Cairo University

IMPROVED CUBIC-EOS SOLID MODEL TO PREDICT ASPHALTENE PRECIPITATION BEHAVIOR

By

Aktham Ehab Amin Mohamed Shoukry

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Petroleum Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Title of Thesis:

Improved Cubic-EOS Solid Model to Predict Asphaltene Precipitation Behavior

Key Words:
Asphaltene Precipitation; Asphaltene Precipitation Modelling; Cubic Equation Of State; Asphaltene Onset Pressure; Solid Model;

Summary:
For the purpose of improving the cubic Peng-Robinson solid model and reducing its dependency on asphaltene precipitation/onset experiments, this thesis introduces the use of aromatics correlations to obtain these parameters. In addition, weighted-averaging methods between waxes and aromatics correlations values, based on reported Saturates; Aromatics; Resins; and Asphaltenes (SARA) fractions and wax content, are also introduced. In addition, an extra empirical relation is suggested and added to the model procedures to track compositional alterations resulting from solvent injection.

Disclaimer

I hearby declare that his thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: **Aktham Ehab Amin Mohamed Shoukry** Date: **13/10/2018**

Signature:

Dedication

To my family, my professors, my friends, and last but not least; to Tulip🌷. The never-forgotten…

Acknowledgments

First of all, I would like to express my endless thanks to **Allah** for giving me the ability to perform this research.

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Finally, I love my work, I love the place I work in. I really wish nothing more than to make all of you proud and to make the petroleum-engineering department a better place…

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Nomenclature

a,b,A,B	=	PR EOS constants
C	=	Empirical coefficient of the AOP relationship with solvent injection concentration
e	=	BIC exponent parameter
f	=	Fugacity (psia)
K	=	Equilibrium constant
M	=	Empirical coefficient of the AOP relationship with solvent injection concentration
MW	=	Molecular weight (lb/lb-mole)
P	=	Pressure (psia)
R	=	Universal gas constant (=10.7315 psia.ft^3/lb-mole.^{o}R)
s	=	Solid mole fraction
T	=	Temperature (^{o}R)
v_a	=	Molar volume of Asphaltene component (ft^3/lb-mole)
v_c	=	Molar critical volume (ft^3/lb-mole)
x	=	Liquid mole fraction
y	=	Vapor mole fraction
z	=	Feed mole fraction
ΔC_P	=	Isobaric heat capacity difference (Cal/lb-mole.K)
ΔH	=	Enthalpy (Cal/lb-mole)
ω	=	Acentric factor
δ	=	Solubility parameter
Ω	=	Binary interaction coefficient
θ	=	Thermodynamic parameter(s) (fusion temperature or enthalpy of fusion)
α	=	Weight fraction of parameter(s) calculated using the waxes correlations
β	=	Weight fraction of parameter(s) calculated using the aromatics correlations

Superscripts

*	=	Reference conditions
L	=	Liquid phase
V	=	Vapor phase
S	=	Solid phase

Subscripts

asp	=	Asphaltene
c	=	Critical
b	=	Boiling
br	=	Reduced boiling