

## CFD multiphase modelling for the nanofluid boiling of the salt solution in a symmetric rectangular boiler

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**ABSTRACT:** Nano-fluids are found in the literature to enhance the boiling heat transfer and there are modelling case studies demonstrate how these effects occur. In this work a mathematical investigation of nanofluid boiling in a horizontal rectangular symmetric tube is presented, as a component of an exploit to improve heat transfer in vapour absorption refrigeration systems (VARs) via nanofluid. Previous research concentrates on water based fluids or commonly found refrigerants and heat transfer fluids. The nanofluid used in this study is acetone/zinc bromide ( $\text{ZnBr}_2$ ) based on the zinc oxide ( $\text{ZnO}$ ) nanoparticles. The process was modelled using ANSYS® Fluent V.15 computational fluid dynamic (CFD) commercially available software using the volume of fluid (VOF) multiphase flow model. An extra user defined code was applied from the literature for boiling of nano-fluids to model the mass transfer on boiling. Different concentration of the nanoparticles (0, 0.1, 0.3, 0.5 & 1 vol. %), the velocities of the fluid (0.005, 0.01 & 0.02 m/s) and temperature of the boiler (330, 333 & 335 K) were simulated to observe the effects of these parameters on the boiling and the phase change of the solution. It was found that the increase in nanoparticles loading leads to an increment in the vapour volume fraction and the heat transfer coefficient because the nanoparticles enhance the heat transfer as a result of increasing the thermal conductivity of the nanofluid. Increasing the boiler temperature increases the vapour volume fraction and decreases the heat transfer coefficient because increasing the vapour with low heat transfer coefficient leads to strike down the heat transfer coefficient of the result. This study is clarifying how the solution with different components and phases behave when its boil and just one of these components evaporate (produce a new phase). The aim of this study is to provide a better mechanism for understanding the heat and mass transfer behaviour of the acetone boiling under the effect of different variables in the boiler.

### KEYWORDS

Acetone-  $\text{ZnBr}_2$ ,  $\text{ZnO}$ , Nanofluid, Boling, CFD, Heat transfer, Mass transfer, Rectangular tube, Phase change.