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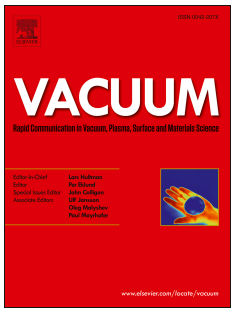

Numerical study on dynamics of single bubble rising in shear-thinning power-law fluid in different gravity environment

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Numerical Study on Dynamics of Single Bubble Rising in Shear-thinning Power-law Fluid in Different Gravity Environment

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Abstract: The bubble dynamics in non-Newtonian fluids play an important role in industrial processes, such as petroleum process, fermentation, wastewater treatment, boiling heat transfer, etc. To understand the bubble dynamics, the single bubble rising in the shear-thinning non-Newtonian fluid is detailedly studied with the volume of fluid (VOF) method, in which the continuous surface tension model and the Carreau model are used to calculate surface tension and liquid viscosity, respectively. Studies are performed on the influence of the rheological index, the Eötvös and Galilei numbers on bubble shape, wake characteristic, terminal velocity and liquid apparent viscosity. The present results show that, the bubble deformation and the circulating region in the bubble wake increase with increasing the Eötvös and Galilei numbers or with decreasing the rheological index. With the decrease of the rheological index, one confined region with the high viscosity exists in the bubble rear, and this region gradually detaches from the bubble rear. The detachment becomes fast with the increase of the Galilei number. In addition, the bubble terminal velocity depends on the bubble shape, the shear-thinning effect of liquid and the gravity level.

Key words: bubble dynamics; shear-thinning fluid; the Eötvös number; the Galilei number