The effect of the operating temperatures and the solubility of paraffin on wax deposition

Shanpeng Han[a], Zhenyu Huang[b], Rainer Hoffmann[c], H. Scott Fogler[b*]

Beijing Key Laboratory for Urban Oil and Gas Distribution Technology, China University of Petroleum, Beijing, 102249, China[a]
Department of Chemical Engineering, University of Michigan, Ann Arbor, Michigan 48109[b]
sfogler@umich.edu
Herøya Research Centre, Statoil ASA, N-3908 Porsgrunn, Norway[c]

Wax deposition in the subsea pipelines has been a major flow assurance problem for the petroleum industry. Flow loop experiments with different operating temperatures can be used to simulate the wax deposition at different axial positions of subsea pipelines. In this work, a series of flow loop deposition experiments are carried out based on different inlet temperatures and a model is applied based on the fundamentals of heat and mass transfer.

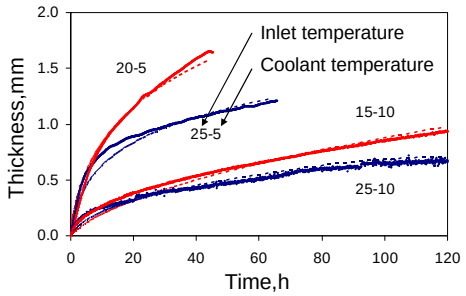

Fig. 1: Experimental and model prediction of deposit thickness as a function of time. The dash line indicates the experimental result while the solid line represents the prediction by the model.

The experimental results show that the wax deposit thickness increases with decreasing inlet temperature, which presents a contradictory trend from a previous study based on model oil [1]. To investigate this discrepancy, theoretical analysis using fundamentals of transport phenomena in the deposition model was carried out on the experiments of both the model oil and the crude oil. According to the deposition model, the temperature gradient at interface and change of wax solubility at interface temperature are the two major elements to affect the growth of the wax deposit. By analyzing these two elements in the two aforementioned experiments, it is found that the discrepancy is due to in the crude oil property and operating conditions. In conclusion, no generalization can be made to estimate on the effect of inlet temperature on wax deposition without considering the change in the temperature gradient of the particular experiment and the slope of the solubility curve of the oil.

References

[1] Hamid, O. B., Mehrotra, A. K. (2009) Energy & Fuels 23 3184-3194