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TITLE:

Investigation of Mechanical Properties studies between Single and Double Layer Polysulfone Substrate Membrane for Desalination Process

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AUTHOR'S DECLARATION

" I, MOHAMAD AIDIL SHAHFITRI BIN AZAMAN, declare that the work presented in this final year project with the Investigation of Mechanical Properties studies between Single and Double Layer Polysulfone Substrate Membrane for Desalination Process, is my own original effort and has not been submitted for any other academic purpose.

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ABSTRACT

Water scarcity is a growing global concern, particularly in arid regions where access to clean and potable water is limited. Desalination has emerged as a viable solution to address this issue, with reverse osmosis (RO) being the most widely used desalination technology. However, the efficiency and longevity of RO systems depend heavily on the mechanical properties of the membranes used. Polysulfone (PSF) membranes are commonly employed in desalination due to their excellent thermal and chemical stability. However, single-layer PSF substrates often break under high pressure, which leads to frequent replacements and high costs. This study compares the tensile strength of single and double layer PSF substrate which are better for desalination using a Universal Tensile Machine (UTM). Results showed that double layer PSF substrate were 60.3 stronger than single layer ones because they distribute stress better and provide more durability. While single layers are more flexible, they are not suitable or strong enough for long term use in desalination. This study suggests that double layer membranes are better option for high pressure desalination. Future research should focus on conducting more testing for mechanical properties such as bending and tearing and improving membranes by adding nanoparticles such as Titanium Dioxide to further improve durability.

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1.0 BACKGROUND

1.1 INTRODUCTION

The oceans represent the largest habitat on Earth, covering 71% of Earth's surface with an average depth of 3.8 kilometers [26]. The total volume of this seawater is around 1.3 billion cubic kilometers, which accounts for 0.24% of the total mass of the Earth. Earth's water is largely covered by saltwater, with approximately 97.5% reside in the oceans and only 2.5% as freshwater [27]. However, even within this small fraction, most of the total freshwater included ice caps and glaciers which are inaccessible for human use [28]. This shows that only a small fraction of Earth's freshwater is accessible at the surface.

The availability of fresh water is a critical global challenge, mainly an issue in dry or arid regions such as the Middle East and North Africa (MENA), where drinkable water is extremely crucial [29]. For examples, Saudi Arabia, the United Arab Emirates, Kuwait and Qatar heavily relies on non-conventional water sources due to limited freshwater availability. Water demands in these areas will far exceed supply by 2030 [29].

The ability to access potable water is an important factor since it determines whether human settlements can be established [1]. Over the few decades, water scarcity has escalated as a major issue. Driven by many factors including rising population, high city development, and the continuous expansion of national and global economies [12]. As the global population continues to grow, the need for clean and safe water rises, which places immense pressure on available freshwater resources [12].

To solve water scarcity, various strategies have been analyzed to maximize the use of available water sources, highlighting the use of seawater [1]. The demands for clean and safe drinking water are increasing and it leads to improvements in water treatments technologies within the water industry [4]. Seawater desalination is a method used to separate saline water into two primary components. One of them is fresh and potable water with low dissolved salt content while the other is brine which has a high concentration of dissolved salts [1].

Among the various desalination technologies, reverse osmosis (RO) is the most widely utilized due to improvements in membrane technology and low consumption in energy used. These improvements have increased the efficiency and output of the system [1].