Evaluation on the Factors Influencing the Deposition of Wax using Full Factorial Design

N. RIDZUAN[1] and A. A. AZHAR [1]

[1]Faculty of Chemical and Natural Resources Engineering, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Kuantan, Pahang, Malaysia

Abstract The purpose of this study is to determine the rate of wax deposition of Malaysian crude oil by evaluating the operational factors using full factorial design (FFD) approach (Design Expert version 7.1.6). Four factors were studied, which are rotation speed (A), cold finger temperature (B), experimental duration (C) and type of wax inhibitor (D), Poly(ethylene-co-vinyl acetate) (EVA) and xylene were used as a wax inhibitor. The individual effects of each factor and its interaction effects towards the response variable were studied. The result demonstrated that fewer wax deposit was obtained (0.0055 g) when optimal conditions of 2 h duration with 600 rpm rotation speed at 15°C cold finger temperature and EVA as an inhibitor were used. From the analysis of variance (ANOVA), factor B was found to be the main factor in affecting the wax deposit formation. However, the interaction between factors A and D shows the highest influence to reduce wax deposition. Furthermore, the model is designated with high determination coefficient (R^2 = 0.8221), which explains 82.21% of the variability in the response. Hence, it can be concluded that factor B, and interaction between factors A and D need to be focused in controlling the parameters to minimize wax deposition.

Keywords Wax deposition, crude oil, cold finger, full factorial design (FFD), design of experiment

1 Introduction

Wax formation from paraffin deposition of crude oil constitutes a major and serious problem in both onshore and offshore production facilities (Oyekunle et. al., 2017). This paraffin deposition will cause flow assurance problem for oil and gas production. During the transportation of crude oil, at temperature below wax appearance temperatures (WAT), the crude oil will be solidified and form wax crystals (Guozhong and Gang, 2010). The wax will grow and form a crystalline net that will trap all molecules of liquid hydrocarbon, causing oil flow blockage in pipeline (Taraneh et. al., 2008). According to Telford (2007), the design of experiments is a structured and organized way of conducting and analyzing controlled test to evaluate factors that are affecting a response variable. Full factorial design (FFD) is a more operative method to determine the impact of two or

Acknowledgments

The authors acknowledge the financial support from Universiti Malaysia Pahang (RDU170352) and the Ministry of Education (MOE), Malaysia, through the Fundamental Research Grant Scheme (RDU 1901060) for having this research project to be successfully conducted. We also thank to Petronas Penapisan Terengganu, Malaysia for providing the crude oil samples for the research project.