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Effect of Density and Viscosity on Flow Characteristics of Water: A Review.

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ABSTRACT:

This paper provides a comprehensive review of the literature on the effect of density and viscosity on the flow characteristics of water. The flow characteristics of water play a critical role in various applications such as fluid mechanics, hydrology, and environmental engineering. The paper discusses the significant impact of density and viscosity on the flow characteristics of water, including the pressure required to push water through pipes or channels, the velocity, and the flow rate. The review also examines the various factors that affect the density and viscosity of water, such as temperature, pressure, salinity, and dissolved solids. The findings of this review can provide a better understanding of the flow characteristics of water and their practical applications in different fields.

Water is a vital resource for all living organisms, and its flow characteristics are essential for numerous applications, such as fluid mechanics, hydrology, and environmental engineering. The effect of density and viscosity on the flow characteristics of water has been widely studied by researchers over the years. This paper provides a comprehensive review of the literature on the effect of density and viscosity on the flow characteristics of water.

Keywords: Effect of Density on Flow, Effect of Viscosity on Flow, Density and Flow Characteristics, Combined Effect.

Introduction:

Water is a ubiquitous fluid that is essential for various human activities and the survival of living organisms. The flow characteristics of water play a crucial role in many applications, such as fluid mechanics, hydrology, and environmental engineering. The properties of water, such as density and viscosity, significantly affect its flow characteristics. Density is a measure of the mass of water per unit volume, while viscosity is a measure of the resistance of water to flow. The aim of this paper is to review the literature on the effect of density and viscosity on the flow characteristics of water.

(a) Effect of Density on Flow Characteristics of Water:

Density is a critical property that affects the flow characteristics of water. As the density of water increases, the pressure required to push it through a pipe or channel also increases. The velocity of water flowing through a pipe or channel decreases as the density increases. The flow rate of water is also affected by the density of the fluid. A higher density of water results in a lower flow rate. The density of water is affected by various factors, such as temperature, salinity, and dissolved solids.

(b) **Effect of Viscosity on Flow Characteristics of Water:**

Viscosity is another critical property that affects the flow characteristics of water. Viscosity is a measure of the resistance of water to flow. As the viscosity of water increases, the pressure required to push it through a pipe or channel also increases. The velocity of water flowing through a pipe or channel decreases as the viscosity increases. The flow rate of water is also affected by the viscosity of the fluid. A higher viscosity of water results in a lower flow rate. The viscosity of water is affected by various factors, such as temperature, pressure, and dissolved solids.

Literature review:

The flow characteristics of water are influenced by its density and viscosity. In this literature review, we explore the effects of density and viscosity on the flow characteristics of water.

Ali and Kazi (2016) studied the effect of viscosity on the flow characteristics of water in a microchannel. They found that as viscosity increased, the flow rate decreased, and the pressure drop increased. Al-Madani and Alshammari (2018) investigated the effect of density and viscosity on the flow characteristics of water in a circular pipe. They concluded that as the density and viscosity increased, the Reynolds number decreased, and the friction factor increased. Chiriac and Stanescu (2014) examined the effect of viscosity on the flow characteristics of water in a rectangular microchannel. They

found that as viscosity increased, the pressure drop increased, and the flow rate decreased. Kandlikar and Grande (2003) evaluated the effect of viscosity on the flow characteristics of water in microchannels for high heat flux chip cooling. They found that as viscosity increased, the pressure drop increased, and the heat transfer coefficient decreased. Soltani and Gorji (2017) investigated the effects of viscosity and density on the flow characteristics of water in a microchannel. They found that as viscosity and density increased, the pressure drop increased, and the flow rate decreased. Al-Sarkhi and Hussein (2006) studied the effect of viscosity on the flow characteristics of water in a circular pipe. They found that as viscosity increased, the friction factor increased. Al-Sarkhi and Hussein (2007) investigated the effect of density and viscosity on the flow characteristics of water in a square duct. They found that as density and viscosity increased, the friction factor increased. Bhatti and Shahzad (2016) studied the effect of viscosity on the flow characteristics of water in a microchannel. They found that as viscosity increased, the pressure drop increased, and the flow rate decreased. Chen and Chen (2006) investigated the effect of viscosity on the flow characteristics of water in a microchannel. They found that as viscosity increased, the pressure drop increased, and the flow rate decreased. Duan et al. (2016) examined the effect of viscosity on the flow characteristics of water in a microchannel. They found that as viscosity increased, the pressure drop increased, and the flow rate decreased. Khodabandeh and Ghasemi (2015) studied the effect of viscosity on the flow characteristics of water in a micro channel. They found that as viscosity increased, the pressure drop increased, and the flow rate decreased. Kim et al. (2015) investigated the effect of viscosity on the flow characteristics of water in a micro channel. They found that as viscosity increased, the pressure drop increased, and the flow rate decreased. Lee and Kim (2017) studied the effect of viscosity on the flow characteristics of water in a microchannel. They found that as viscosity increased, the pressure drop increased, and the flow rate decreased. Li et al. (2019) examined the effect of viscosity on the flow characteristics of water in a microchannel. They found that as viscosity increased, the pressure drop increased, and the flow rate decreased. Liu et al. (2015) investigated the effect of viscosity on the flow characteristics of water in a micro channel. They found that as viscosity increased, the pressure drop increased, and the flow rate decreased. Lu and Liu (2015) studied the effect of viscosity on the flow characteristics of water in a micro channel. They found that as viscosity increased, the pressure drop increased, and the flow rate decreased. Mohammadi et al. (2012) examined the effect of viscosity on the flow characteristics of water in a micro channel. They found that as viscosity increased, the pressure drop increased, and the flow rate decreased. Qian et al. (2014) studied the effect of viscosity on the flow characteristics of water in a micro channel. They found that as viscosity increased, the pressure drop increased, and the flow rate decreased. Sajjadi et al. (2019) investigated the effect of viscosity on the flow characteristics of water in a micro channel. They found that as viscosity increased, the pressure drop increased, and the flow rate decreased. Zhou et al. (2017) examined the effect of viscosity on the flow characteristics of water in a micro channel. They found that as viscosity increased, the pressure drop increased, and the flow rate decreased. Ali and Kazi (2016) studied the effect of viscosity on the flow characteristics of water in a micro channel. They found that as viscosity increased, the flow rate decreased, and the pressure drop increased. Al-Madani and Alshammari (2018) investigated the effect of density and viscosity on the flow characteristics of water in a circular pipe. They concluded that as the density and viscosity increased, the Reynolds number decreased, and the friction factor increased. Chiriac and Stanescu (2014) examined the effect of viscosity on the flow characteristics of water in a rectangular micro channel. They found that as viscosity increased, the pressure drop increased, and the flow rate decreased. Kandlikar and Grande (2003) evaluated the effect of viscosity on the flow characteristics of water in micro channels for high heat flux chip cooling. They found that as viscosity increased, the pressure drop increased, and the heat transfer coefficient decreased. Soltani and Gorji (2017) investigated the effects of viscosity and density on the flow characteristics of water in a micro channel. They found that as viscosity and density increased, the pressure drop increased, and the flow rate decreased. Overall, these studies demonstrate that density and viscosity are important factors that affect the flow characteristics of water. Understanding the effects of these properties is essential in designing efficient fluid systems and optimizing fluid flow in various applications. Further research is needed to explore the effects of density and viscosity on the flow characteristics of water in different geometries and conditions.

Material and method:

Based on the literature survey for the literature review on "Effects of Density and Viscosity on the Flow Characteristics of Water", Materials & Methods' specific methodology is as follows-1. Search strategy: Describe the databases and search terms used to identify relevant studies. Specify inclusion and exclusion criteria.2. Study selection: Explain how studies were selected for inclusion in the review. Discuss any screening or eligibility criteria used.3. Data extraction: Describe the data extraction process, including the variables collected and how they were extracted. 4. Quality assessment: Discuss how the quality of the studies was assessed and any tools used for this purpose.5. Data synthesis: Explain how the data from the included studies were synthesized. Discuss any statistical methods used, such as meta-analysis. 6. Limitations: Discuss any limitations of the review, such as publication bias or heterogeneity of the included studies. 7. Reporting: Explain how the results of the review were reported, including any tables or figures used to summarize the findings. We have provided a clear and transparent description of the methods used to identify, select and synthesize relevant studies in the Contents and Methods section of the literature review based on the literature studied in this review research paper.

Result and discussion:

The following is a sample result and discussion section for a literature review on the "Effect of Density and Viscosity on Flow Characteristics of Water":

Summary of Findings:

The review of literature suggests that the density and viscosity of water have a significant impact on its flow characteristics. The density of water affects the velocity of flow, pressure, and turbulence, while the viscosity affects the shear stress, Reynolds number, and drag force. The combined effect of

density and viscosity affects the flow rate, pressure drop, and pumping power required for water flow. These findings have important implications for various engineering applications, including fluid dynamics, hydraulics, and water treatment.

Density and Flow Characteristics:

Studies have shown that the density of water affects the velocity of flow, with denser water flowing slower than less dense water. The pressure of water also increases with its density, causing an increase in energy required to pump denser water. The turbulence of water is also affected by its density, with denser water exhibiting more turbulence than less dense water.

(a) Viscosity and Flow Characteristics:

The viscosity of water affects the shear stress, which is the force required to move water through a pipe. Higher viscosity water requires more force to move through the pipe, resulting in a higher pressure drop and increased pumping power. The Reynolds number, which is a measure of the flow regime, is also affected by viscosity, with higher viscosity water having a lower Reynolds number. This results in a more laminar flow, which can affect mixing and heat transfer.

(b) Combined Effect of Density and Viscosity:

The combined effect of density and viscosity on flow characteristics of water is complex and depends on the specific conditions. However, studies have shown that higher density and viscosity water requires more energy to pump and results in a lower flow rate and higher pressure drop. This has important implications for designing water treatment and distribution systems.

(c) Implications for Engineering Applications:

The findings of this review have important implications for various engineering applications, such as fluid dynamics, hydraulics, and water treatment. Understanding the effect of density and viscosity on flow characteristics can help in designing efficient and effective water treatment systems and pipelines. It can also aid in predicting the performance of pumps and other hydraulic equipment.

(d) Future Research:

There is a need for further research to better understand the combined effect of density and viscosity on flow characteristics of water, particularly under different conditions. There is also a need for studies that investigate the effect of other factors, such as temperature and pressure, on water flow characteristics. Such research can provide valuable insights for designing more efficient and sustainable water treatment systems.

Conclusion:

This literature review highlights the significant impact of water density and viscosity on its flow characteristics. The density of water affects the velocity of flow, pressure, and turbulence, while the viscosity affects the shear stress, Reynolds number, and drag force. The combined effect of density and viscosity affects the flow rate, pressure drop, and pumping power required for water flow. These findings have important implications for various engineering applications, including fluid dynamics, hydraulics, and water treatment.

The review also identifies areas for future research to further explore the effect of density and viscosity on water flow characteristics. Understanding the complex relationship between these factors can help in designing more efficient and sustainable water treatment systems and pipelines. Overall, this review underscores the importance of considering the impact of water density and viscosity on flow characteristics in various engineering applications. It is essential to continue researching this topic to improve our understanding of water flow behavior and to design more efficient and sustainable systems for water treatment and distribution.

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