

การประยุกต์ใช้แบบจำลองการไหลสี่สถานะของ Guo ในหลุมผลิตที่มีสอง และสามสถานะ



นายไซ โจว โจว ออง

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิศวกรรมศาสตรมหาบัณฑิต

สาขาวิชาวิศวกรรมปิโตรเลียม ภาควิชาวิศวกรรมเหมืองแร่และปิโตรเลียม

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APPLICATION OF GUO'S FOUR-PHASE FLOW MODEL TO
TWO-PHASE AND THREE-PHASE FLOW WELLS

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การศึกษานี้มีวัตถุประสงค์เพื่อตรวจสอบการประยุกต์ใช้แบบจำลองการไหลสี่สถานะของ Guo กับแบบจำลองสองสถานะและสามสถานะของการไหลภายใต้สภาวะต่างๆเพื่อเพิ่มความแม่นยำของแบบจำลองดังกล่าว ข้อมูลจำนวน 208 ชุดถูกนำมาใช้ในการคำนวณความดันขณะไหลของก้นหลุมจากความดันขณะไหลของปากหลุมที่ทราบค่าโดยใช้แบบจำลองการไหลสี่สถานะของ Guo และความสัมพันธ์การไหลสหภาคอีก 6 แบบ (Duns and Ros (modified), Hagedorn and Brown, Fancher and Brown, Beggs and Brill, and Duns and Ros (original)) จากนั้นจึงปรับแต่งและประเมินผลเพื่อเพิ่มความแม่นยำของแบบจำลอง ตัวประกอบที่ถูกนำมาปรับแต่งนี้ ได้แก่ ตัวประกอบการอัดตัวได้ของก๊าซ (Z) , อัตราส่วนของก๊าซในน้ำมันต่อน้ำมัน (R_g), ตัวประกอบปริมาตรของน้ำมัน (B_o) และ การคำนวณความดันสูญเสียย่อยในส่วนต่างๆของท่อ จากนั้นแบบจำลอง Guo ที่ถูกปรับแต่งบนพื้นฐานของการปรับแต่งหลายๆแบบรวมกันถูกนำมาเปรียบเทียบกับความสัมพันธ์อื่นอีก 6 ความสัมพันธ์ที่กล่าวมา จากการเปรียบเทียบพบว่าค่าเฉลี่ยสัมบูรณ์ผิดพลาดของแบบจำลอง Guo ที่ถูกปรับแต่งด้วยตัวประกอบการอัดตัวได้ของก๊าซสำหรับการไหลของก๊าซจะดีกว่าแบบจำลองของ Guo ที่ถูกปรับแต่งแบบอื่นๆและความสัมพันธ์การไหลสหภาคทั้ง 6 ความสัมพันธ์ดังกล่าว ยกเว้นความสัมพันธ์ Duns and Ros (ปรับแต่ง) และความสัมพันธ์ Duns and Ros (ดั้งเดิม) ดังนั้นแบบจำลองที่ถูกปรับแต่งในการศึกษานี้สามารถนำมาใช้ได้ด้วยความแม่นยำสูง

ภาควิชาวิศวกรรมเหมืองแร่และปิโตรเลียม
สาขาวิชาวิศวกรรมปิโตรเลียม
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ลายมือชื่ออาจารย์ที่ปรึกษา.....
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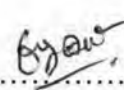
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This study is intended to investigate the applicability of Guo's four-phase flow model to two-phase and three-phase flow wells under different conditions and improve its accuracy. Two hundred and eight data sets were used to calculate the bottomhole flowing pressure (BHFP) from the known wellhead flowing pressure (WHFP) by Guo's four-phase flow model and six other multiphase flow correlations (Duns and Ros (modified), Hagedorn and Brown, Fancher and Brown, Beggs and Brill, and Duns and Ros (original)). Then, modifications were tried and evaluated in order to improve the model's accuracy. These modifications are improving the tuning factor, inclusion of gas compressibility factor (Z), solution gas-oil ratio (R_s), and oil formation volume factor (B_o), and incremental calculation of pressure losses. Then, the modified Guo's models based on different combinations of modifications were compared against the other six multiphase flow correlations. In the comparison, it can be seen that the average absolute error of Guo's model modified with the Z factor tuning for gas flow rate is better than the other modified Guo's models and multiphase flow correlations except Duns and Ros (modified) correlation and Duns and Ros (original) correlation. Therefore, the modified model proposed in this study may be used with high accuracy.


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Nomenclature

A	cross-section area
B	formation volume factor
d_H	hydraulic diameter
e	wall roughness
f	Moody friction factor
F_{LHU}	tuning factor for liquid holdup
g	gravity force
GLR	gas-liquid ratio
H	vertical depth
L	measured depth
P_{wh}	wellhead pressure
P_{hy}	hydraulic pressure
Q_{gs}	gas rate at standard conditions (14.7 psia, 60° F)
Q_s	volumetric flow rate of solid
Q_w	water production rate
Q_o	oil production rate
R_s	solution gas oil ratio
R_{sw}	solution gas water ratio
S_g	specific gravity of gas
S_o	specific gravity of oil
S_s	specific gravity of solid
S_w	specific gravity of produced water
T	average temperature
v	fluid velocity
Z	gas compressibility factor



GREEK LETTER

γ_m	specific weight of mixture
------------	----------------------------

SUBSCRIPTS

<i>g</i>	gas
<i>l</i>	liquid
<i>o</i>	oil
<i>s</i>	solid
<i>w</i>	water