DESIGN AND ANALYSIS OF SUBMERSIBLE SCREW PUMP

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Abstract: There are two ways of optimizing the pump performance, first by optimizing the cost and the second by increasing the overall efficiency of the pump. Hence this method is to achieve the performance of the pump at low cost compared to the present impeller type submersible pump. The aim of the project is to decrease the cost of submersible pump by adapting screw pump method in submersible application. The first step is to analysis the existing impeller model and determining its overall efficiency. And to make a list of components used, with the existing model cost estimation. The second step is to redesign the submersible pump with screw type pump for the same power input and increase in output. The screw type submersible pump modelled in Solid works 2018, have analysis in Ansys 17.2. The graphical representation of the same power pump overall efficiency has been compared. This process is made to reduce the amount of bore well irrigation process. The change which is made in impeller type submersible pump with screw type submersible pump with the using of altered cables can reduce the total pump cost and will have increase in total efficiency.

***Index Terms* – Drilling, Welding, Grinding, Submersible pump, Performance.**

I. INTRODUCTION

A pump is a device that moves fluids, or sometimes slurries, by mechanical action. Pumps can be classified into three major groups according to the method they use to move the fluid: direct lift, displacement, and gravity pumps.

Pumps operate by some mechanism (typically reciprocating or rotary), and consume energy to perform mechanical work moving the fluid. Pumps operate via many energy sources, including manual operation, electricity, engines, or wind power, come in many sizes, from microscopic for use in medical applications to large industrial pumps.

Mechanical pumps serve in a wide range of applications such as pumping water from wells, aquarium filtering, pond filtering and aeration, in the car industry for water-cooling and fuel injection, in the energy industry for pumping oil and natural gas or for operating cooling towers. In the medical industry, pumps are used for biochemical processes in developing and manufacturing medicine, and as artificial replacements for body parts, in particular the artificial heart and penile prosthesis.

A submersible pump (or sub pump, electric submersible pump (ESP)) is a device which has a hermetically sealed motor close-coupled to the pump body. The whole assembly is submerged in the fluid to be pumped. The main advantage of this type of pump is that it prevents pump cavitation, a problem associated with a high elevation difference between pump and the fluid surface. Submersible pumps push fluid to the surface as opposed to jet pumps having to pull fluids. Submersibles are more efficient than jet pumps.

A screw pump is a positive-displacement (PD) pump that use one or several screws to move fluids or solids along the screw(s) axis. In its simplest form (the Archimedes' screw pump), a single screw rotates in a cylindrical cavity, thereby moving the material along the screw's spindle. This ancient construction is still used in many low-tech applications, such as irrigation systems and in agricultural machinery for transporting grain and other solids.

Development of the screw pump has led to a variety of multiple-axis technologies where carefully crafted screws rotate in opposite directions or remains stationary within a cavity. The cavity can be profiled, thereby creating cavities where the pumped material is "trapped".

In offshore and marine installations, a three-spindle screw pump is often used to pump high-pressure viscous fluids. Three screws drive the pumped liquid forth in a closed chamber. As the screws rotate in opposite directions, the pumped liquid moves along the screws' spindles.

To design and fabricate the positive displacement submersible pump based on irrigation purpose at low capital cost and to achieve the efficiency of the present impeller type pump with low powered motor.

To obtain the performance characteristics of newly developed submersible pump with low power consumption with high efficiency.

II. LITERATURE SURVEY

Muhammed R. A, et al., (2002) had found the alternative to Screw pumps which available from a long time in the lifting of viscous fluids application. The earliest version is the famous Archimedes' we'll still in use for raising water. Historically, the domain of twin screw pump applications was highly viscous liquids.

Vijay kumar.K, et al., (2011), had found that a screw pump is a positive-displacement (PD) pump that uses one or several screws to move fluids or solids along the screw(s) axis. In its simplest form (the Archimedes' screw pump), a single screw rotates in a cylindrical cavity, thereby moving the material along the screw's spindle. This ancient construction is still used in many low-tech applications, such as irrigation system and in agricultural machinery for transporting grain and other solids. Development of the screw pump has led to a variety of multiple-axis technologies where carefully crafted screws rotate in opposite directions or remains stationary within a cavity. The cavity can be profiled, thereby creating cavities where the pumped material is "trapped". In offshore and marine installations, a three-spindle screw pump is often used to pump high-pressure viscous fluids. Three screws drive the pumped liquid forth in a closed chamber. As the screws rotate in opposite directions, the pumped liquid moves along the screws' spindles.

Samip Pankajkumar Trivedi, et al., (2014), had studied on this topic in conclusion, using the generic terminology screw pump fails to recognize the key mechanical design and performance differences that each screw pump type offers. However, once they are understood, engineers will find a proven technology suitable for a wide range of applications in multiple industries. It can also perform on various viscosities and for the various fluids such as a Newtonian and non-Newtonian fluid at a desired pressure.

Mohan kumar.S (2015), has made a transient multiphase CFD model was set up to investigate the main causes which lead to cavitation in positive displacement (PD) reciprocating pumps. Many authors such as Karsten Opitz agree on distinguishing two different types of cavitation affecting PD pumps: flow induced cavitation and cavitation due to expansion. The flow induced cavitation affects the zones of high fluid velocity and consequent low static pressure e.g. the valve-seat volume gap while the cavitation due to expansion can be detected in zones where the decompression effects are important e.g. in the vicinity of the plunger. This second factor is a distinctive feature of PD pumps since other devices such as centrifugal pumps are only affected by the flow induced type. Unlike what has been published in the technical literature to date, where analysis of positive displacement pumps are based exclusively on experimental or analytic methods, the work presented in this paper is based entirely on a CFD approach, it discusses the appearance and the dynamics of these two phenomena throughout an entire pumping cycle pointing out the potential of CFD techniques in studying the causes of cavitation and assessing the consequent loss of performance in positive displacement pumps.

India Geographical Information Study (2017), Geographical Information System (GIS) tool is utilized to examining spatial data from various disciplines. It incorporates, analyze and represent spatial information and database of any resource, which could be effectively utilized for resource improvement arranging, ecological assurance and logical inquiries. GIS have been utilized for a variety of groundwater studies. Therefore, this system will be beneficial for farmer's community in estimation of the required submersible pumping system.

Ram Prasad.R, et al. (2017), has explained that Submersible pump (or sub pump, electric submersible pump (ESP)) is a device which has a hermetically sealed motor close-coupled to the pump body. The whole assembly is submerged in the fluid to be pumped. The main advantage of this type of pump is that it prevents pump cavitation, a problem associated with a high elevation difference between pump and the fluid surface. Submersible pumps push fluid to the surface as opposed to jet pumps having to pull fluids. Submersibles are more efficient than jet pumps. A screw pump is a positive-displacement (PD) pump that uses one or several screws to move fluids or solids along the screw(s) axis. In its simplest form (the Archimedes' screw pump), a single screw rotates in a cylindrical cavity, thereby moving the material along the screw's spindle. This ancient construction is still used in many low-tech applications, such as irrigation system and in agricultural machinery for transporting grain and other solids.

III. DESIGN AND WORKING

3.1 Introduction

In this chapter a brief view of the materials designed and methods used for the fabrication of screw type submersible pump is discussed. And the project is planned and executed in a well manner.

3.2 Conceptual Design

The conceptual design and the isometric view of submersible screw pump shown in Fig.3.1 were done with the 3D modelling software and it is analysed. Conceptual design and the parts design are shown in isometric view,

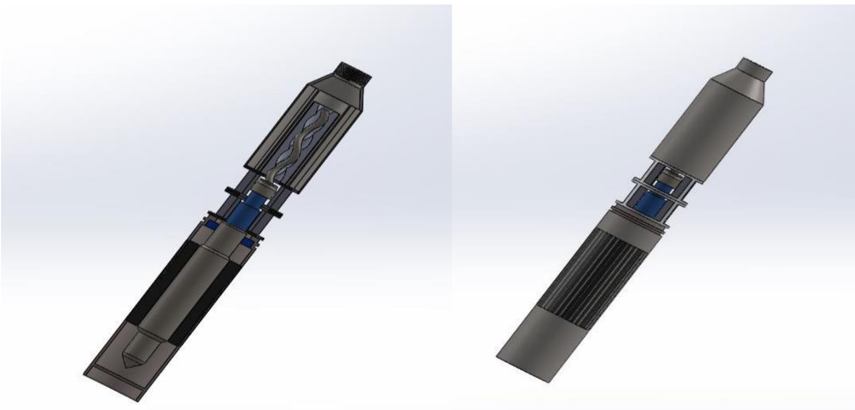

Fig.3.1 Conceptual design

3.3 List of components

The major components employed in the fabrication are as follows.

i. Stator
ii. Rotor
iii. Flow meter
iv. Coil winding
v. Cables

3.4 Working

In fabrication process, the rotor is drilled to fix in position with existing motor shaft and also motor shaft drilled to fix with the rotor. The pump head is cut to fix with stator in it without any movement acting on it.

The fabricated prototype is as shown in Fig 4.1 on 2 dimensional views done by one of the 3d modeling software each and every components dimensions is drafted on the below picture. All the dimensions are in (mm).

Fig.3.2 Prototype of positive displacement pump

In this process, place the pump set inside a tank or drum with proper insulation of wires and cables and connect a pressure gauge with the outlet pipe. And make sure that the connections are proper, and kept in insulation cover. Now keep the junction box away from the water source. Now turn ON the power circuit and calculate the results in the pressure gauge. If the power supply is not sufficient, then connect a capacitor with the junction box. Once the circuit gets the supply, it will work on its way. Close the outlet value for getting the flow of water of pressure. Now calculate the measured results and note down.

IV. RESULT AND DISCUSSION

4.1. Specification

The overall specification of fabricated Positive displacement pump is given. The overall weight of the pump is about of 25kg which can be easy for handling and portability. It can rotate at the maximum of 2800 rpm based on the capacity of capacitor.

4.2 Trail inference

The head output of entire assembly process was identified using bar graphs. In order to improve productivity, time taken by the head output activity needed to be crashed down economically. Trials were conducted as mentioned previous chapter and the results of trials are tabulated.

S. no	Time taken (head)	Amount of flow (discharge in lit)
Trail 1	25	1.05

Trail 2	50	0.60
Trail 3	100	0.00

The fabricated prototype is validated experimentally on off track test. And the of track testing is shown in below figures

Trail 1

The first trail is taken and the readings are noted down, the reading for trail 1 is 25 feet head which is taken from pressure gauge and the amount of flow is 1.05 liters which is taken from panel board and the flow of water is controlled by using gate value.

Fig.4.1 Experimental validation for trail 1

Trail 2

The second trail is taken and the readings are noted down, the reading for trail 2 is 50 feet head which is taken from pressure gauge and the amount of flow is 0.60 liters which is taken from panel board and the flow of water is controlled by using gate value.

Fig.4.2 Experimental validation for trail 2

Trail 3

The third trail is taken and the readings are noted down, the reading for trail 3 is 100 feet head which is taken from pressure gauge and the amount of flow is 0.00 liters which is taken from panel board and the flow of water is controlled by using gate value.

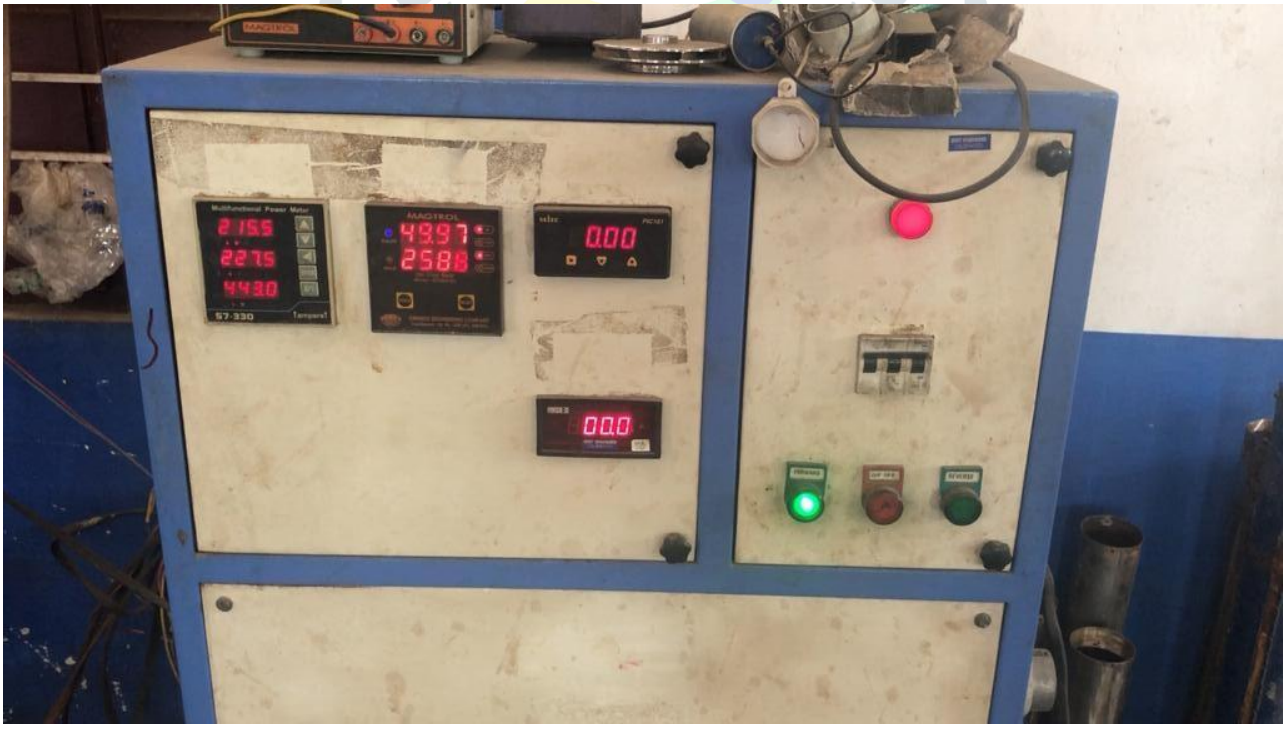

Fig.4.3 Experimental validation for trail 3

V. CONCLUSION

Thus a submersible pump was designed and developed for irrigational purpose. The cost of pump is ₹15,300 which is a reasonable price since the productivity is increased with the decrease in the amount spent on labor. The project was completed within the given amount of time and the project ended on a successful note. The existing pump has an efficiency of 75.5% on working condition. By obtain result in newly developed submersible pump gives 85% on working condition. The project was completed with keeping in mind all the safety measures that are required while carrying out pertains on the machine.

VI. REFERENCES

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