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Original Article

Experimental Analysis of Evaporative cooler using Solar Energy

Mr. Mukesh D. Bankar[1], Mr. Akash B. Gawade[2], Mr. Dattatray J. Sangale[3]
[1,2,3]First-Third Mechanical Department, First-Third MSBTE, Shrimant Shivaji Raje Nagar-Thakurki Phaltan, Dist-Satara (Maharashtra), India

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Correspondence Address:
First-Third Mechanical Department, First-Third MSBTE, Shrimant Shivaji Raje Nagar-Thakurki Phaltan, Dist-Satara (Maharashtra), India
mukesh.bankar38@gmail.com

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Abstract

Evaporative coolers are required for cooling purpose in summer. Large amount of energy used for their operation. Solar operated evaporative cooler will save this electricity and also will be beneficial where there is shortage of electricity. The main objective is to compare operating cost for evaporative cooler operating on electricity and solar energy.

Keywords: *Evaporative cooler, solar energy, electricity, operating cost.*

Introduction

Solar Power is an economically and environmentally sound source of renewable energy. As a society, we are beginning to understand that it is important to open up to new concepts of energy production. Solar Power plants convert the sun's energy into solar electricity. The sun is the largest source of energy in the form of heat and light energy. Solar Power has a huge potential to make a major impact on the electricity requirement in homes and industries. That the sun supplies as much energy onto the earth in a single day that equals the annual energy requirement is enough to judge the amount of solar energy that goes untapped.

An evaporative cooler produces effective cooling by combining a natural process - water evaporation - with a simple, reliable air-moving system. Fresh outside air is pulled through moist pads where it is cooled by evaporation and circulated through a house or building by a large blower.

Problem Defination

Evaporative coolers are required for cooling purpose in summer. Large amount of energy used for their operation. Solar operated evaporative cooler will save this electricity and also will be beneficial where there is shortage of electricity.

Objective

The main objective is to compare operating cost for evaporative cooler operating on electricity and solar energy.

Experimental Set-up

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Table 2. Observation table for evaporative cooler Running on Solar system

Time		Inlet		Outlet			
	Flow	DBT	Flow	DBT	Flow	DBT	Time (10p)
9 am	I	33.4	22.6	27.4	22.0	3.4523	75.76
	II	31.8	22.8	27.5	22.2	3.6850	80.71
	III	32.1	22.9	27.5	21.8	3.0350	92.96
12 pm	I	33.3	23.6	26.5	21.0	3.0925	74.19
	II	33.9	23.8	26.8	21.7	3.3900	83.43
	III	33.5	23.5	26.7	21.5	3.6650	96.44
3 pm	I	37.5	23.4	29.3	22.8	3.4650	72.14
	II	37.7	23.5	29.5	22.5	3.6246	80.50
	III	37.5	23.7	28.7	22.1	3.9430	100

Results and Discussion

Table 3. Result table for evaporative cooler Running on Electricity

Time		RH					
	FLOW	Inle t %	Outlet %	Sat. Eff. %	Ma Kg/hr	Cooling capacity KJ/hr	Energy consum ption KW-hr
9 am	I	41	58	41.05	1181.46	4699.88	0.184
	II	41.5	57	43.01	1263.78	5156.25	0.165
	III	43	56.5	43.01	1385.41	5652.48	0.132
12 p m	I	52.2	58	53.24	1240.9	5189.52	0.177
	II	50	60	48.8	1264.66	5288.81	0.157
	III	55	58	56.41	1534.00	6888.00	0.133
3 p m	I	45	56	60	1206.57	7017.32	0.175
	II	46	59	58.33	1252.42	7153.85	0.160
	III	42	55	64.89	1462.00	9097.70	0.128

Table 4. Result table for evaporative cooler Running Solar System

Time		RH					
	FLOW	Inle t %	Outlet %	Sat. Eff. %	Ma Kg/hr	Cooling capacity KJ/hr	Energy consum ption KW-hr
9 am	I	48	62	45.4	1199.97	4895.88	0.148
	II	48	64	47.7	1280.85	5617.83	0.139
	III	49	64	50.0	1402.10	6580.57	0.121
12 p m	I	45	62	70.1	1081.12	7498.67	0.151
	II	42	66	70.2	1178.31	8533.37	0.134
	III	44	65	68.0	1266.95	8787.57	0.116
3 p m	I	32	58	58.1	1197.5	10015.9	0.155
	II	31	58	57.7	1211.18	10130.3	0.139
	III	32	59	63.7	1370.56	12309.2	0.112

1) Operating cost = C = 1000 * A *Cost/unit Rs/season

=184.4 * 5.53

= 1019.73 Rs/season

2) Cost of solar panel, Battery, Inverter = S = 15000 Rs

3) Payback period = S/C season

= 15000/1019.73

= 14.70season

= 15 Seasons = 15 Years

In such application the operation will be continuous and payback period may be calculated as

Assuming 18 h operation per day,

Units per day =0 .184 *18

= 3.312 kWh = 3.3 units

Cost per day = 3.3 *5

= 17 Rs per day

Pay back = 15000/17

= 882 days

= 2.5 years approx.

If Power Consumption is Higher, This may be further reduced.

Conclusion

There are many regions in India as part of Rajasthan, part of Bihar, M.P., Vidarbha and north Maharashtra and some hot spots in north where evaporative cooling will produce a condition well within the summer comfort zone. There is increasing demand of evaporative coolers in these regions as they are quite inexpensive compared with refrigerated air conditioning system. so in this region solar energy available abundantly. This energy can be stored in battery by using solar panel. It can be used to run the evaporative coolers.

If we used evaporative coolers three month in year (season) i.e.1000 hr operation then pay back period is 15years. This payback is more. So by optimizing cost of solar panel, battery and inverter payback period can be reduced. After payback period we will get upto 10-15 year free of cost evaporative cooling.

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Conflicts of interest

The authors declare that they have no conflicts of interest related to this research.

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