplies by the insulated copper tube and throws the cooking vessel. Steam is used for cooking. In this paper, a portable solar steam cooker and different cooking applications like boiling potato, cooking rice, idle, etc. As per American standard, Per standardized Minimum temperature difference of 50 °C between ambient air and cooking vessel water temperatures and steam temperature 100 °C for a parabolic-type cooker. This setup achieved 256 °C May and June days. So the author intends to study solar cooking because in India sun is available nearly 8 to 11 hours/day though all year and can achieve 300°C to750°C by the parabolic type solar concentrator.***

Keywords: Solar energy, parabolic dish, solar cooker, solar steam cooker, non-renewable energy, composite climate, and copper cylinder

1. Introduction

In the current scenario, our world comes this situation that our energy sources are almost empty another word it says that nowadays non-renewable energy available is a low quantity so it's are gait to use renewable energy source so we use different types of renewable source like wind, solar, water (hydro), biomass and geothermal. If we didn't find a better alternative process of renewable sources of energy then there is nothing left for our future generations. Many types of fossil fuel are non- renewable energy resources. They are coal, natural gas, oil, and nuclear energy; once these resources are used up, they can't be replaced, which is a significant problem for humanity. It is currently dependent on them to supply most of our energy needs. Hence, they have a low percentage on this earth [3].

A renewable resource is a natural resource that will replenish to replace the portion depleted by usage and consumption, either through natural reproduction or other recurring processes in a finite amount of time on a human time scale [4].Energy is an ability to be very active or do a lot of works without getting tired in other words, it says that energy is the capacity of doing work. According to the law of conservation plays a significant role because the utilization of Non-renewable resources also impacts our environment. Especially, the usage of fossil fuels supplies air and water pollution such as carbon dioxide is produced when oil, coal, and gas combust in power stations, heating systems, and engines. There are two types of energy i.e. .renewable and non-renewable energy. Renewable energy sources like wind, solar, water (hydro), biomass, and geothermal, etc. and the non- renewable energy resources include coal, natural gas, petroleum oil wood, and nuclear energy [1], etc. In non-renewable energy sources have limited in its use. Firewood's are the primary energy source LPG is another petroleum gas source but these are limited, these are used our entire world [2]. It has solar steam energy is used like solar cooker but solar cooker uses outside the kitchen in filed but steam cooker is used in the kitchen. Steam supply by the insulated copper pipe and this steam are used as cooking in this paper it study a portable solar cooker and use a different cooking application like boiling potato, cooking rice, idle, etc. [6]. But our intention to study solar cooking because of in India sun is available nearly 8 to 11 hours/day though all year [5]. Therefore, solar energy should be an alternative energy source for the present-day due to the low availability of non-renewable sources of energy. Cooking is the most important energy-consuming operation at home, in India mostly rural area housemaid used firewood as fuel but now day LPG is commonly used in rural and urban areas. LPG and other energy sources are also using as fuel, but they are in low quantity we are compared to firewood in the urban region the firewood is less than as compared to the rural area.[13] So it's are replacing the traditional Cooking method with solar energy can be considered. The solar cooker is the best option to use solar energy for cooking. Solar cooking is an outdoor kitchen another ward it says that solar cooker is used on the outdoor field where solar recitation reaches the amount of heat and solar energy are used where fuel is low amount firewood and LPG. So solar cooking is often used in a situation where minimum fuel consumption is important and this cooking method is safe no types of danger or accidental fire is high, health and safe environmental

pollution and it is an alternative service.[9]present-day non-renewable energy available low quantity, so it has to use renewable energy i.e. renewable energy are available free of cost because they are available different types of source in this earth like wind, solar, water (hydro), biomass and geothermal, etc. solar and wind are. Cheaper no cost but solar energy is available in more than enough Amount in the surrounding area free of cost. So, that it can use solar energy as a better option for renewable energy sources. Cooking is the most important energy-consuming operation at home, in India mostly rural area housemaid used firewood as fuel but now day LPG is commonly used in rural and urban areas. , LPG and other energy sources are also using as fuel, but they are in low quantity it is compared to firewood in the urban region the firewood is less than as compared to the rural area. So it is replacing the traditional Cooking method with solar energy that can be considered. [10]The solar cooker is the best option to use solar energy for cooking. The solar cooker is an outdoor kitchen another word it says that solar cooker is used on the outdoor field but this paper study a portable steam cooker it is applicable into the kitchen .it knows that solar recitation reaches the amount of heat and solar energy is used as fuel. So solar cooking is often used in situations where minimal fuel consumption is important and this cooking method is safe no types of danger or accidental fire it is high, healthy, and safe environmental pollution and it is an alternative service. This paper provides a better understanding of solar steam cookers i.e. this steam cooker like a parabolic dish type steam cooker. Cooking solar energy is simple, safe, and convenient without consuming fuel and polluting the environment [5]

2. Research Objective

This experimental setup mainly uses from a composite climate in India. To provide useful feedback on the experiences of using large scale institutional solar steam cooking systems. It is proved the indoor cooking by solar energy. It has a better future for cooking in rural areas. In this setup assessed the performance of household type solar cookers. In this paper increase and Standardized cooking power and all measurement of performance are reported

3. Development of Experimental Setup

Solar steam cooker comprises the technology that converts heat concentrated from the parabolic thermal collector at an optical focal point utilized into heating the water inside the copper cylindrical tank kept at the focus, wherein all radiations are absorbed. Copper is an eminent component into solar thermal heating systems used and this thermal heating system boil water into the copper cylinder and this boiling water generates high-pressure steam this steam is applicable in the cooking system. This thermal heating system is complete two circuit primary circuits of solar collector circuit like solar heat collector and the secondary circuit is a steam cooker like a heat exchanger.

It comprises of following components in the making:

- Frame of parabola shape.
- Structural frame to support the parabola.
- Reflector sheet.
- Concentrator (Copper cylinder as boiler).
- Copper pipes.
- Flexible pipes.
- Tracking system

4. Operating Principle

Technically this parabolic dish help to reflected sunlight at a focal point the dish made by acrylic mirror sheet reflectivity approx. 90% and this focal point set on the copper cylinder (receiver) bottom this point connecter a black body. Copper cylinder ¼ bottom area painted black paint and upper area are insulated by glass wool, aluminum foil paper, and taps this concentrator copper cylinder work like a boiler. A plane mirror is used in a box-type solar cooker. But Concave mirrors are the best mirrors to use in these cookers.[11] because they are the only types of mirrors that reflect sunlight in towards a single focal point another word we say that a mirror surface has high reflectivity is used to concentrate light coming from sun on a small receiver area this cylinder ¼ filled water and this label maintains by the sump tank and top of the cylinder insulated copper tube and a pressure gauge connected this tube also connected by the steam cooker with controlling tab and the dish also automatically tracking by Wiper motor is very potency motor to be used in the experimental setup. The framework of the motor is tailored with a devious shaft that drives the oscillating mechanism through nylon gear. [15] typically design to achieve temperature 60o to 450o C on sunny day Sunlight concentrates on focal point on the bottom black surface of the cylinder temperature increase and approx. 450oC after 5 to 10 minutes water is boil and steam is generated this steam pressure control by the tab and softy valve and this steam utilize for cooking[14]

5. Observation

It's completed fabrication and installation work in the entire setup. After it, the dish was positioned in the south-facing at the angle of 260. Then starts the system and it starts the readings under the weather conditions. The thermocouple was attached at the bottom of the cylinder for the calculation of the outer surface temperature and another thermocouple is placed to take the reading of the water tank. And another thermocouple place into the steam cooker also a pressure gauge placed on the top of the cylinder to read the steam pressure all the readings are taken on May-June clear days on the top floor of the ISBM building in the energy lab of Suresh GyanVihar University, Jaipur. Some of the day's better performance is shown in blow tables and graphs.

6. Figures

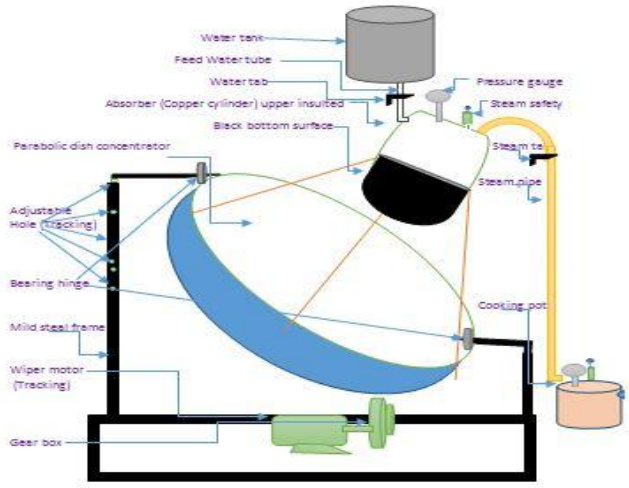


Figure 1: Parabolic Dish Type Solar Steam Cooker

Figure 2: Parabolic Dish Type Solar Concentrator

Figure 3: Copper Cylinder (Boiler)

6.1 Specifications of Experimental Setup

Table 1: Specification of experimental setup

S. No.	Components	Specifications
1.	Parabolic concentrating collector	Major Axis – 2a = 70.86 Inch Focal Point – 27.16 Inch
2.	Cu cylinder	Useful Volume 5litre Water Volume 3Litre
3.	Infrared thermometer	Range –100°C to 400°C
4.	General thermometer	0°C to 100°C
5.	Thermocouple	K type Range 0°C To 600°C
6.	Steam cooker	3 Liter
7.	Copper tube	3Mtr &10 mm Dia.
8.	No of Reflector Sheet	12 pieces
9.	Sheet Angle	30°

6.2 Reading of Solar Parabolic Dish Type Solar Cooker Day 1

Table 2: Reading of Solar Parabolic Dish Type Solar Cooker Day 1

South Facing-26° Humidity 16%

Time of Day (Hrs.)	Global Radiation (w/m^2)	Atmospheric Temp. (°C)	Wind Speed (m/s)	Cylinder Outer Surface Temp. (°C)	Water in-cylinder Temp. (°C)	Steam pressure (psi)
10:00	545	32.9	1.35	115.2	78.6	0.02
10:30	620	34.9	3.41	181.4	138.9	0.72
11:00	785	39.6	2.52	190.4	156.3	12.2
11:30	800	41.1	3.23	215.6	162.7	14.6
12:00	830	42.3	1.42	229.9	207.7	16.9
12:30	910	43.9	3.60	232.6	214.2	21.6
13:00	840	43.1	4.47	243.3	225.3	23.3
13:30	800	42.3	3.81	242.4	231.6	24.2
14:00	720	37.6	3.12	245	237.2	24.1
14:30	530	35.8	5.31	221.6	190.9	17.2
15:00	350	34.3	4.57	183.3	184.3	15.3
15:30	220	33.4	3.42	146.8	139.3	5.5
16:00	200	33.5	4.65	130.6	128.2	1.3

6.3 Reading of Solar Parabolic Dish Type Solar Cooker Day 2

Table 2: Reading of Solar Parabolic Dish Type Solar Cooker Day 2

South Facing-26^0 Humidity 14%

Time of Day (Hrs.)	Global Radiation (W/m^2)	Atmospheric Temp. (°C)	Wind Speed (m/s)	Cylinder Outer Surface Temp (°C)	Water in-cylinder Temp. (°C)	Steam pressure (psi)
10:00	750	35.9	3.21	140.2	119.6	0.04
10:30	780	36.2	2.65	161.4	130.9	08.9
11:00	850	39.6	2.86	190.4	172.3	14.2
11:30	870	42.2	1.69	205.6	192.7	14.7
12:00	835	41.9	1.87	219.9	197.7	18.9
12:30	850	43.9	1.98	225.6	214.2	22.6
13:00	860	43.3	2.47	233.3	229.3	23.3
13:30	850	42.8	2.65	232.4	224.6	23.1
14:00	730	38.1	3.12	205	193.2	20.2
14:30	700	35.9	4.54	181.6	170.9	19.2
15:00	340	34.2	3.43	163.3	154.3	10.7
15:30	300	34.7	2.29	146.8	139.3	08.7
16:00	350	35.6	2.00	132.6	118.2	02.6

6.4 Reading of Solar Parabolic Dish Type Solar Cooker Day 3

Table 3: Reading of Solar Parabolic Dish Type Solar Cooker Day 3

South Facing-26° Humidity 18%

Time of Day (Hrs.)	Global Radiation (W/m2)	Atmospheric Temp. (°C)	Wind Speed (m/s)	Cylinder Outer Surface Temp (°C)	Water in-cylinder Temp. (°C)	Steam pressure (psi)
10:00	625	33.9	1.63	119.8	111.4	0.9
10:30	770	33.2	2.78	121.4	118.9	04.9
11:00	840	37.4	2.36	190.4	169.3	12.3
11:30	890	40.9	1.54	225.8	212.3	17.2
12:00	875	42.1	1.49	239.9	227.8	21.2
12:30	700	42.5	2.68	242.6	234.2	22.8
13:00	880	43.6	1.47	243.2	236.7	24.3
13:30	960	47.4	3.73	252.4	237.9	25.2
14:00	830	46.6	4.87	225.2	201.8	20.1
14:30	710	44.7	4.84	171.2	160.9	19.2
15:00	600	39.8	3.97	133.3	124.5	11.3
15:30	610	37.4	6.29	126.8	119.3	04.8
16:00	470	35.8	6.27	110.6	98.2	0.4

6.5 Reading of Solar Parabolic Dish Type Solar Cooker Day 4

South Facing-26° Humidity 17%

Time of Day (Hrs.)	Global Radiation (W/m2)	Atmospheric Temp. (°C)	Wind Speed (m/s)	Cylinder Outer Surface Temp (°C)	Water in-cylinder Temp. (°C)	Steam pressure (psi)
10:00	585	29.7	1.95	97.8	85.6	0.03
10:30	860	32.8	2.61	151.4	119.2	08.72
11:00	820	38.6	2.96	180.4	166.3	13.23
11:30	890	40.9	3.34	215.8	203.9	20.6
12:00	895	44.3	3.45	239.1	227.7	21.2
12:30	910	45.9	2.12	252.6	244.2	24.6
13:00	900	44.6	1.00	243.9	235.0	24.8
13:30	840	42.8	2.16	222.6	211.0	17.0
14:00	760	38.2	3.24	205.2	193.2	14.1
14:30	610	36.8	5.32	181.6	179.8	12.2
15:00	545	35.1	2.84	143.3	134.3	10.3
15:30	640	35.4	6.18	116.1	119.3	06.7
16:00	390	34.5	6.37	109.7	97.2	0.6

Table No.5 Reading of Solar Parabolic Dish Type solar cooker Day 4

6.6 Reading of Solar Parabolic Dish Type Solar Cooker Day 5

South Facing-26° Humidity 16%

Time of Day (Hrs.)	Global Radiation (W/m²)	Atmospheric Temp. (°C)	Wind Speed (m/s)	Cylinder Outer Surface Temp (°C)	Water in-cylinder Temp. (°C)	Steam pressure (psi)
10:00	535	31.1	4.73	88.2	65.6	0.02
10:30	640	33.7	3.64	127.9	99.9	0.05
11:00	780	35.6	2.45	220.4	189.3	07.8
11:30	810	36.1	2.17	237.6	221.7	14.2
12:00	885	37.3	2.61	239.9	231.9	18.8
12:30	926	40.9	2.43	241.2	234.2	24.1
13:00	890	43.1	1.87	256.1	249.2	25.3
13:30	890	42.3	2.15	253.9	241.6	22.9
14:00	860	39.6	2.21	225.9	183.9	17.8
14:30	760	36.2	3.42	181.7	170.6	14.7
15:00	620	34.2	3.67	191.3	154.3	11.9
15:30	580	32.2	2.42	186.2	139.6	09.8
16:00	510	32.1	2.32	160.4	121.2	02.9

Table No.6 Reading of Solar Parabolic Dish Type solar cooker Day 5

6.7 Reading of Solar Parabolic Dish Type Solar Cooker Day 6

South Facing-26° Humidity 16%

Time of Day (Hrs.)	Global Radiation (W/m²)	Atmospheric Temp. (°C)	Wind Speed (m/s)	Cylinder Outer Surface Temp (°C)	Water in-cylinder Temp. (°C)	Steam pressure (psi)
10:00	605	30.9	3.10	99.2	88.7	0.02
10:30	710	32.0	3.25	125.6	104.9	0.82
11:00	790	32.8	3.90	150.9	136.3	11.2
11:30	880	36.1	2.00	185.6	152.7	14.6
12:00	935	40.6	2.35	219.9	207.9	18.1
12:30	960	43.8	1.20	233.6	217.1	23.3
13:00	820	43.1	2.79	243.3	235.9	24.3
13:30	740	41.3	3.24	252.4	241.7	24.8
14:00	710	38.1	5.66	247.8	236.2	23.7
14:30	670	35.8	4.42	241.6	230.9	21.2
15:00	500	32.3	4.65	188.3	184.3	14.3
15:30	550	33.9	5.15	138	115.5	05.8
16:00	490	33.4	4.42	120.5	100.2	01.9

Table No.7 Reading of Solar Parabolic Dish Type solar cooker Day 6

6.8 Reading of Solar Parabolic Dish Type Solar Cooker Day 7

South Facing-26° Humidity 18%

Time of Day (Hrs.)	Global Radiation (W/m²)	Atmospheric Temp. (°C)	Wind Speed (m/s)	Cylinder Outer Surface Temp(°C)	Water in-cylinder Temp. (°C)	Steam pressure (psi)
10:00	865	33.2	2.50	120.2	101.9	0.02
10:30	795	33.7	1.12	197.4	157.1	0.65
11:00	830	37.2	2.32	201.4	199.3	06.2
11:30	870	40.1	2.17	232.6	205.1	17.7
12:00	865	42.7	3.42	241.4	217.3	21.9
12:30	940	45.1	2.75	252.8	244.2	24.1
13:00	880	43.6	1.10	253.3	245.1	24.3
13:30	850	41.9	2.35	212.9	181.7	23.4
14:00	760	38.8	3.60	195.5	153.3	17.9
14:30	720	34.8	4.55	161.6	130.2	10.9
15:00	640	33.7	4.73	135.7	129.5	06.7
15:30	550	32.4	4.65	129.1	119.3	02.3
16:00	360	31.5	5.21	99.0	82.6	00.5

Table No.8 Reading of Solar Parabolic Dish Type solar cooker Day 7

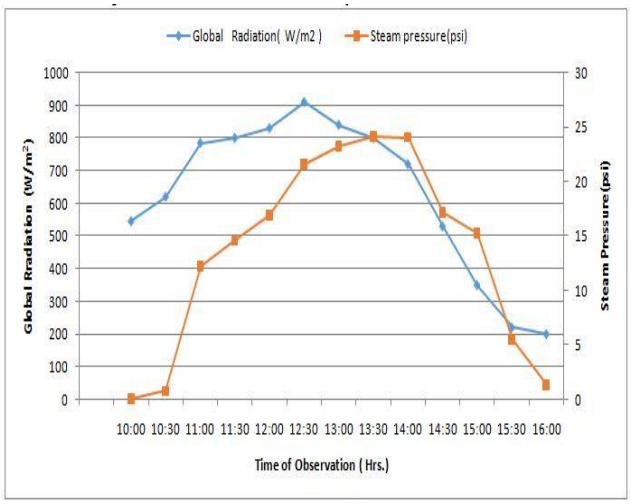
6.9 Reading of Solar Parabolic Dish Type Solar Cooker Day 8

South Facing-26° Humidity 21%

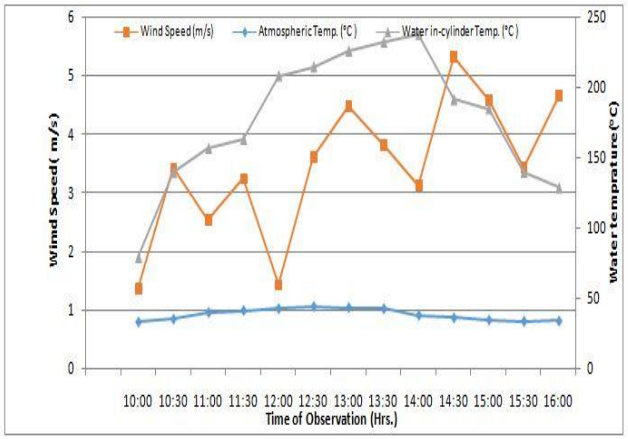
Time of Day (Hrs.)	Global Radiation (W/m²)	Atmospheric Temp. (°C)	Wind Speed (m/s)	Cylinder Outer Surface Temp (°C)	Water in-cylinder Temp. (°C)	Steam pressure (psi)
10:00	530	28.6	2.15	85.6	65.2	0.02
10:30	635	30.2	2.21	105.3	95.1	0.04
11:00	710	32.5	1.86	145.4	131.7	04.4
11:30	745	36.1	2.94	214.6	198.1	16.2
12:00	770	39.9	2.41	235.8	215.6	22.2
12:30	815	42.1	1.75	245.4	225.6	23.9
13:00	865	42.9	1.47	245.9	230.9	24.3
13:30	870	43.3	2.85	220.6	216.2	18.2
14:00	780	39.4	3.88	185.1	150.2	13.6
14:30	720	38.2	4.64	172.7	139.8	10.1
15:00	640	35.1	3.57	145.2	122.3	06.2
15:30	420	34.4	1.42	125.3	113.2	03.6
16:00	310	33.9	2.20	110.5	99.3	00.4

Table No.9 Reading of Solar Parabolic Dish Type solar cookerDay 8

6.10 Overall Graph of the Different Parameters for Day 1

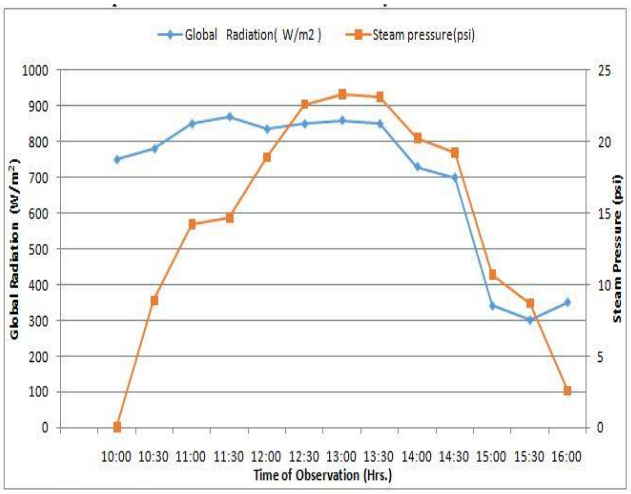


Graph No. 1 Day1 Variations of Global Radiation Steam Pressure with Solar Cooker Penal

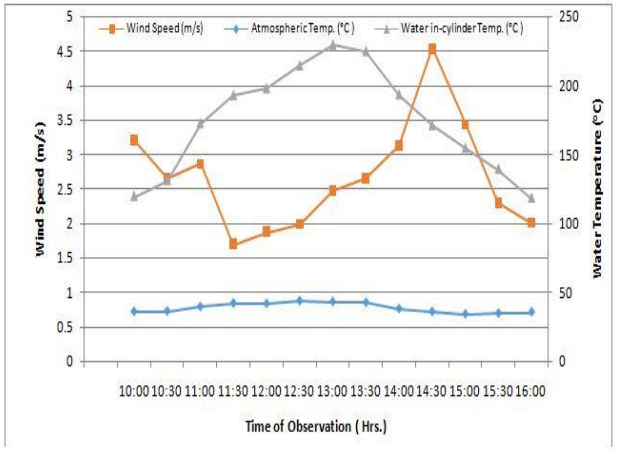


Graph No. 2 Day1 Variations of Water Temperature, Atmospheric Temperature, and Wind Speed with Solar Cooker Penal

6.11 Overall Graph of the Different Parameters for Day 2

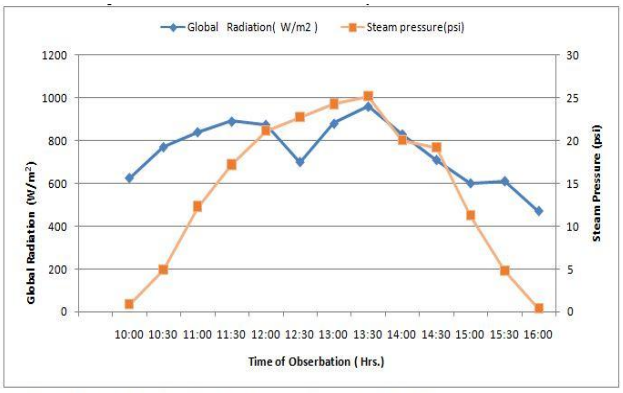


Graph No. 3 Variations of Global Radiation Steam Pressure with Solar Cooker Penal Day 2

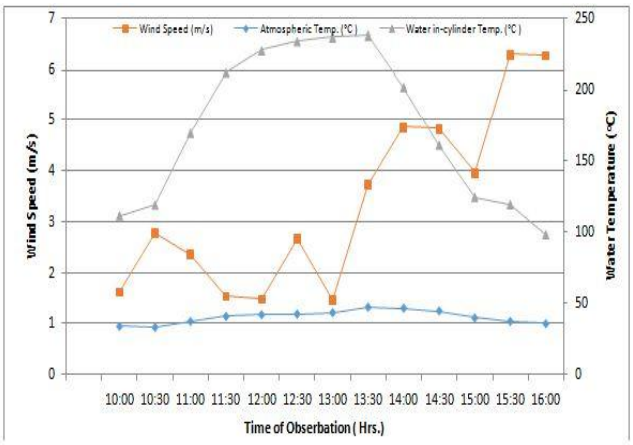


Graph No. 4 Variations of Water Temperature, Atmospheric Temperature, and Wind Speed with Solar Cooker Penal Day 2

6.12 Overall Graph of the Different Parameters for Day 3

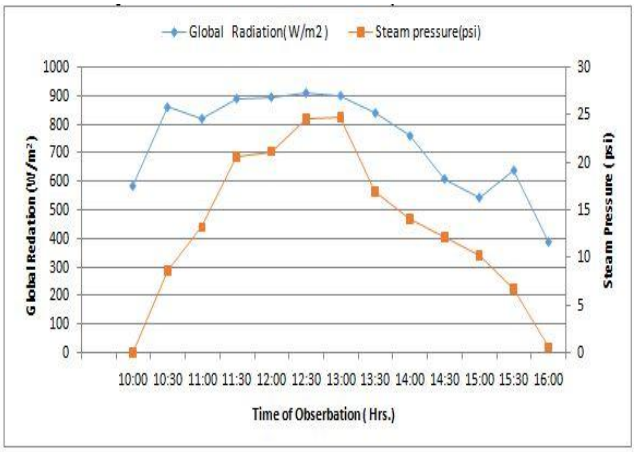


Graph No. 5 Variations of Global Radiation Steam Pressure with Solar Cooker Penal Day 3

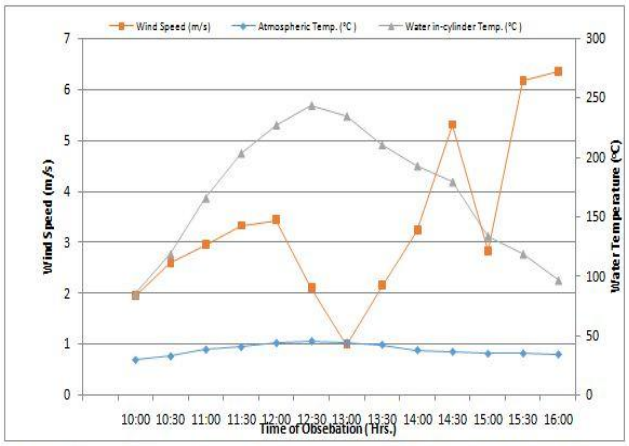


Graph No. 6 Variations of Water Temperature, Atmospheric Temperature, and Wind Speed with Solar Cooker Penal Day 3

6.13 Overall Graph of the Different Parameters for Day 4

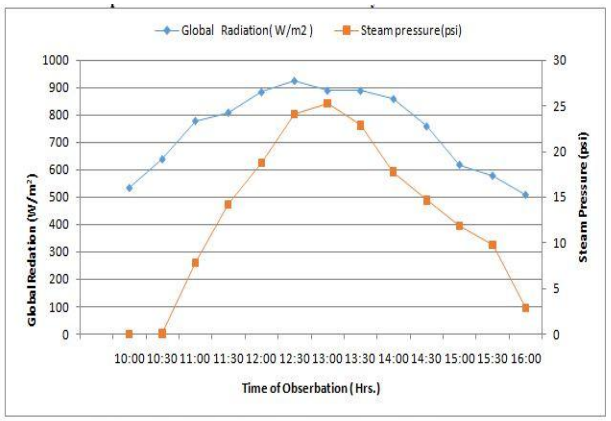


Graph No. 7 Variations of Global Radiation Steam Pressure with Solar Cooker Penal Day 4

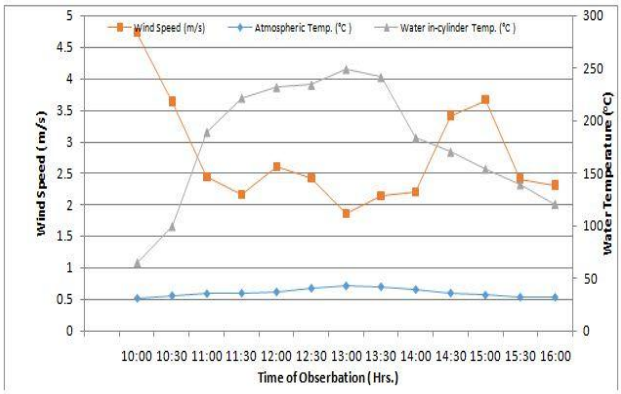


Graph No. 8 Variations of Water Temperature, Atmospheric Temperature, and Wind Speed with Solar Cooker Penal Day 4

6.14 Overall Graph of the Different Parameters for Day 5

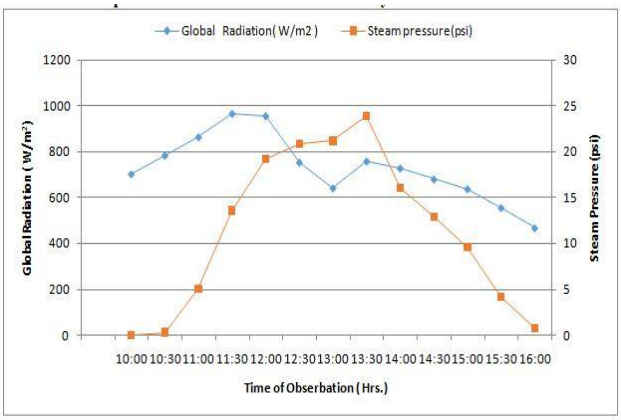


Graph No. 9 Variations of Global Radiation Steam Pressure with Solar Cooker Penal Day 5

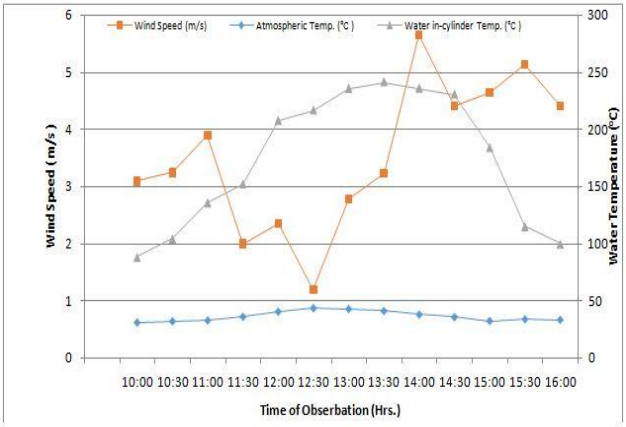


Graph No. 10 Variations of Water Temperature, Atmospheric Temperature, and Wind Speed with Solar Cooker Penal Day 5

6.15 Overall Graph of the Different Parameters for Day 6

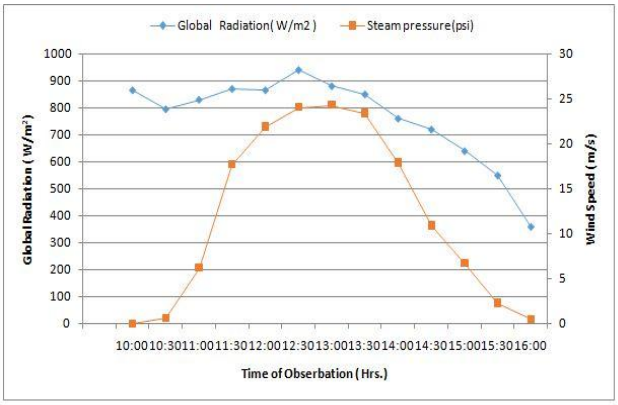


Graph No. 11 Variations of Global Radiation Steam Pressure with Solar Cooker Penal Day 6

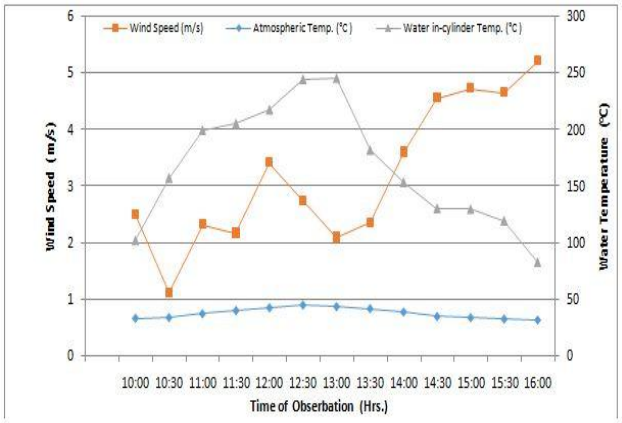


Graph No. 12 Variations of Water Temperature, Atmospheric Temperature, and Wind Speed with Solar Cooker Penal Day 6

6.16 Overall Graph of the Different Parameters for Day 7

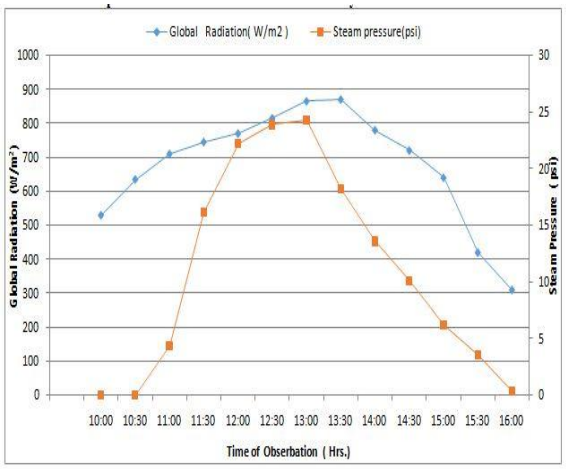


Graph No. 13 Variations of Global Radiation Steam Pressure with Solar Cooker Penal Day 7

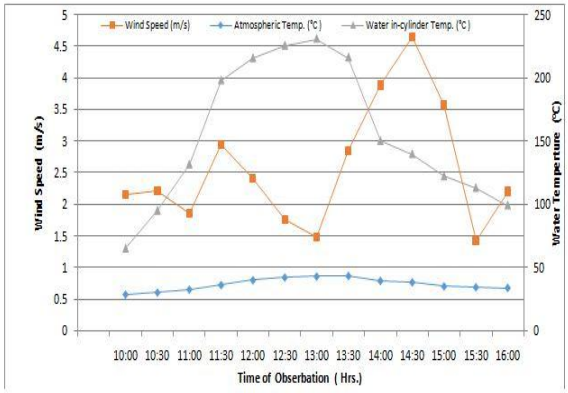


Graph No. 14 Variations of Water Temperature, Atmospheric Temperature, and Wind Speed with Solar Cooker Penal Day 7

6.17 Overall Graph of the Different Parameters for Day 8



Graph No. 15 Variations of Global Radiation Steam Pressure with Solar Cooker Penal Day 8



Graph No.16 Variations of Water Temperature, Atmospheric Temperature, and Wind Speed with Solar Cooker Penal Day 8

7. Results and Discussion

This paper deals with the results in the form of graphs as shown in figures 5-11. The graphs are obtained by the experimental work on the parabolic dish in a ray concentrator by using the water as working on the steam cooker. This paper mainly deals in, the increasing or decreasing in solar radiation, the whole day increasing, and decreasing the temperature is been recorded. On this setup are all design and fabrication pare meters that are a consideration with the climate condition of Rajasthan Jaipur. All fabrication work on the side. All measuring equipment is calibrated .so it found all data are almost corrected. When it runs the setup found good results. Calculated in the following results then find the annual amount of steam generated is estimated to vary between 150 and 540 kg per m2 area of concentrator parabolic dish. The above results discuss in May-June Month. It achieved more than 2bar steam pressure and 256oC temperature With the Portable parabolic dish type solar steam cookers in the composite climate

In these graphs, the orange line shows the steam pressure (psi) and on the blue line shows the global radiation in (W/m2), and at the bottom side of the graph shows the time.

In this Paper all work on an experiment and find some good results. In Rajasthan (India) Sun is Inclined at 26oC to 27oC and the maximum area is a dessert so the temperature is more than 45oC in summer and global radiation is reaching more than 1000 W/m2. Their climate is the heating zone. Then the solar energy is available in large quantities. So this setup is performance is good and it achieves more than 256oC temperature and 2 bar Pressure for cooking purposes. When it uses Nano-fluid the steam temperature is high so the pressure is also high but it is no used for cooking. Because Nano-fluid (ALO3) is pollutant content. So it is using other applications.

Boiling Preparation of

- Pulses (Dal)
- Stew (Sāmbhar)
- Kidney beans
- Vegetables
- Milk
- Tea

Steaming Preparation of

- Idle
- Rice
- Misc.
- Hot Water for Cleaning.

8. Conclusion

In this paper, the study of a portable parabolic dish type solar steam cooker for domestic use has been done. Also, an explanation has given about the working and construction of a portable parabolic dish type solar steam cooker and its advantages and disadvantages. There are many aspects of solar Steam cooker require development and that should be subject for working in the future. But steam Cookers are not working at night but by using thermal storage will be possible in future

9. Future Scope

In the Future this setup is used as thermal storage and Domestic type Steam power Generation. It is increasing water Temperature to use Nano-fluid particles. It increases the latent heat of water with the help of Nano-fluid. This setup is used as a domestic type of solar steam power plant high-pressure steam is heat up with the help of an external source of heat. It increases the supersaturated point and throws the turbine blade and generates power. These setups are moderated and generate the steam various form and utilize many kinds of steam applications in future scope.

References

[1] FA Al-Sulaiman" Energy analysis of parabolic trough solar collectors integrated with combined steam and organic Rankine cycles" Energy Conversion and Management, 2014 – Elsevier.

[2] Kumaresan G., Raju G., Iniyan S., Velraj R. "CFD analysis of flow and geometric parameter for a double-walled solar cooking unit" Applied Mathematical Modeling January 2015.

[3] M.R. Patil and P.S. Patil, Techno-Economic Assessment of solar steam cooking system, April 2016.

[4] NdiagaMbodji, Ali Hajji "Performance Testing of a Parabolic Solar Concentrator for Solar Cooking" J. Sol. Energy Eng. Aug 2016, 138(4): 041009

[5] Craig, O., and Dobson, R. T. "Parabolic Solar Cooker: Cooking with Heat Pipe vs. Direct Spiral Copper Tubes." in AIP Conference Proceedings, 160004, 2016.

[6] LameckNkhonjera, Tunde Bello-Ochende' Geoffrey John, Cecil K. King'ondu "A review of thermal energy storage designs, heat storage materials and cooking performance of solar cookers with heat storage" Renewable and Sustainable Energy ReviewsAugust 2017.

[7] GhassanZubi, FilippoSpertino, Monica Carvalho, Tamer Khatib "Development and assessment of a solar home system to cover cooking and lighting needs in developing regions as a better alternative for existing practices" Solar Energy October 2017.

[8] DawangevSahebrao "Renewable Energy Technology: A Case Study of Solar Steam Cooking System" ShriSaibabaSansthan Trust, Shirdi, MS, India. Int. Res. J. of Science & Engineering, Special Issue A4, January 2018.

[9] Sunil Indora, Tara C. Kandpal "Institutional cooking with solar energy: A review" Renewable and Sustainable Energy Reviews March 2018.

[10] Atul G. Bhave, Kavendra A. Thakare" Development of a solar thermal storage cum cooking device using salt hydrate"Solar Energy1 September 2018.

[11] Rodrigo Bonilla Mariano, Jose VctorGalaviz Rodriguez, Jonny Carmona Reyes" Solar Kitchen"International Journal of Science and Research (IJSR) ISSN: 2319-7064 Volume 7 Issue 11, November 2018.

[12] In Zhou, Xiuqiang Li, George W. Ni, Shining Zhu and Jia Zhu "The revival of thermal utilization from the Sun: interfacial solar vapor generation" National Science Review 6: 562–578, 2019 DOI: 10.1093/nsr/nwz030 Advance access publication 4 March 2019.

[13] Sunil Indora, Tara C. Kandpal "Financial appraisal of using Scheffler dish for steam-based institutional solar cooking in India" Renewable Energy May 2019.

[14] Ramalingam Senthil "Enhancement of productivity of parabolic dish solar cooker using integrated phase change material" Renewable and Sustainable Energy Reviews 9 March 2020.

[15] Atul G. Bhave, Chirag K. Kale "Development of a thermal storage type solar cooker for high-temperature cooking using solar salt "Solar Energy Materials and Solar Cells May 2020.

[16] P. K. Devan, ChidambaranathanBibin, S. Gowtham, R. Hariharan " A comprehensive review on solar cooker with sun tracking system" Renewable Energy22 July 2020.

[17] Seth M. Ebersviller, James J. Jetter "Evaluation of performance of household solar cookers"Solar Energy15 September 2020.

[18] U.C. Arunachala, Ashok Kundapur"Cost-effective solar cookers: A global review" Solar Energy1 September 2020.