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ABSTRACT

Effect of Solvent Type on Scaling Enhanced Solvent Oil Recovery Processes

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Understanding the use of solvents in the economic recovery of bitumen from oil sands in Alberta, Canada, continues to be a relevant research area [1]. In addition, understanding the underlying behaviour of different solvent types in solvent oil recovery is still not well described in the literature, nor is the scaling of the processes from lab to field scale. This research uses a scaling approach that was developed for thermal processes [2], in conjunction with the use of reservoir simulation [3] to understand the mechanisms described by the scaling groups to examine and compare several multiple solvent oil recovery processes that were proposed in a patent by Texaco [4].

To understand the effectiveness of the method of injecting multiple solvents, simulation tests on CMG software STARS were conducted. The objective was to explore the different mechanisms and the implications of scaling for 9/26 claims outlined in patent 4,004,636 [4[, using the CMG STARS simulation software to assess the proposed claims. A comparative analysis was conducted on the influence of different parameters, such as temperature and capillary pressure, used to manifest scalability characteristics.

The aim was to identify the claim within the patent that exhibits the most favorable oil recovery and scalability. Results are presented for 9 different claims with variant conditions have been tested for the field scale (scale 3) and then were scaled down to mid and laboratory scales (scale 2 and 1, respectively). This subset of the claims used steam, butane and heptane for the multiple solvent strategy where one solvent is in the gas phase upon injection, while the second solvent is in the liquid phase upon injection. Different concentrations and injection orders were studied according to the patent recommendations.

A comparison of the results obtained from using multiple solvents for enhanced oil recovery are presented for the three scales for 9 different claims.

[1] Sayed Gomaa, Khalaf G. Salem, A.N. El-hoshoudy, Enhanced heavy and extra heavy oil recovery: Current status and new Trends,Petroleum,Volume 10, Issue 3,2024,Pages 399-410.

[2] L. Pujol and T.C. Boberg, Scaling Accuracy of Laboratory Steam Flooding Models, SPE Paper 4191, SPE California Regional Meeting, 8-10 November, Bakersfield, California, (1972). [3] M. Shook, D. Li and L.W. Lake, Scaling Immiscible Flow Through Permeable Media by Inspectional

Analysis, In Situ, 16(4), p. 311-349, (1992).
[4] Brown, A., Wu, C.H., and Konopnicki, D.T. “Combined Multiple Solvent and Thermal Heavy Oil Recovery”, U.S. Patent 4.004.636, Texaco Inc. (1975).