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Characterization and Wax Mass Flux Analysis of Bakrol Field India Crude Oil

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Abstract

Wax deposition is one of the most expensive flow assurance issues encountered in crude oil production and transportation. It can lead to drastic production loss and ultimately heavy economic losses to E&P companies. Thus, precise prediction for field case is necessary to avoid this issue. Generally, two basic models, Film Mass Transfer (FMT) and Equilibrium Model (EM) are utilized to determine wax mass deposition in the crude oil pipelines. In this study, theoretical wax mass flux is computed based on these methods and compared with a field data point of wax mass deposited in 1.7 km long buried gathering line at Bakrol field, Gujarat, India. For a field flow rate of 100 m^3/day in 4 in. pipe (ID = 3.765 in.), the fluid is in laminar flow regime. This contradicts the presumption that only turbulent flow condition prevails in the field. In addition to this, the analysis revealed that actual field wax mass flux for Bakrol field gathering line is close to the estimated value using FMT model and not EM. This agreement of the field data with laboratory flow loop data might be due to the closeness of field pipe ID (3.76 in.) with flow loop pipe ID (0.5 to 2 in.). Therefore, for Bakrol field, it is suggested to use FMT model for the calculation of wax mass flux rather than the EM model. However, previous researchers have reported predictions from FMT model also holds true for turbulent flow conditions in field case, which is in contradiction with the observation and explanation available in the literature for laboratory scale flow loop data. Thus, field data with larger diameter pipe and different waxy crude oils are required to make a robust conclusion.

Introduction

Crude oil with a high wax content can cause major problems during the production and transportation of crude in a pipeline (Singh *et al.* (2000)). Wax gets deposited mostly by molecular diffusion. Wax deposition occurs in almost every part of the production system including reservoir, wellbore, pipelines and surface facilities. Due to this blockage, the cost of oil production increases significantly (Singh *et al.* (2000)). This cost can be reduced if wax deposition in a pipeline can be accurately predicted (Lee (2008)). Generally, two theoretical models, FMT and EM, are utilized for prediction of wax deposition in crude oil pipeline (Karami (2011), Singh *et al.* (2011), Soedarmo *et.al.* (2017)). It is observed that for certain field cases the prediction from FMT is closer to the field data while it over predicts in other cases (Singh *et al.* (2011), Singh *et al.* (2014), Soedarmo *et al.*(2017)). Moreover, limited field data is available for making robust conclusion (Singh *et al.* (2011), Singh *et al.* (2014), Soedarmo *et al.* (2017)). A crude oil sample from 1.7 Km long