ABSTRACT

Nowadays, the phenomena of vortex flow have been the main concern for researchers in the period of the last century. Along the development of industrial technology, currently many emerging industrial equipment with the use of vortex flow. One of them is hydrocyclones separator.

This separator is currently very popular and more widely used than conventional separators such as gravity-based and vessel-type separator because it has several advantages such as light weight, low cost, no moving parts, easy operation, and high separation efficiency. Because of those advantages, hydrocyclones are widely used in several fields such as minerals, chemicals, textile, pharmaceutical and petrochemical industries. The development of hydrocyclones continues to gain the maximum performance systems mainly for oil and water mixture.

This study aims to determine the phenomena of oil-water separation and the separation performance of the Liquid-Liquid Cylindrical Cyclone (LLCC). An experimental runs has been designed and commissioned, and results from both experiments and numerical simulations are presented. General characteristics of separation process and flow behaviour in the LLCC were explained in the form of qualitative observation and quantitative explanation. For the experimental runs, the LLCC was tested under a wide range of operating parameters such as inlet mixture velocity, split-ratio, and different inlet oil volumetric concentration. The acquired data include the underflow watercut and overflow oil volume fraction. Data analysis reveals that the LLCC can be used successfully for bulk separation of oil and water mixture, with the value of watercut and oil volume fraction up to 99%.

In order to further understand the detailed process of the oil-water separation, flow behaviour in the LLCC, and the phase distribution in the LLCC, numerical simulations were carried out. Computational Fluid Dynamics (CFD) technique is applied to simulate the oil-water flow in the LLCC with the mixture model (Euler-Euler approach) for multiphase model and the Reynolds Stress Model (RSM) for turbulence model. Through numerical simulation, the multiphase flow field is achieved and other operation parameters are studied on the influence of the separation performance. Predictions of the CFD simulations showing good agreement with the experimental data.

Keyword : LLCC, optimum split-ratio, inlet mixture velocity, inlet oil volumetric concentration, split-ratio, watercut, oil volume fraction.