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Literature review related to Non-Newtonian fluids using computational fluid dynamics techniques (CFD) in the year 2022

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This document retrieves the articles published in 2022 related to non-Newtonian fluids studies using CFD techniques. Only the meaningful articles have been taken in account, while others have been discarded following the criteria detailed below. A total of 116 articles have been selected, while 4 had not met the requisites.

I. CONTEXT AND MOTIVATION: WHY ARE NON-NEWTONIAN FLUIDS RELEVANT?

Non-Newtonian fluids are fluids that exhibit behavior that deviates from the standard viscosity and flow properties observed in Newtonian fluids, which includes most common liquids such as water and oil. In contrast, Non-Newtonian fluids show different behavior when subjected to forces or stress such as pressure, shear stress, or deformation. This can result in unique properties such as shear-thinning (viscosity decreasing with increasing shear rate) or shear-thickening (viscosity increasing with increasing shear rate) behavior.
Non-Newtonian fluids are of particular interest in science and technology because they have a wide range of applications in various fields such as materials science, biotechnology, food science, and engineering. Understanding the behavior of non-Newtonian fluids is important for designing and optimizing processes that involve these materials.
Some examples of non-Newtonian fluids include blood, ketchup, toothpaste, and polymers. In the medical field, non-Newtonian fluids are used as artificial blood, and in drug delivery systems. In food science, they are used as thickeners, emulsifiers, and stabilizers. In materials science, they can be used as smart fluids for sensing and actuation, and in industrial processes such as coating and painting.
In conclusion, non-Newtonian fluids have unique properties that make them important in science and technology. They are used in a wide range of applications, and understanding their behavior is essential for developing new materials and optimizing processes involving them

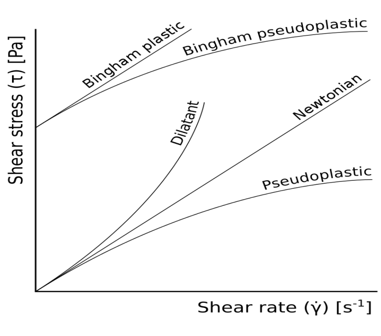

FIG. 1. Behaviour of different types of fluids under shear stress.

A. The importance of computational fluid dynamics

Computational fluid dynamics (CFD) is a numerical tool used to study the behavior of fluids and gases by solving complex equations that describe the flow of fluids. CFD has become an essential tool for researchers and engineers to understand the behavior of non-Newtonian fluids and make advancements in the field.
One reason why CFD is so important is that non-Newtonian fluids exhibit complex behavior that is difficult to describe mathematically. CFD allows researchers to simulate the behavior of these fluids in a virtual environment and obtain insights into their behavior that would be difficult to obtain through experimentation alone.
Furthermore, CFD can be used to optimize processes involving non-Newtonian fluids, such as polymer processing or drug delivery systems. By simulating these processes, researchers can identify the best conditions for achieving a desired outcome and optimize the process to minimize costs and maximize efficiency, therefore developing new materials with unique properties that can be tailored to specific applications.
Overall, CFD has become an essential tool for understanding the behavior of non-Newtonian fluids and making advancements in the field. It allows researchers to simulate complex fluid behavior in a virtual environment, optimize processes involving these fluids, and design new materials with tailored properties. As our understanding of non-Newtonian fluids continues to evolve, CFD will play an increasingly important role in driving advancements in the field.

II. SEARCH DESCRIPTION AND PARAMETERS

The search has been performed using the database *Scopus*, a bibliographical database property of Elsevier. For a first approach using the *search documents* section, the keywords 'Non Newtonian Fluids' and 'CFD' have been passed as inputs, also setting the year range to 2022. This first search has ended up in 120 potential articles, which have been revised, classified and in some cases discarded. A first glance of the titles and abstracts has been enough to determine the

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content of the article, therefore deciding to select or discard it. It has been necessary to pay attention for synonyms of Non-Newtonian fluids, such as shear-thinning, viscoelastic, pseudoplastic, Bingham, power-law or Herschel-Buckley fluids.

A. Criteria followed in the selection

The selected articles must have studied a system made of or directly involving non-Newtonian fluids using some sort of simulation or numerical calculation.

B. Discard reasons

From the 120 retrieved articles, a total of 4 have been discarded for diverse reasons. They are detailed as follows:

Articles have appeared in the indexed search for the use of Newtonian fluids, instead of non-Newtonian ones.

- Liaw, K. L., Kurnia, J. C., & Sasmito, A. P. (2022). Laminar convective heat transfer in helical twisted multilobe tubes. Case Studies in Thermal Engineering, 39. doi:10.1016/j.csite.2022.102459
- He, L., Liu, Z., & Zhao, Y. (2022). An extended unresolved CFD-DEM coupling method for simulation of fluid and non-spherical particles. Particuology, 68, 1–12. doi:10.1016/j.partic.2021.11.001

Article is a conference where the main topics discussed are not Non-Newtonian fluids.

- 9th International Conference on Fluid Flow, Heat and Mass Transfer, FFHMT 2022. (2022).

Fluid was assumed as Newtonian in the study

- Subramaniam, T., & Rasani, M. R. (2022). Pulsatile CFD Numerical Simulation to investigate the effect of various degree and position of stenosis on carotid artery hemodynamics. Journal of Advanced Research in Applied Sciences and Engineering Technology, 26(2), 29–40. doi:10.37934/araset.26.2.2940

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