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IMPROVING EFFICIENCYOF SOLAR PANELBY COOLING TECHNIQUE

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ABSTRACT

Now a day's development of Renewable energy Industry has become the need of the society. Non-conventional energy is clean, pollution free and eco-friendly source of energy. Among the various sources of energy solar energy is the mother of all forms of energy. Due to high temperature Photovoltaic module experiences short effect (efficiency loss) and long effect (permanent damage) degradation. Therefore Cooling of Photovoltaic is one of the main concerns for enhancing the performance of the PV system. Photovoltaic electricity is generated by receiving solar irradiance. The electrical efficiency of solar cell generates photovoltaic (PV) cell is adversely affected by the significant increase of cell operating temperature during absorption of solar radiation. The objective of the present work is to reduce the temperature of the solar cell in order to increase its electrical conversion efficiency. Experiments were performed with or without water cooling. A linear trend between the efficiency and temperature was found. Without cooling the temperature of the panel was high and solar cell achieved an efficiency of 8-9%. However when the panel was operated under water cooling condition, the temperature dropped maximally by 4°C leading to an increase in efficiency of solar cells by 12%.Thus research paper explains a practical approach to enhance the efficiency of solar panel by the use of cooling mechanism. Experimental results indicates appreciable enhancement in overall output of solar panel.

KEYWORDS: Automation Cooling Technique, Solar Energy, Solar PV Panel, Temperature, Voltage Efficiency, Sunlight peak hours, Water Soaking Foam.

1. INTRODUCTION

Solar energy in 1 hour is the energy used in 1 year globally, considering the solar constant 1.7 x10^5TW at the top of the earth's atmosphere. However, the solar energy incidence, around 1 kW/m^2, is quite dilute and requires vast area of energy converters to meet the world's energy consumption. The current world's consumption of electric energy is around 12-13 TW and the earth receives more than that but energy conversion is crucial. Solar cells, also called photovoltaic are devices of converting the energy of the sunlight into electricity by the photovoltaic effect discovered by the French scientist Henri Becquerel in 1839. Electron-hole pairs are generated by the energy of the incident photons overcoming the energy band gap of the photovoltaic material to make a current flow. Solar cells have been recognized as an important alternative power source especially since the 1970's after oil crises. Solar cells are also promising as a carbon-free energy source to suppress the global warming. The energy conversion efficiency of a solar cell is defined as the ratio of the electric power generated by the solar cell to the incident sunlight energy into the solar cell per time. Currently the highest reported cell efficiencies in laboratories are around 40% while the energy conversion efficiencies for thermal power generation can exceed 50%. This fact however never means the superiority of thermal generation since its resources such as fossil fuels are limited while the solar energy is essentially unlimited. Everyday sun sends out tremendous amount of energy in the form of heat and radiations called solar energy. Solar energy is a limitless source of energy which is available at no cost. The major benefit of solar energy over other conventional power generators is that the sunlight can be directly harvested into solar energy with the use of small and tiny photovoltaic (PV) solar cells.

2. PROBLEM DEFINITION

The sun offers the most abundant, reliable and pollution-free power in the world. However, problems with solar energy, namely the expensive cost and inconsistent availability, have prevented it from becoming a more

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utilized energy source. Another problem, it is well known that a decrease in the panel temperature will lead to an increase in electrical efficiency, so in recent years different cooling techniques have been proposed and tested experimentally. The efficiency drops with the rise in temperature, with a magnitude of approximately 0.5 %/°C. Increase in electrical efficiency depends on cooling techniques, type and size of the module, geographical position and the season of the year, and usually corresponds with a rise of 3-5 % in overall efficiency. In water cooling technique, amount of water consumption plays an important role. So in this work, efficient water cooling technique is proposed to improve solar panel life time along with reduced power to drive the water cooling system.

3. METHODS

This technique can be named as water spray cooling technique. This analysis is based on following methods i.e.

A. Without water cooling
B. Water cooling.

Figure:-

Without cooling fig.(a)

4. WORKING

The performance under concentrated solar radiation the performance of solar cell reduces 50% when its temperature rises from 46̊C to 84̊C and when the ultraviolet rays is coming from the sun on the up (photovoltaic cell) in under natural cooling the temperature on the panel should be calculated is more and the efficiency of the panel is lower as compare to the normal temperature greater than 45̊C.The temperature is above 60̊C because of that the output temperature is low and the efficiency is less. All about of these reasons we use cooling techniques to solve the problem of temperature increasing. We use flow of water under the surface of the panel where a water soaking agent (foam) is attached because of that the whole water flow from the pipe is sucked and the flow of surrounding air may cool the panel. In our research we practical the whole setup in free area where the solar panel may be installed as same as the condition it may suffer everywhere solar rays coming directly

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without any irradiance. After the cooling the temperature on the surface of the panel is about 40℃ to 42℃ the efficiency is also may increases. Therefore, an efficient cooling system is quite essential to maximize solar cell's efficiency and to prevent the cell from degradation and damage. Photovoltaic panels can be cooled actively or passively. The difference between active and passive is that active system requires some external power source to run while passive system needs no additional power source. Improving solar panel efficiency data is based on experimental data (reading and graphs) obtained from different cooling techniques. All these readings were recorded during three bright sunny days of month April. A poly crystalline solar panel made of silicon semiconductor was used for this experiment. A soft soaking agent which soak the water called foam is attach in the inside of the panel and also there is a installation of water pipe sprayer in the upper side through which the water ma continuous the foam is wet every time in the sunny environment and it may continuous cool the panel and temperature not raised up to 42℃.The whole setup is installed under the supervision of our guider and also the readings is noted with perfection the instrument which measure the reading is also approved by the mentor. A plastic pipe with holes of 1 cm of difference was fixed over the solar panel from a water tank which was filled by an electric motor.

With Cooling fig.(b)

5. RESULTS AND DISCUSSION

Without Cooling (Sample Calculation)

EFFICIENCY = $V \times I / A \times R$

= (8*4.69)/(0.677*877)

=6.42

Where V= Voltage (V)

I= Current (A)

A= Cross section Area (m2)

R= Solar Irradiance (W/m2)

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WITH OUT COOLING Table (3.1)

Time	Voltage (v)	Current (A)	Intensity	Temp.1 (°C)	Temp.2 (°C)	Temp.3 (°C)	Temp.4 (°C)	Average Temp. (°C)	Power (w)	Efficiency
11:00	8.00	4.69	870	67	62	69	64	65.5	37.52	6.42
11:20	8.32	4.75	872	71	67.4	74	58.4	67.7	41.94	6.74
11:30	8.42	4.76	874	69	61.5	72	58	65.12	40.07	6.82
11:45	8.82	5.17	878	71	67.3	75	71.3	69.65	45.54	7.73
12:00	8.88	5.12	876	74	72.9	75	72.3	73.55	45.46	7.48
12:30	9.02	5.22	904	71	68.8	69	69.4	69.55	47.08	7.75
12:40	8.71	4.93	880	64	68.6	67	67.2	67.45	42.94	7.26
12:50	9.85	5.02	890	66	67.6	68	66.8	67.35	9.44	8.27

WITH COOLING Table (3.2)

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Time	Voltage (v)	Current (A)	Intensity	Temp.1 (°C)	Temp.2 (°C)	Temp.3 (°C)	Temp.4 (°C)	Average Temp. (°C)	Power (w)	Efficiency
11:00	10.00	5.00	866	30	30	34	34	31.5	50	8.59
11:15	10.34	5.01	870	30	30	30.8	30.8	30.37	51.80	8.86
11:30	11.00	5.18	903	30	31	32.6	32.6	31.4	56.98	9.12
11:50	11.82	5.78	925	31	31	34	34	32.07	68.31	10.94
12:00	11.53	5.05	923	31	30	35	35	32.55	53.17	8.57
12:10	10.50	4.00	855	30	30	32	34	31.75	51.45	8.45
12:30	9.94	4.20	876	30	31	31	30	31.5	41.74	7.34
12:40	10.45	4.33	860	29	29	29.6	28.8	29.4	50.47	8.73
12:50	10.64	4.85	850	30	29	28.3	33	29.02	51.60	9.03
1:00	10.58	4.67	862	28	28	28	29.2	29.25	49.40	8.53
1:20	10.56	4.45	810	29	29	30	29.3	29.3	46.99	8.63
1:40	10.54	4.18	807	29	29	30	29.8	29.45	44.05	8.12

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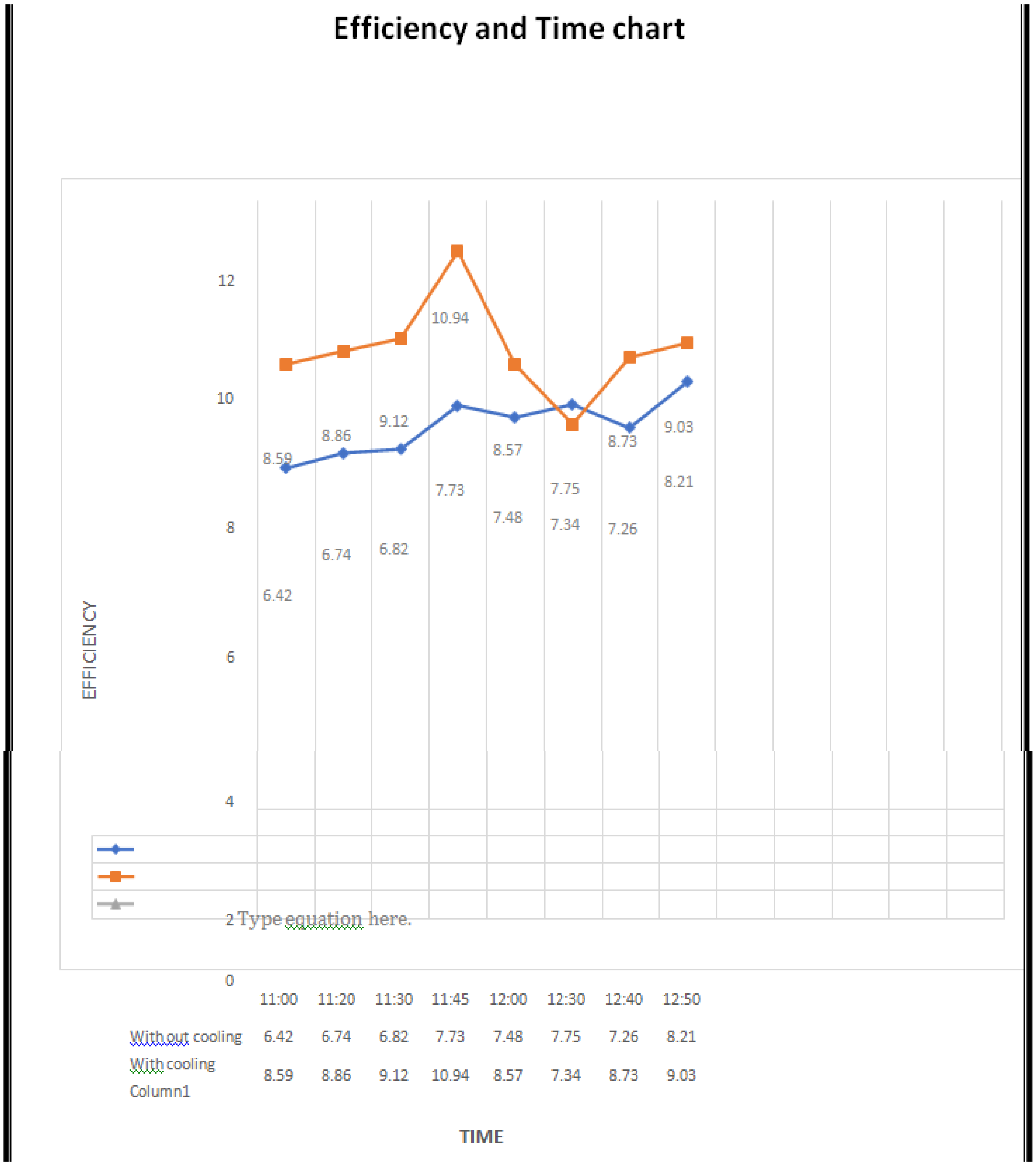
1:50	10.56	4.20	803	29	29	32.4	32.2	30.65	44.35	8.23



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Temperature and Time chart

Time	Voltage (v)	Current (A)	Intensity	Temp.1 (°C)	Temp.2 (°C)	Temp.3 (°C)	Temp.4 (°C)	Average Temp. (°C)	Power (w)	Efficiency
10:20	10.01	4.12	712	44	40	47	45	44	41.24	8.62
10:30	9.73	4.32	814	42	47	48	42	44.75	42.03	7.68
10:40	9.71	4.48	806	40	45	44	39	42	43.50	8.30
10:50	9.67	4.60	805	41	46	43	40	42.5	44.48	8.22
11:00	9.66	4.68	832	42	47	42.7	43	43.67	45.20	8.03
11:10	9.60	4.79	822	46	50	43.2	39	44.55	45.98	8.32
11:20	9.57	4.97	836	47	52	45.4	43	46.85	47.56	8.46
11:30	9.54	4.99	840	50	54	47.7	52.4	51.02	47.60	8.43
11:40	9.49	5	850	49	54	55.2	52.9	52.77	47.45	8.31
11:50	9.44	5.13	880	47	53	57	53	52.5	48.42	8.19
12:00	9.41	5.14	905	51	57	60.3	54.1	55.6	48.36	7.95
12:50	9.42	5.02	822	50	56	59	53	54.5	47.28	8.56
1:25	9.54	4.99	790	49	53	57	48.2	51.8	47.60	8.97

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Without Cooling

Time	Voltage (v)	Current (A)	Intensity	Temp.1 (°C)	Temp.2 (°C)	Temp.3 (°C)	Temp.4 (°C)	Average Temp. (°C)	Power (w)	Efficiency
10:20	10.01	4.12	712	44	40	47	45	44	41.24	8.62
10:30	9.73	4.32	814	42	47	48	42	44.75	42.03	7.68
10:40	9.71	4.48	806	40	45	44	39	42	43.50	8.30
10:50	9.67	4.60	805	41	46	43	40	42.5	44.48	8.22
11:00	9.66	4.68	832	42	47	42.7	43	43.67	45.20	8.03
11:10	9.60	4.79	822	46	50	43.2	39	44.55	45.98	8.32
11:20	9.57	4.97	836	47	52	45.4	43	46.85	47.56	8.46
11:30	9.54	4.99	840	50	54	47.7	52.4	51.02	47.60	8.43
11:40	9.49	5	850	49	54	55.2	52.9	52.77	47.45	8.31
11:50	9.44	5.13	880	47	53	57	53	52.5	48.42	8.19
12:00	9.41	5.14	905	51	57	60.3	54.1	55.6	48.36	7.95
12:50	9.42	5.02	822	50	56	59	53	54.5	47.28	8.56
1:25	9.54	4.99	790	49	53	57	48.2	51.8	47.60	8.97

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Time	Voltage (v)	Current (A)	Intensity	Temp.1 (°C)	Temp.2 (°C)	Temp.3 (°C)	Temp.4 (°C)	Average Temp. (°C)	Power (w)	Efficiency
10:20	10.96	4.14	715	28	28	27	28	27.75	45.37	9.4
10:30	10.68	4.34	722	29	29	29	28	28.75	46.35	9.55
10:40	10.33	4.50	748	34	35	35.1	33.1	34.3	46.48	9.25
10:50	10.47	4.62	750	33	31	31.7	31.1	31.7	48.37	9.6
11:00	10.38	4.70	772	36	34	35.2	32.6	34.45	48.78	9.40
11:10	10.54	4.81	775	31	31	29.1	32	30.77	50.69	9.73
11:20	10.45	5	825	30	32	34	29	31.25	52.25	9.42
11:30	10.39	5.10	815	35	35	34	33	34.25	52.98	9.67
11:40	10.29	5.02	845	38	37	33.8	35.2	36	51.65	9.09
11:50	10.25	5.15	888	38	41	32	35	36.5	52.78	8.84
12:00	10.17	5.20	890	40	40	38	38	39	52.88	8.84
12:50	10.12	5.25	933	44	48	48	46	46.5	53.13	8.47
1:25	9.97	4.99	790	43	41	43.5	42.93	42.60	49.75	9.34

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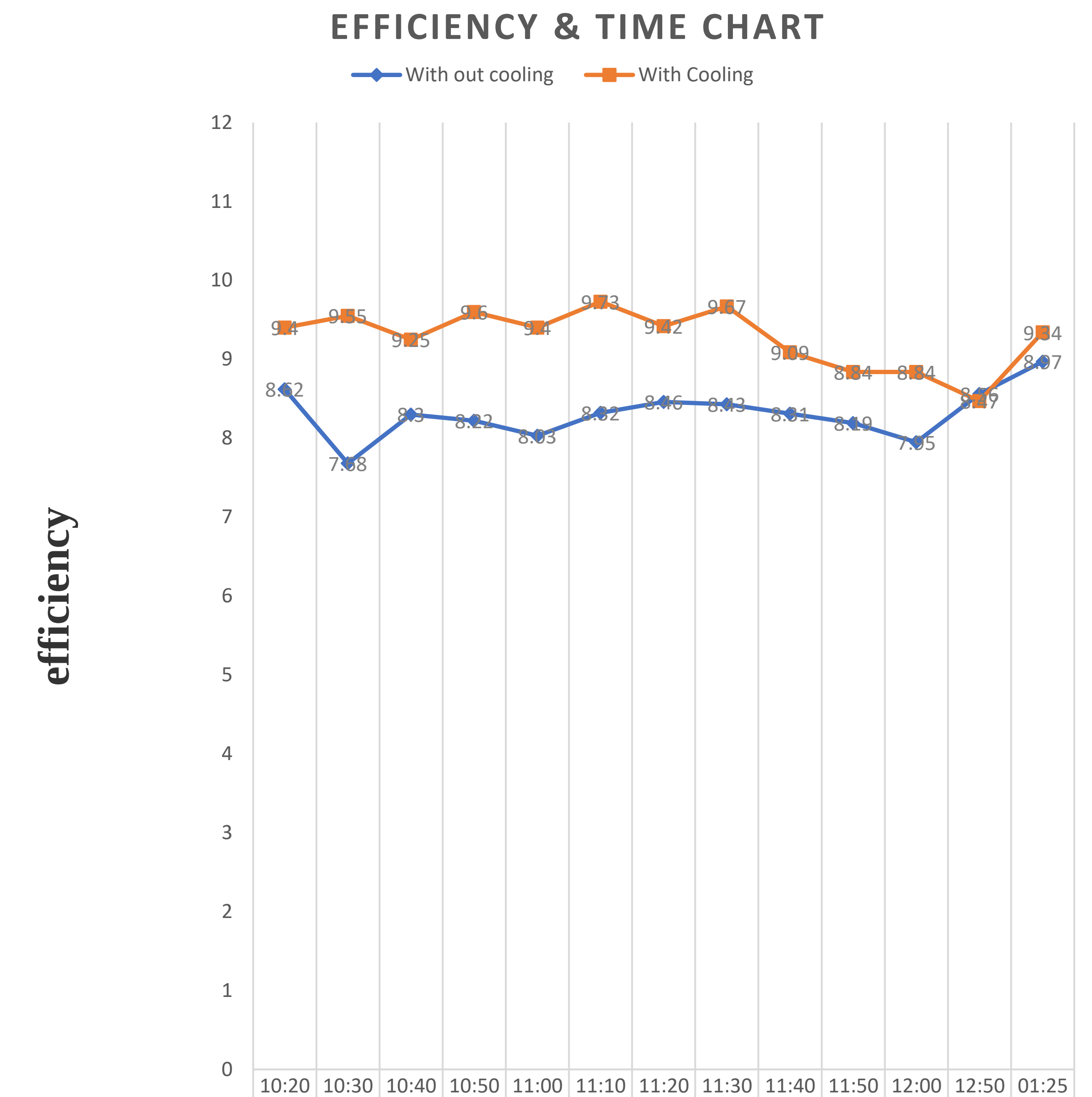
Efficiency & Time chart



	10:20	10:30	10:40	10:50	11:00	11:10	11:20	11:30	11:40	11:50	12:00	12:50	01:25
With out cooling	8.62	7.68	8.3	8.22	8.03	8.32	8.46	8.43	8.31	8.19	7.95	8.56	8.97
With Cooling	9.4	9.55	9.25	9.6	9.4	9.73	9.42	9.67	9.09	8.84	8.84	8.47	9.34

Time

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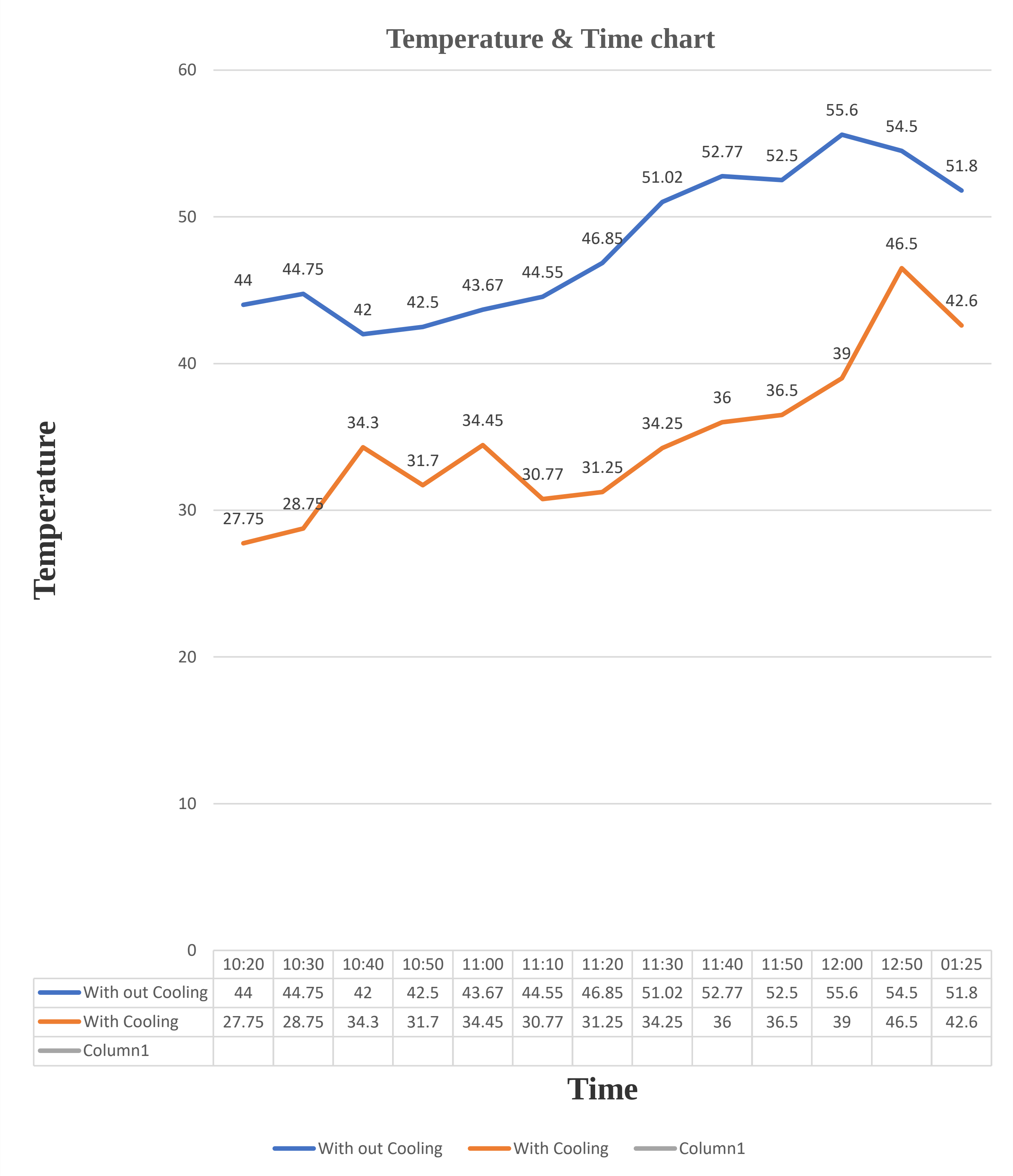
Temperature & Time chart



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6. CONCLUSION

In this research, the performance of PV panels was enhanced by developing an efficient cooling system. The comparison had been made between the output from the PV panels with and without using the cooling system. The objective was to cool the PV panel with the least amount of water and energy. A non-pressurized cooling system was developed based on spraying the PV panels by water. The experimental setup developed to create an effective model that significantly improved the output of the PV cell and to study the influence of cooling on the performance of PV panels.

In overall the system consumed much power than the solar panel actually could have been produced. But the same system can be implemented in much larger solar panel system and then the cooling system would be beneficial and efficient for the solar cell.

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