



Technical Paper

Wastewater pumps

Session 2-2

Single Blade Impeller Optimisation using the Design of Experiments Method in Combination with Numerical Simulation

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Summary

This paper deals with the optimisation of Single-Blade-Impeller designs as are used in the wastewater industry. When considering wastewater pump hydraulics, it is clear that both solids handling ability and hydraulic efficiency are essential criteria for optimisation. It is not sufficient to optimise single-blade-impeller designs for hydraulic performance alone, as this could lead to poor solids handling ability and continuous operational disturbance by clogging.

An innovative approach was taken to this optimisation problem through the combination of two separate tools; Design of Experiments (DOE) and Computational Fluid Dynamics (CFD). Design of Experiments is a numerical regression / statistical method. It provides a structured approach to optimisation, minimising the number of runs or attempts required and maximising the amount of information returned. Through the use of DOE, it was possible to investigate the effect on hydraulic performance of five key parameters identified as being critical to solids handling. The experiment required 32 runs, as compared to 243 runs which would have been necessary using the traditional "change one thing at a time" "trial and error" approach. For each DOE run, a unique impeller geometry was created and performance tested in CFD. A mathematical model was then created from the completed database. The resulting model has advanced the state-of-the-art in terms of single-blade-impeller design, quantified relationships between solids handling parameters and led to the development of new higher efficiency Single-Blade-Impeller designs with improved solids handling ability over conventional designs.