339d A Mathematical Description of Bubble Growth in Bread Dough

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Bubble dynamics in different materials has attracted considerable attention over the past several decades [1]. The process involves heat, mass and momentum transfer between bubbles and between bubbles and their surroundings; each of these affecting the other. The complexity of the problem led several authors to use assumptions to simplify the resulting complexity [2, 3]. A common approach is to consider some of the transport phenomena negligible for certain bubble size ranges [4]. However, this raises issues as to how one can identify the pertinent size ranges. The problem is compounded even further when one considers analysis of bubble growth in Non-Newtonian fluids [5].

In the food industry, puffing processes, in which release or expansion of gas inside a material causes the appearance of porous internal structure, have been commonly applied [6]. Even though this structure is created mostly through growth and merging of bubbles in the material, the former has mostly been considered from the standpoint of the size of the final product and how it changes with time [7]. Even when growth of individual bubbles is considered [8], there is relatively little work done on expansion of bubbles in bread dough after a sudden release of pressure [9, 10] ; seen in puffing and a common food processing method called extrusion cooking.

In this work, the need for an inclusive and more complete bubble growth model is addressed by the development of a bubble growth model that considers the dynamics of a bubble growing in an isothermal viscoelastic fluid medium (bread dough) saturated with a volatile material while the fluid mass is expanding after compression.

Good correlation was found with experimental results for a similar system [9]. The growth regimes identified in previous work were observed [1]. In addition, a methodology was developed to circumvent the previous assumption of dominant phenomena which can be applied for other systems of the same nature.

References

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