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Dispersion of Viscoelastic Fluids in Porous Structures: An Experimental and Computational Investigation

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Introduction

The role of emulsions is of increasing importance in the food and pharmaceuticals industries. Customer demand for higher product quality together with adherence to increasingly strict government regulation has made studying the emulsification process and its influencing parameters of utmost significance. Parameters such as the porosity and pore size distribution, along with the membrane's surface wettability or charge, directly affect the stresses within the porous structure and thus the resulting emulsions. Additionally, the physical properties of the dispersed fluid itself when under such conditions have an influence on the resulting emulsion and droplet size distribution. Furthermore viscoelasticity, the adapting of a fluid's viscosity based on the exerted on it stress, has a direct effect on the liquid-liquid as well as the liquid-solid interactions of a droplet inside a porous membrane.[1]

Methods & Objectives

The work revolves around the interaction and interconnection of all these parameters with the aim of understanding the emulsification process and droplet break-up mechanisms down to a fundamental level. To this end emulsification simulations in idealised pores and complex membrane structures are carried out. Varying the contact angle as well as the pore size of an ideal pore the aim is to determine the ideal conditions for droplet entry as well as the behaviour of the droplet and break-up mechanism once inside the pore. A big step in this direction is analysing the instabilities between the two phases as well as the walls occurring inside the pore. Further to that by altering the viscoelastic moduli of the fluids the effect of viscoelasticity on the instabilities leading to droplet break-up in the pore is studied.

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