UNIVERSITI TEKNOLOGI MARA

ANALYSIS OF CAPILLARY LEAKAGE THROUGH NARROW GAP BETWEEN MANIFOLD AND PLATE INTERFACES VIA SIMULATION APPROACH

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AUTHOR'S DECLARATION

I declare that the work in this dissertation was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This dissertation has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Hydraulic fluid leaking is a common problem or failure mode that was observed in any hydraulic field applications. This is not only specified to any specific fluid medium such as mineral oil, tapped water, filtered water, water glycol and few more fluids medium, but also happened when using gases, based on each application in each industry. In Oil and gas industry, an enormous amount of money required to retrieve one unit of failure subsea control modules from the seabed and to replace with replacement unit. The change out operation also required an experienced team to ensure the successfully of the operation. Due to these circumstances the objectives of this study aims to identify the maximum allowable gap that can be allow during testing with a combination of constant low pressure and the maximum high pressure before the leaks start to occurred and to investigate the capillary leaks pattern between the interface once leaking regardless any combination of low pressure and the maximum high pressure. With specific configuration selected based on two variables, such as pressure applied and the opening dimensions this will be enabling to identify the failure point before it can happen through analysing the failure pattern. Numerical analysis (CFD simulations) has been chosen to visualize the flow pattern in this study. The pressure simulated consist of a combination of between a constant low-pressure circuit and four high pressure circuit. The constant low pressure is set at 345 Mpa and high pressure set at 0Mpa, 345Mpa, 690Mpa and 852Mpa. The leakage flow is observed through a gap based on the geometrical tolerances at 0.1mm, 0.2mm, 0.3mm, 0.4mm and 0.5mm. The fluid distribution around the gap in each case is studied to determine the fluid velocity corresponding to the pressure distribution. The result shows that the flow can be clearly seen until the edge for gap 0.5mm and 0.4mm. Even though the flow within gap 0.3mm is not significant and mainly concentrating in the middle section of the plain compared to gap 0.5mm and 0.4mm, the condition still could not be considered as no leak because of the risk is too high for the leak to occur. The highest velocity is observed in one of the cases of constant low pressure only with 0.5mm gap. Gap 0.2mm and 0.1mm can be allowed with a combination of 345Mpa and 852 Mpa without any risk of leaking fluids.

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