

REVIEW ON DESIGN IMPROVEMENT OF MIXED FLOW PUMP

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Abstract-Mixed flow pump has found the wide range of application in country like china and India .It is necessary to improve the volumetric efficiency in order to improve the overall efficiency and hence power consumption. This paper will give you brief overview about the parameters that affects the design of the mixed flow pump in order to improve the design and performance of the pump. This paper also analyze deign parameter like peripheral thickness of the pump in order to improve the volumetric efficiency of the pump, need to justified analytically, experimentally and by CFD analysis.

Keywords-Mixed flow pump; volumetric efficiency; design parameters; peripheral thickness; CFD analysis.

I. INTRODUCTION

Pump is classified according to its mechanism based on reciprocating and rotary. A mixed flow pump is a centrifugal type of pump working on the rotary mechanism. Centrifugal is classified based on the impeller imparts energy to water to transform velocity in to head or liquid enters and leaves the casing. Based on the impeller configuration and specific speed the pump is classified traditionally as radial flow, axial flow and mixed flow pump.

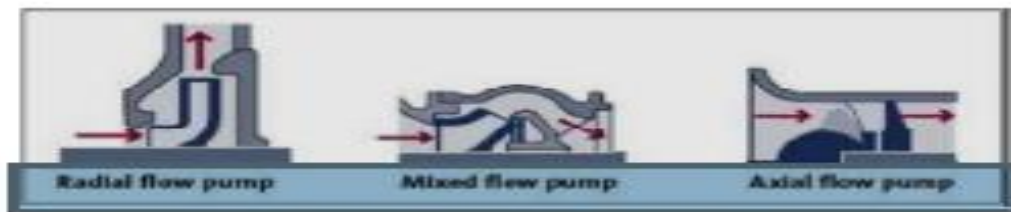


Figure 1. Types of pump [1]

A. Mixed flow pump:

Mixed flow pump where Head is developed partially by centrifugal action and partially by lift of the vane on liquid. The liquid enters axially and discharges in radial and axial direction. The casing of the pump may be volute type of diffusion type. They may have single or double suction and may be multistage. The mixed flow pump is applicable for medium head application (7-16m) and for medium or large application.

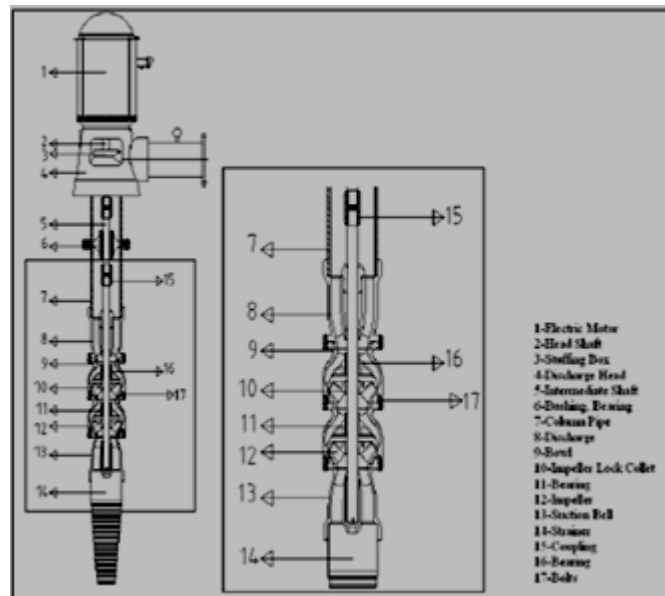


Figure 2. parts of the mixed flow pump assbly[1]

B. Application:

Typical application of mixed flow pump is in irrigation, waste water discharge, flood water pumping.

II .PERFORMACE ANALYSIS

Mr. Jidong Li has done CFD analysis of mixed flow pump considering optimum design, it is found that the hydraulic performance of the pump was improved by enlarging the section area of volute and reducing the blade inlet angle also the performance of the pump can be improved by reducing number of blades and increasing radial curvature of the original impeller blade. It is found that optimum design of mixed flow pump is achieved by reducing number of blade from 7 to 5, design of C type curve section reduces the occurrences of vertexes at the head of the blade and increases the blade inlet structure angle properly and reducing the blade outlet structure angle gives optimum performance. The hydraulic model of the vertical turbine type mixed flow pump, designed based on three dimensional viscosity flow can be simulated on software like ANSYS CFX and numerical simulation can be done on FINETM, turbo module of NUMECA software. Design based on this simulation results can meet the engineering requirement. [2]

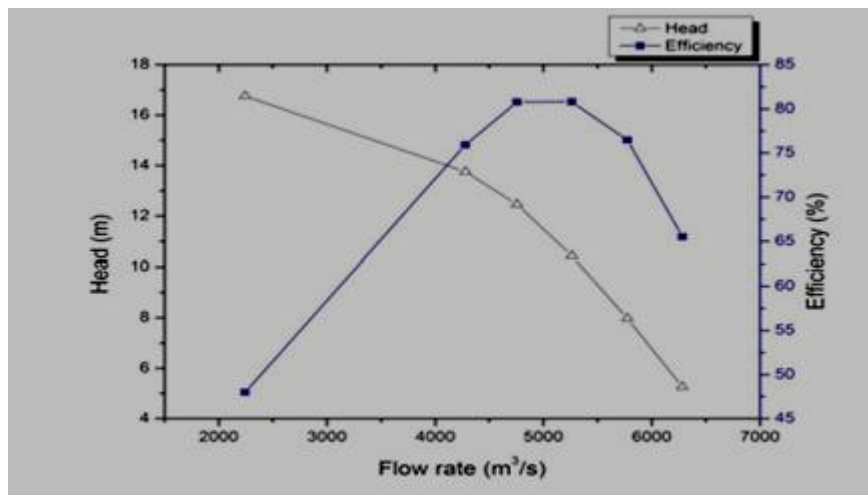


Figure 3. Fitted head-flow rate and efficiency-flow rate curve of various calculating points of the Original pump [2]

Mr. Micahal Varchola has done geometry design of a mixed flow pump based on experimental result of an internal impeller flow and it gives the following results. There is no exact pattern for inlet to outlet passage of the impeller .Design of the impeller can be done by assuming lowest possible losses. The inlet geometry is primarily influenced by parameter of suction and outlet geometry is achieved by considering the desired specific energy .The impeller should be designed with respect to the linear distribution of pressure from inlet to outlet. It can be said that the method used for projection of a blade cut based on the characteristic pressure distribution in the channel of the impeller, seems to be perspective for the prime projection of geometry of the diagonal pu mp. [3]

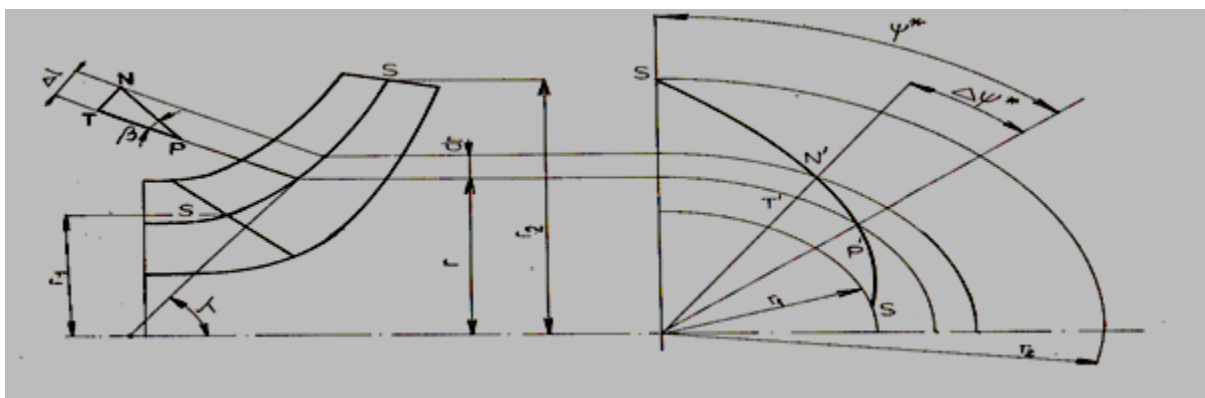


Figure. 4 .Impeller geometry [3]

Mr. Hao bing has analyzed that impeller design with three dimensional flow assumption has better hydraulic performance and has significantly improvement of energy conversion capacity of blade than two dimensional flow assumptions. It is worth noticing that on blade trailing edge, circulation on each meridional streamline is basically the same, satisfying requirement for uniform circulation distribution on the blade trailing edge. This demonstrates that the TDP has obvious advantages over the design method based on two-dimensional flow assumption. [4]

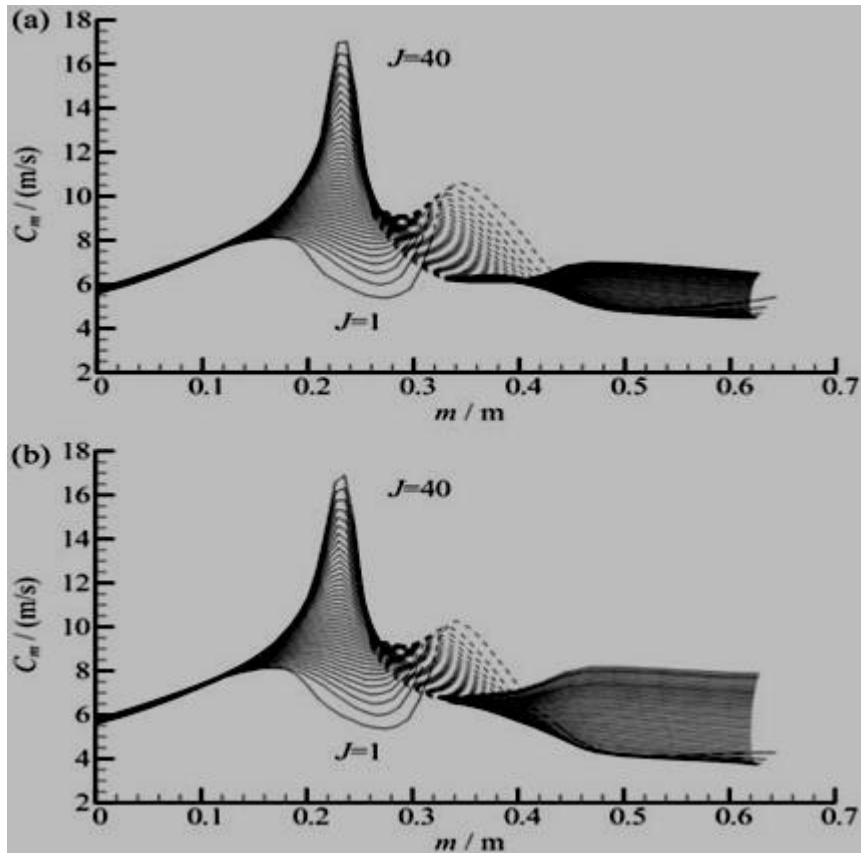


Figure 5. Meridional velocity distribution obtained by direct calculation: (a) impeller designed based on two-dimensional flow assumption and (b) impeller designed with TDP. TDP: three-dimensional design platform. [4]

Mr. W.G Li has found that the blade discharge angle has equal influence on the head, efficiency and shaft power of the pump figure.6 shows the variation of head curve versus flow rate when the viscosities of working liquid are 1, 98 and 255mm²/s, respectively. A larger discharge angle causes the pump to develop a higher head than a smaller one does. As the viscosity is 1mm²/s, the peak head has occurred at a flow rate of $Q = 8\text{m}^3/\text{h}$; rather than at zero flow rate.[5]

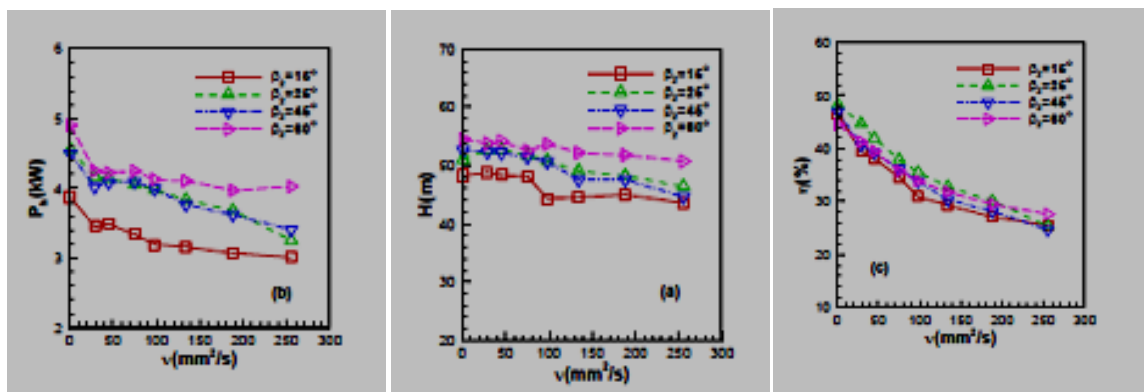


Figure.6 Head (a), hydraulic power (b) and efficiency (c) at BEP in terms of viscosity [5]

Mr. R. Ragoth Singh has found that the contributions of all the design parameters have good importance for determine the performance. The conformation experiments were also conducted to verify the optimal combination of design parameters obtained. Good agreement between the predicted and actual values for static pressure and discharge has been observed and backward vane profile of the impeller has better efficiency compared to the forward vane profile.[6]

A Manivannan Department of Mechanical Engineering, PSG College of Technology Coimbatore, INDIA in his studies of CFD analysis of mixed flow pump derived that the efficiency is increased by 18.18% by changing the inlet and outlet vane angle. The characteristic curve between discharge and head is given in Figure 7. It shows that for the existing impeller the head decreases while discharge increases. While discharge rate increases the velocity of fluid also increases and this increased velocity leads to pressure drop. Thus head reduces while discharge increases. The characteristic curve between discharge and head for the modified impeller1 shows that manometric head is increased by 3.22% at best efficiency point. The increased outlet angle leads to smooth flow in exit region. [7]

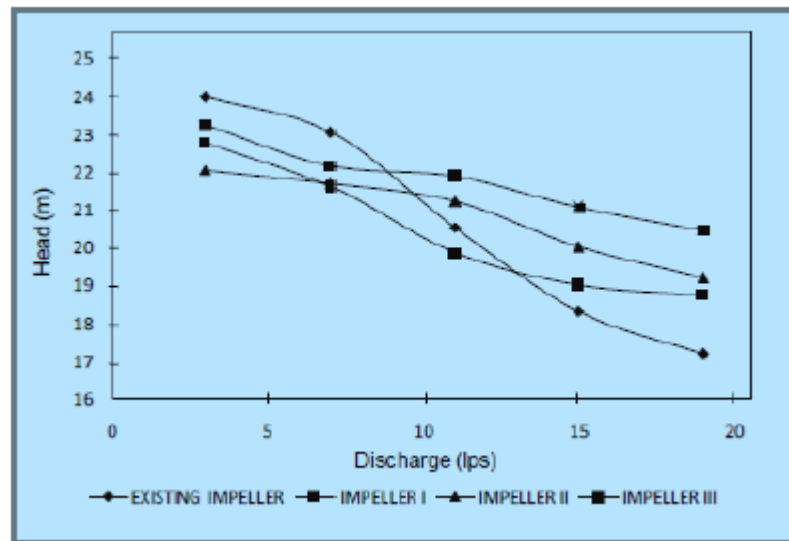


Figure 7. Head developed by the existing and modified impeller [7]

The characteristic curve between discharge and overall efficiency is given in Fig.12. It shows that overall efficiency for the existing impeller starts decreasing after 11 lps. Due to high discharge rate, velocity of the fluid increases and this high velocity cause cavitations losses and recirculation inside the impeller. [7]

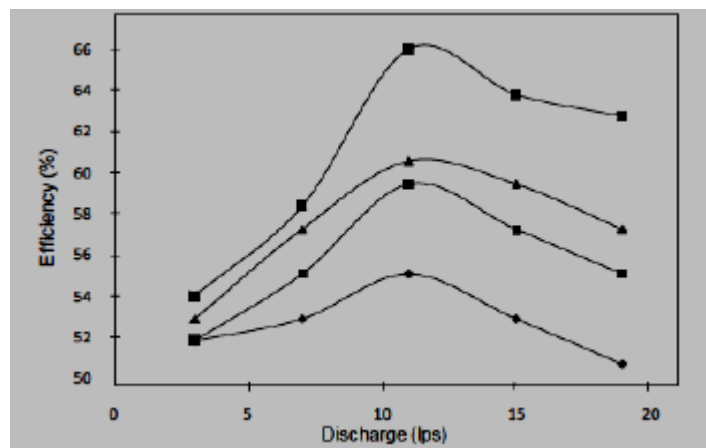


Figure 8. Efficiency of the existing and modified impeller [7]

Mr. Jidong Lia has claimed that under filling impeller blades at the trailing edge improved the performance of the pump. Best efficiency point of the pump that is designed in this study moves from 53 l/s to 56 l/s and system efficiency increases 2% for the best efficiency point. [2]

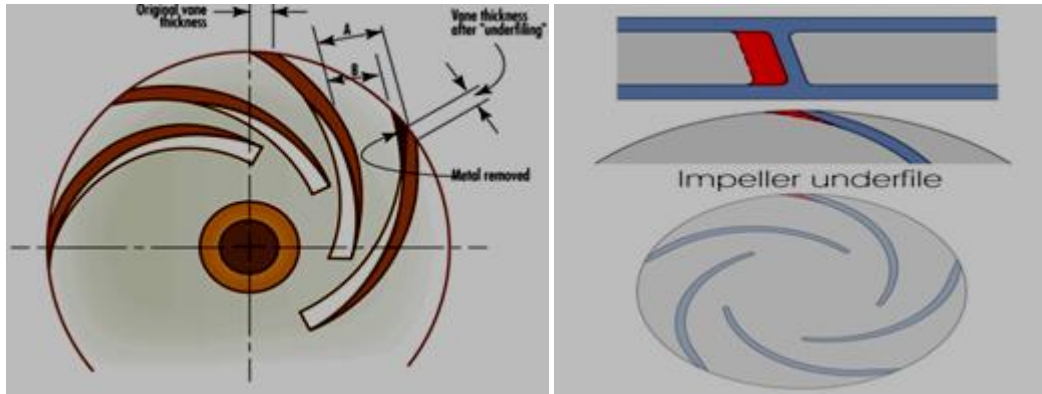


Fig 9. Undefiled impeller [2]

III. CONCLUSION

From above studies, we can say determinately that there are many factors related to performance of pump needs to explore. Performance of the mixed flow pump can be improved by -

1. Reducing number of blades
2. Properly increasing the blade inlet structure angle and reducing the blade outlet structure angle.
3. Impeller design with three dimensional flow assumptions.
4. Decreasing the thickness of impeller blade at periphery.

It is also noted from the above result that these parameters should be analyzed experimentally and also by the CFD analysis to achieve better result.

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