How to design a centrifugal pump with constant power consumption for all flow rates

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Long Abstract

Introduction

The power consumption of centrifugal pumps depends on the type of impeller. Typically it increases with the flow rate of radial impellers and it decreases with the flow rate of axial impellers. Semi-axial impellers show a different behavior, depending on the specific speed number. However, each type of impeller shows a significant maximal power consumption, which defines the adequate motor power for the driver.
The idea of the project presented in this paper was to design a small pump for drum pump application with constant power consumption and thus a resulting smaller motor size. This pump also would require less speed and therefore produce less noise and finally obtain a relative high efficiency.

1.Methods

Conventional hydraulic pump design for centrifugal pumps focuses on high efficiency of the duty point. It is a new approach to influence the power curve of a centrifugal pump as guidance for the design process. From literature, e.g. *Gülich [2]* , it could be found, that flattest power curves are given for semi-axial type impellers with a specific speed number around n_q=100. Based on this, the selected impeller is of the semi-axial type with significant variation of inlet diameter, outlet width, blade number and backup blades (Figure 1). The different design parameters are systematically investigated, which results in approximately ten different impellers combined with a new diffuser within the frame of a drum pump concept. All impellers are tested in a special test stand which allows a detailed loss analysis to determine the pump efficiency.

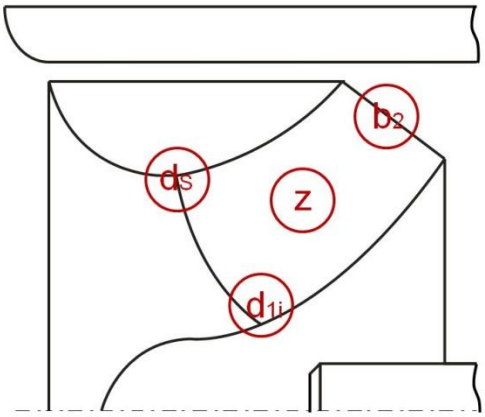

Figure 1. Overview of investigated design parameters

2. Results

The power consumptions for all tested impellers are displayed in Figure 2. The best impeller has a nearly constant power consumption at low power consumption with corresdondingly relative good efficiency. Compared to the original curve (LR), the power consumption at peak is reduced from 470 W down to 220 W by the effect of increased efficiency and flat power curve.

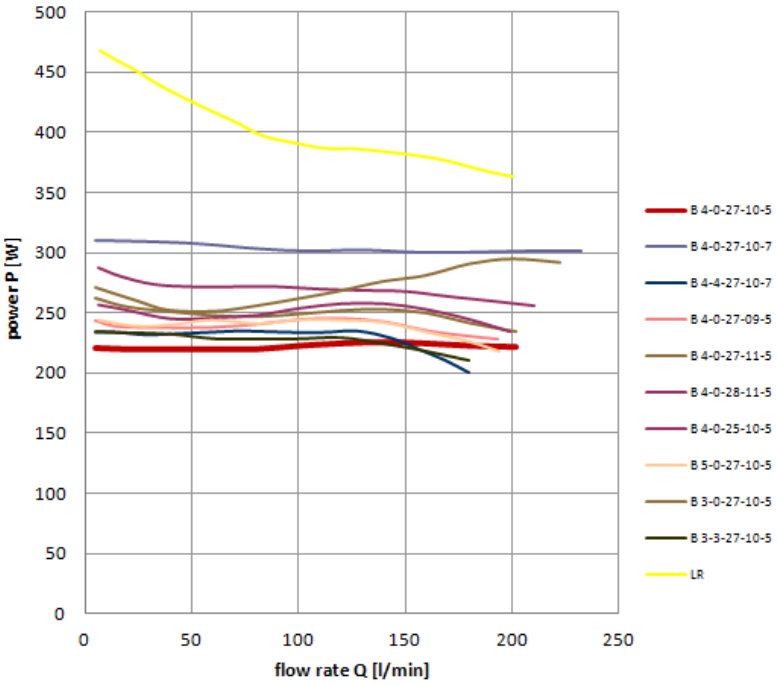

Figure 2. Experimental investigated power curves of the new hydraulic

Within the presentation, the detailed design steps and influences from variation of inlet diameter, outlet width, blade number and backup blades are demonstrated.

References

[1] Liu, S., Nishi, M., Yoshida, K.: Impeller Geometry Suitable for Mini Turbo Pump, Journal of Fluids Engineering,; Vol. 123; 2002.

[2] J.F. Gülich: Centrifugal pumps – Detailed design procedures for pumps; Third Edition; Springer Verlag; 2014.

[3] product catalogue; Lutz Pumpen GmbH; Wertheim; 2014. http://lutz-pumpen.tpk6.de/smart3/pub/katalog-englisch-europa/ web may 12th 2015