

METAL TO COMPOSITE: REDESIGN OF CENTRIFUGAL PUMP IMPELLER

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ABSTRACT

The project aims to redesign a cast iron centrifugal pump impeller from Grundfos. The objective is to reduce the energy consumption of the pump when it accelerates the impeller. This will be done by reducing the weight of the impeller and optimizing its shape with respect to reducing the mass moment of inertia. To achieve the weight reduction, the impeller material will be replaced with fibre reinforced polymer, due to its favourable stiffness to weight and strength to weight ratio.

The original impeller geometry must not be altered in a way that decreases its efficiency, as it is assumed that this is already at an optimum. In addition, it must be bounded to fit inside the original housing and must fit the original shaft and seals.

To analyse the impeller a one-way Fluid Structure Interaction (FSI) will be made, coupling a Computational Fluids Dynamics (CFD) analysis with a structural Finite Element Analysis (FEA), as illustrated in Figure 1. First, the CFD analysis will approximate the fluid forces acting on the impeller. The results are used in the FEA to approximate the deformations and stresses. The FSI will also be used to compare the steady state load case, with a transient load case modelling the start-up of the impeller, to determine which situation is the most severe.

Optimizing the impeller with respect to the mass moment of inertia might lead to an alteration of the unbound geometry. Although this might not seem a problem when manufacturing via casting, it would require advanced manufacturing methods to achieve with a composite material.

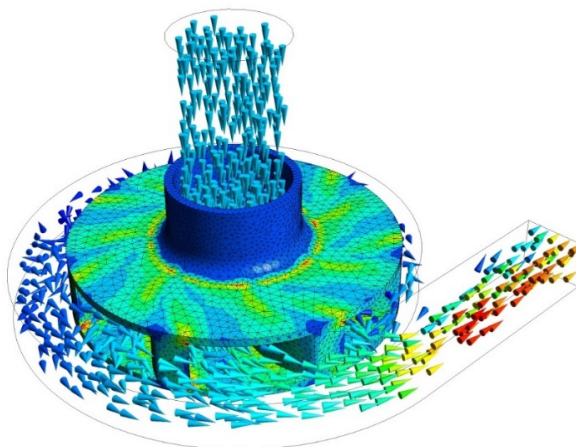


Figure 1: FSI using common CFD input on generic centrifugal pump.

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