Summary of Deliverable D4.8: Model validation and application to gear pump

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In this study, the developed three-phase cavitation model which was presented in the Deliverable 4.7 is applied along with an immersed boundary model for predicting cavitation in the presence of non-condensable gas (NCG) in a gear pump. Different from the previous report, where a Large Eddy Simulation (LES) was used for resolving turbulence, in the present report a $k-\omega-SST$ turbulence model is used. The results from the simulations are qualitatively validated against the experimental and numerical results from the literature. The Immersed boundary (IB) approach presented in this study allows a faster and easier way of modeling gear pump without any mesh interpolation. Moreover, the use of IBM enabled the modeling of gear contact easier without any additional numerical efforts.

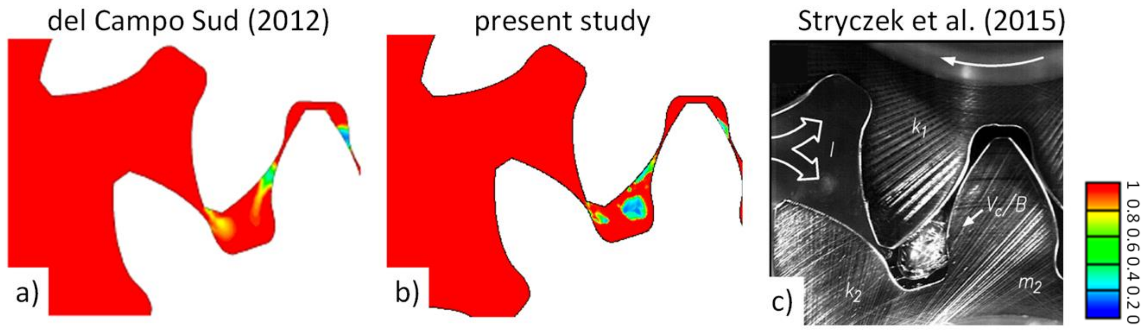

Figure 1: Validation of the numerical model against numerical (1) and experimental (2) work

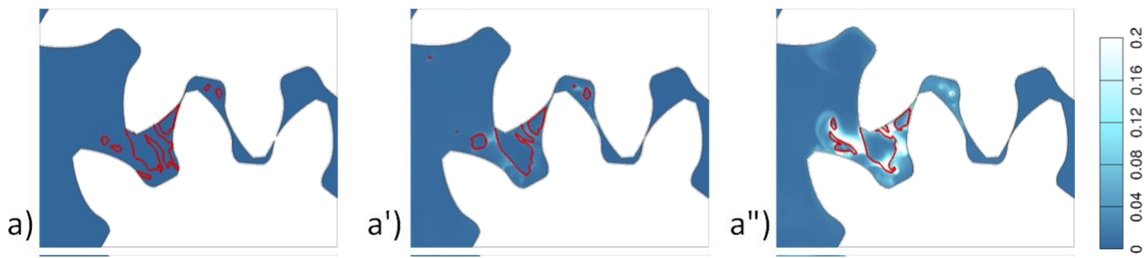

Figure 2: Evolution of NCG and cavitation; (a-d) for 0% NCG, (a'-d') for 0.2% and (a"-d") for 1% NCG content. The iso-lines of 50% vapour volume fraction shown in red lines. The instances are chosen randomly so as to highlight main features over a gearing period.

The cavitation model with the immersed boundary is applied on a 2D gear pump and validated against the work of (1) and (2) as shown in Figure 1. The model is further used to study the effect of NCG on cavitation. The results from the simulations suggest that the presence of NCG reduces the intensity and spread of cavitation (see Figure 2) without having much impact on the average flow rates.

References

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2. Stryczek J, Antoniak P, Jakhno O, Kostyuk D, Kryuchkov A, Belov G, et al. Visualisation research of the flow processes in the outlet chamber–outlet bridge–inlet chamber zone of the gear pumps. Arch Civ Mech Eng [Internet]. 2015 Jan;15(1):95–108. Available from: http://dx.doi.org/10.1016/j.acme.2014.02.010