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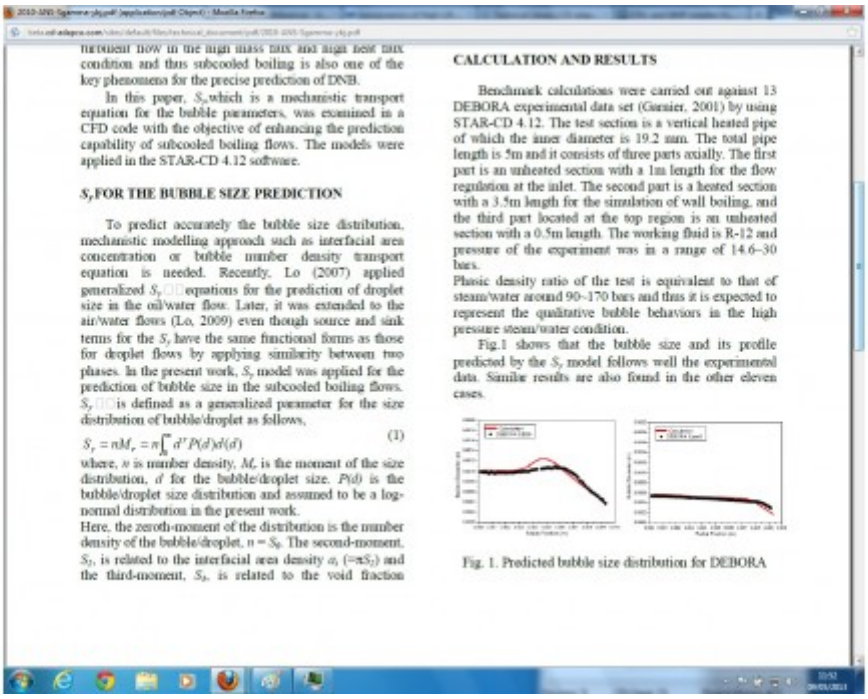
Application of Sgamma Model with CFD Code to Predict Subcooled Boiling Flow



CALCULATION AND RESULTS

Benchmark calculations were carried out against 13 DEBORA experimental data set (Garnier, 2001) by using STAR-CD 4.12. The test section is a vertical heated pipe of which the inner diameter is 19.2 mm. The total pipe length is 5m and it consists of three parts axially. The first part is an unheated section with a 1m length for the flow regulation at the inlet. The second part is a heated section with a 3.5m length for the simulation of wall boiling, and the third part located at the top region is an unheated section with a 0.5m length. The working fluid is R-12 and pressure of the experiment was in a range of 14.6~30 bars.

Phasic density ratio of the test is equivalent to that of steam/water around 90~170 bars and thus it is expected to represent the qualitative bubble behaviors in the high pressure steam/water condition.

Fig.1 shows that the bubble size and its profile predicted by the S_γ model follows well the experimental data. Similar results are also found in the other eleven cases.

Fig. 1. Predicted bubble size distribution for DEBORA

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Abstract:

Accurate simulation of subcooled boiling flow is essential for the operation and safety of nuclear power plants (NPP). In recent years, the use of computational fluid dynamics (CFD) codes has been extended to the analysis of multi-dimensional two-phase flow for the NPP. Among the applications of CFD code for the NPP analysis, the first target was selected as a mechanistic prediction of DNB (Departure from Nucleate Boiling) in PWR (Bestion et al, 2006). In DNB-type CHF (Critical Heat Flux), the expected flow regime is bubbly or churn turbulent flow in the high mass flux and high heat flux
condition and thus subcooled boiling is also one of the key phenomena for the precise prediction of DNB.In this paper, S?,which is a mechanistic transport equation for the bubble parameters, was examined in a CFD code with the objective of enhancing the prediction capability of subcooled boiling flows. The models were applied in the STAR-CD 4.12 software.

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