

# Factors Affecting Pump Performance- An Insight into Research and Investigation

Sunil Jayant Kulkarni

Datta Meghe College of Engineering, Airoli, Navi Mumbai, Maharashtra, India

## ABSTRACT

Different geometrical parameters such as slot radial position ( $R_s$ ), slot height ( $h_s$ ) and slot inclination angle ( $\theta_s$ ) affects pump performance. Many investigators have carried out experiments and simulation studies to optimize the parameters affecting pump performance. Current review summarizes research and investigation on pumps and factors affecting pump performance. Studies by various researchers confirm that with increasing the slot height, the impeller head decreased. For proper selection of a pump, it is important to have proper understanding of design restrictions, operating conditions of the irrigation system, and required flexibility in system operation. Series configurations are used for very high heads and parallel are used in high flow rate applications. Also studies indicated that that the friction effect on centrifugal pump can be reduced by properly studying the impeller friction losses, volute friction losses and disk friction losses.

**Key words:** Disperser Impeller blade, performance, efficiency, suction, head, losses.

## INTRODUCTION

Pump, compressor and fans are important fluid moving devices. Pump is a mechanical device using suction or pressure. It is used to raise or move liquids, compress gases, or force air into inflatable objects such as tyres. Compressor is a machine used to supply air or other gas at increased pressure. A fan is a machine used to create flow within a fluid, typically a gas such as air blowers and gas moving devices. Centrifugal pump and positive displacement pump are two important types of pumps. Important factors affecting pump performance are surface roughness; internal clearances; mechanical losses, such as those related to bearings, lip seals, mechanical seals, and packing; high suction specific speed; impeller trim; and the viscosity of the fluid pumped. Many investigators have carried out experiments and simulation to optimize the parameters affecting pump performance. Current

review summarizes research and investigation on the research on pumps and factors affecting pump performance.

## FACTORS AFFECTING PUMP PERFORMANCE- AN INSIGHT INTO RESEARCH AND INVESTIGATION

Hassan et. al. carried out investigation on effect of slot of impeller blade on performance of centrifugal pump. [1] In their investigation, they modified different geometrical parameters such as slot radial position ( $R_s$ ), slot height ( $h_s$ ) and slot inclination angle ( $\theta_s$ ). They observed that with increasing slot radial position, the head decreased. In  $-110$  to  $0^\circ$  angle, they obtained maximum efficiency. They also observed that, with increasing the slot height, the impeller head decreased. Haman discussed selection of centrifugal pump. [2] For proper selection of a pump, it is important to have proper understanding of design restrictions, operating conditions of

the irrigation system, and required flexibility in system operation. They also discussed importance and effect of the role and importance of pump characteristic curves. They noted important aspects of series and parallel configuration. Series ones are used for very high heads and parallel are used in high flow rate applications. Mohammed discussed hydraulic ram pump. [3] It is a pump used to lift water from a depth of 2m below the surface without external energy source. He discussed various aspects of ram pump. The impulse and delivery valves are most important parts of hydraulic ram pumps. According to him, the difference between other pumps and ram pumps lies in fact that rampump uses the inertia of moving part rather than water pressure and operates in a cycle. Timar discussed various dimensionless characteristics of centrifugal pump. [4] He observed that the Newton number is a function of the flow coefficient. He found that maximum efficiency of the tested pump was approximately 50 %. Salunkhe et.al. investigated modification of suction manifold for improvement of efficiency of centrifugal pump. [5] They discussed the available material of performance improvement through various parameters. Their review indicates that vortices and cavitation induces inefficiency in pumps. Discharge achieved per Kw is function of suction head and the delivery head. A uniform flow distribution of the sumps for a uniform flow distribution of the sumps is important. Shastri et.al. carried out an investigation on losses of centrifugal pump. [6] Selecting and optimizing a number of independent geometrical parameters has been the problem area in the modernization of pumps. The results of wrong pump selection lead to increase pumping costs and reduce productivity. They concluded that the friction effect on centrifugal pump can be reduced by properly studying the impeller friction losses, volute friction losses and disk friction losses. Also the mismatch of fluid and metal angles causes shock losses. Teuteberg discussed the use of

pump-as-turbine technology and direct-drive systems. [7] During his studies, he found that, a reverse running pump that powers a different pump through a direct drive system was most suitable design. Sahdev has discussed basic concepts of operation, maintenance, and troubleshooting for centrifugal pump. [8] According to him, it is important to handle the centrifugal with due care and maintain properly. The problems regarding operation of pump includes leakages, loss of flushing, cooling, quenching systems, loss of lubrication, cooling, contamination of oil, abnormal noise, leakages from pump casing, very high noise and vibration levels. According to him it is important to identify the type of failure, mechanical or functional. For a chemical engineer, to protect his pumps from frequent failures, it is important to have thorough knowledge of the mechanics of the pump. Babayigit et.al. investigated single and multistage centrifugal pumps. [9] They studies blade exit angle effect on the performance. In their work, they employed Ansys-Fluent computational fluid dynamics software. Tan, in his work, developed, tested and characterized a compact piezohydraulic pump with active valves. [10] Also he developed theoretical models. Comparison of the data indicated that the compressibility of the fluid was important to system performance. Studies were carried out on the performance and efficiency of hydraulic pumps and motors by Grandall. [11] Both, experiments and modeling approaches were employed by him to predict the performance and efficiency of hydraulic pumps and motors. To avoid unpredictability, he recommended displacement sensors in the pump/motor units being tested. Osborne et.al. carried out investigation on head and flow of a high efficiency free centrifugal-pump impeller. [12] They carried out investigation on flow through the various components of hydrodynamic machinery. They in their work, operated impeller as an isolated unit. It was hydraulically free of the casing. White sides discussed basic pump

parameters and the affinity laws. [13] He discussed fundamentals of centrifugal pump. According to him, it is always convenient to consider the basic parameters as variables. Affinity laws can be used to predict changes in pump performance. Riglin discussed performance characteristics of airlift pumps. [14] In his investigation, he experimentally examined the effect of the swirl component of air injection on the performance. He found that the nozzle with only axial injection produced a water flow rate equivalent to or better than that induced by the nozzle with swirl. He found that the swirl component of air injection was detrimental to pump performance. Smallest air injection can be used (10 psig to 15 psig). Geerts carried out experimental and numerical study of axial flow pumps. [15] He developed a numerical model to make a numerical flow field analysis in the impeller of the axial flow pump. He found that the numerical methods predicted the complex flow field reasonable well.

## CONCLUSION

Studies by various researchers confirm that with increasing the slot height, the impeller head decreased. For proper selection of a pump, it is important to have proper understanding of design restrictions, operating conditions of the irrigation system, and required flexibility in system operation. Also studies indicated that that the friction effect on centrifugal pump can be reduced by properly studying the impeller friction losses, volute friction losses and disk friction losses. Series configurations can be used for very high heads and parallel ones are used in high flow rate applications. According to Whitesides, it is always convenient to consider the basic parameters as variables. Affinity laws can be used to predict changes in pump performance.

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