15. <u>CAVITATION PROCESS SIMULATION FOR INDUSTRIAL APPLICATIONS</u>

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SUMMARY

The boiling of liquid under conditions where there is a significant pressure decrease is termed hydraulic cavitation. This cavitation starts with the formation of bubbles in the liquid which are filled with vapor and dissolved gases. The presence of caviation can occur in many fluid flow devices, for example, pumps, taps, turbines, marine propellers, etc. and can both significantly alter their performance and, in many cases, negatively degrade it or cause damage to the device. For example, in injectors, the presence of cavitation can impact the mass flow provided, as well as have a corrosive impact on its structural elements.

However, there is difficulty associated with determining the liquid parameters at the saturation curve for liquids such as mineral and synthetic oils, gasolines, diesel fuel and similar types. Therefore, the creation of a cavitation model within a 3D Computational Fluid Dynamics (CFD) simulation package with a minimal number of setting parameters is important to understand its occurrence and severity.

A description of a model for the simulation of hydraulic cavitation of industrial liquids is presented in this paper. The basis of the model is formed from the assumption that the characteristic time-scale of the vapor formation process is much less than the characteristic time-scale of the liquid flow. Therefore, the cavitation process occurs in conditions close to thermodynamic equilibrium. Further, it can be assumed that, in most cases, this process is isothermal, since the medium temperature changes due to phase transition are insignificant. The validity of this assumption is confirmed by numerous test data validation studies. This approach allows for the reduction level of specification of required thermodynamic properties of the liquid. The liquid flow in this presentation is described by 3D Navier-Stocks equations with k-ε turbulence model and a special barotropic state equation.

Several validation examples for different industrial liquids flowing within injectors, rotary pumps and even one external flow example around an aerofoil are presented. Comparison of the calculation results against test data show satisfactorily close agreement, indicating the validity and appropriateness of the model in these classes of application.