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Electrical Energy Saving in Water Motor Pump by Water Cooling

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ABSTRACT: Water motor pumps are the heart of the most industrial, Irrigation and home process and the second most common machine in the world. These pumps are the potential source to improved productivity. The performance of water motor pumps are usually improved with enhance to design, material and its cooling system. This work consider water motor pumps kept covered at domestic level, the cover is of metal box or plastic in India to save motor from splashing water or rain water. The survey is carried out at local level for the use of water motor pumps (0.5 to 1.5HP) for domestic purpose. As per the survey most of the motor pump are running under adverse situations (covered by metal box or Plastic). The pumps running under adverse condition have less performance and high energy consumption. In this project cheapest and widely used water motor pump (0.5HP) is selected, the cooling is spread over its surface by removing fins. The cooling coil enhance the performance of the motor under adverse conditions and saving of electrical energy. The electrical energy of Rs. 35 to Rs. 48 can saved per month, which is affordable for common peoples in India.

KEYWORDS: Energy Saving, Energy Conservation, Effective Cooling, Water Motor pump,

I. INTRODUCTION

Today's modern electric machines achieve a high power dimension ratio. Now it needs a highly effective cooling and Ventilating system which can ensure sufficient heat removal from the machine inside. There are several ways to cool Electric machines; an air cooling is used widely for heat removal from lower medium-power electrical machines. Unfortunately, internal surfaces inside the machine, which can serve for heat removal, are small. Substantial improvement can be achieved by different cooling method, for example the water cooling is able to ensure relatively low temperatures of a stator. The water-cooled machines do not need a big external heat exchanger (air-water) as usually installed on top of the motor. The water-cooled machines can be significantly smaller than air-cooled. The 0.5HP water motor pumps can be made water cooled in order to improve the performance when they are kept in adverse conditions (covered by metal box or Plastic).

Excess Heat Generation: The motor design and application is heat is major consideration. Excessive heat will affects motor insulation, which deteriorates and cause premature insulation failure. Excessive heat also cause a breakdown of bearing lubrication ,which damages the bearings of a motor. The total temperature develops in motor by two factors which as external, or ambient temperature; and internal, or motor temperature rise. Most Motors are designed to operate in a maximum ambient temperature of 40° C. If the ambient temperature exceeds 40° C, the motor may need to be modified to compensate for the increase in temperature.

Losses: The temperature rise of the motor is the result of heat generated by motor losses during operation. At no-load, friction in the bearings, core losses (eddy Current and hysteresis losses), and stator losses contribute to Temperature rise; at full-load, additional losses which causes heating rotor losses and stray load losses. Since current increases with



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Vol. 8, Issue 6, June 2019

an increase in motor load and under Locked-rotor, temperature will be rise significantly high. The temperature also rises due improper ventilation or cooling arrangements.

The advantages of water cooling can be summarized as following:

- The water cooling is highly effective due to high specific heat
- Capacity of water and high heat-transfer coefficients.
- Improved power of the machine.
- Energy conservation is possible

II. THEROTICAL ANALYSIS

A water motor pump is of a very simple design. It only has one moving part, an impeller that is attached to a shaft and is driven by the motor. The two main parts of the pump are the impeller and the diffuser. Impellers can be made of bronze, polycarbonate, cast iron, stainless steel as well as other materials. The diffuser (sometimes called a volute) houses the impeller and captures and directs the water off the impeller.

The head (or pressure) that a pump will develop is in direct relationship to the impeller diameter, the number of impellers, the size of impeller eye, and shaft speed. All of these factors affect the horsepower size of the motor to be used. The more water to be pumped, the more energy is required.

 $\frac{\text{Electrical cost} = \text{HP*0.746* time of operating motor in hrs.*KW cost}{\text{Efficiency of motor}}$

 $\frac{\text{Motor Efficiency} = \text{HP * 746 watt/hp}}{\text{Power in watt}}$

Kw – Motor Kw rating. Rs. per KwHr- electrical company charges for Kw rating,

Kw = I * E *Pf1000

Where,

I – Motor Amperage.

E – Motor Voltage

Pf- power Factor, the value of pf for 0.5 hp motor is 0.90.

Factors affecting this rate of heat transfer are:

- Motor enclosure: Different enclosures result in different airflow patterns, which vary the amount of airflow in contact with the motor.
- Frame surface area: Increasing the area of a motor enclosure in contact with the air will increase the rate of heat transfer.
- Airflow over motor: The velocity of air flowing over the enclosure affects the rate of heat transfer.
- Ambient air density: As air density reduces the rate of heat transfer from the motor reduces. The air temperature increases with altitude. The standard motors are normally operates up to 3300 feet with designed parameters. The motors with service factor 1.0 may be used at altitudes up to 9900 feet.

Objectives

The objectives of these projects are to improve the performance of water motor pump used for residential purpose kept under adverse conditions (covered by metal box or Plastic). By proper cooling performance can be improved, the failure rate can be reduced and the energy conservation can be achieved. The specific objectives are:

• The optimum cooling which helps to balance heat generated in rotor.



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Visit: www.ijirset.com

Vol. 8, Issue 6, June 2019

• Use of modified water cooling for energy conservation by balancing motor operating temperature.

III. DESCRIPTION OF PROJECT

While doing survey in homes and farms in India. We observed that the people used to covered water motor pump by external means i.e. Metal casing, plastics covers, plastics bags etc. Which initiate the problems regarding heat transfer from the motor surface and hence the temperature of motor rises. This effects motor performance, more energy consumption, High losses and decreasing the life of winding insulation ultimately motor failure takes place.

For this project we have selected the motor which is available in market at cheapest cost which most of the people purchase for water pumping purpose. It is found that these water motor pumps are cheaper but lagging behind due to following reasons:.

- Life of motor is approximately six month
- Winding get damage due to rise in operating temperature working at high load or long time running.
- Less Discharge.

After studying these draw backs we have selected the motor for experiment and modified its cooling system as well as cooling fans for better performance. This selection of motors is based on the following survey mentioned in table 1.

Sr. No	Name of Company	Body Material	Winding	Discharge per hrs.	rpm	Cost
1.	Sharp Master	AL	CU	800	2880	2000
		CI	CU	2800	2880	3500
2.	Kirloskar Brothers	AL	CU	800	2800	2500
		CI	CU	2800	2800	3000
3.	Laxmi pumps	AL	AL	750	2880	1500
		CI	AL	-	2880	2000
4.	Texmo Pumps	AL	CU	1750	3000	3000
		CI	CU	2820	3000	4500

Table 1 Cost of various motors available in local market (Jalgaon, January 2018)

IV. LAYOUT OF MODIEFIED SYSTEM

The motors parts are well assembled and fix in their standard condition. These parts includes impeller, field winding, armature winding, cooling fan, capacitor, inlet outlet valve, cover body etc. for achieving high performance requires modify some parts and construct new parts, New modified parts are described below. The layout of modified system is shown in fig 2.

Heat Exchanger Cooling Tubes: For extra cooling the cooling tubes are installed outer side, beside to fins ie. at unfins area. The installed tubes as heat exchanger , its one end (inlet) connected to delivery pipe and another end (outlet)



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Vol. 8, Issue 6, June 2019

connected to suction pipe of motor. The heat exchanger passes over the motor in zig zag way, which reduces operating temperature of motor. The actual picture of heat exchanger is given in fig.1.



Fig 1. Modified Motor Cooling tubes installed in motor

Cooling fans: It is the most familiar and valuable cooling device which is use in each a one device that requires balancing operating temperature. This fan installed on rotating shaft. For this purpose requires some energy. But in this project we modified the design of fans, makes its simple design which conserve energy at low level also.



Fig. 2. Layout of Project



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Vol. 8, Issue 6, June 2019

Temperature vs losses pump head 200 180 160 140 **ENERGY LOSSES** 120 100 80 60 40 20 0 44.55 47.8 50 50.2 50.27 54.3 **TEMPERATURE**

V. EXPERIMENTATION RESULTS





Fig.4. Temperature vs. energy losses graph of with covering motor pump

The fig. 3 and fig 4 compares the energy losses due to increase in motor winding temperature. The available head on pump increases energy losses, as head increases the winding temperature increases hence losses increases, The steep in fig 4. It should be avoided.



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Calculations

Electrical cost for Sharp company motor. Motor efficiency = 52.9 % Power = 0.633 kW Electrical cost of 5 hrs.= 13.388 Rs. Electrical cost for modified laxmi company motor. Motor efficiency=56.56% Power = 0.594Kw Electrical cost of 5 hrs. = 11.76 Rs. Cost saving by modified laxmi motor per month per single motor = 48 Rs.

VI. CONCLUSION

It increases the life of motor as well as conserves energy by modifying cooling system at adverse condition when motor is covered. The motor with heat exchanger performed better than motor without heat exchanger. The modified motor runs at lower lowest cost. Cost saving by modified laxmi motor per month per single motor is 48 Rs.

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