

**INHIBITION OF BARIUM SULFATE SCALE PRECIPITATION
USING SCALE INHIBITORS**



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A Thesis Submitted in Partial Fulfilment of the Requirements
for the Degree of Master of Science
The Petroleum and Petrochemical College, Chulalongkorn University
in Academic Partnership with
The University of Michigan, The University of Oklahoma,
and Case Western Reserve University

2002

ISBN 974-03-1570-4

Thesis Title : Inhibition of Barium Sulfate Scale Precipitation Using Scale Inhibitors
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Accepted by the Petroleum and Petrochemical College, Chulalongkorn University, in partial fulfilment of the requirements for the Degree of Master of Science.

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ABSTRACT

4371025063 : PETROCHEMICAL TECHNOLOGY PROGRAM

Thammanoon Sreethawong: Inhibition of Barium Sulfate Scale
Precipitation Using Scale Inhibitors.

Thesis Advisors: Assoc. Prof. Sumaeth Chavadej, Dr. Pomthong
Malakul, and Prof. H. Scott Fogler, 86 pp. ISBN 974-03-1570-4

Keywords : Barium Sulfate/ Scale/ Precipitation/ Scale Inhibitor/ ATMP/
DTPMP/ PPCA/ Supersaturation Ratio/ Critical Supersaturation
Ratio

Barium sulfate (BaSO_4) scale deposition is a serious problem encountered during the secondary oil recovery process. Many scale inhibitors are currently used to prevent the scale formation. Therefore, this research focused on studying the effect of testing time, scale inhibitor concentration, initial solution pH, and type of scale inhibitors on the formation of BaSO_4 precipitates. The scale inhibitors used in this work were Aminotri(methylene phosphonic acid) (ATMP), Diethylenetriamine-penta(methylene phosphonic acid) (DTPMP), and Phosphinopolycarboxylic acid polymer (PPCA). The concept of a critical supersaturation ratio was developed to characterize the effectiveness of the scale inhibitors on the BaSO_4 scale inhibition. The critical supersaturation ratio at which the BaSO_4 precipitation occurs was obtained at different testing times and used as an index to evaluate the effect of various precipitating conditions on BaSO_4 scale inhibition. The results indicated that the critical supersaturation ratios decreased with increasing testing time until reaching a constant value, but increased with increasing scale inhibitor concentration and initial solution pH. Higher scale inhibitor concentration and initial solution pH resulted in smaller and more spherical BaSO_4 particles. The results also revealed that a longer testing time, a higher scale inhibitor concentration, a higher initial solution pH, and a greater number of ionizable protons gave a broader particle size distribution and a smaller mean diameter of the BaSO_4 precipitate. PPCA was found to be more effective for BaSO_4 inhibition than DTPMP or ATMP.

บทคัดย่อ

ธรรมเนียม ศิริทวงศ์ : การยับยั้งการเกิดตะกรันแบเรียมซัลเฟตโดยการใช้นสารยับยั้งการเกิดตะกรัน (Inhibition of Barium Sulfate Scale Precipitation Using Scale Inhibitors)
 อ. ที่ปรึกษา : รศ. สุเมธ ชวเดช, ดร. ปมทอง มาลากุล ณ อยุธยา, และ ศ. เอช สก็อตต์ ฟ็อกเลอร์ (Prof. H. Scott Fogler) 86 หน้า ISBN 974-03-1570-4

การพอกเกาะของตะกรันแบเรียมซัลเฟตเป็นปัญหาสำคัญที่ต้องเผชิญในระหว่างกระบวนการผลิตน้ำมันชั้นทุติยภูมิ ในปัจจุบันสารยับยั้งตะกรันหลายชนิดได้ถูกนำมาใช้ในการป้องกันการเกิดตะกรัน ดังนั้นงานวิจัยนี้ได้มุ่งเน้นศึกษาถึงอิทธิพลของเวลาที่ใช้ในการทดสอบ, ความเข้มข้นของสารยับยั้งตะกรัน, ค่าความเป็นกรดต่างเริ่มต้นของสารละลาย, และชนิดของสารยับยั้งตะกรัน ที่มีต่อการเกิดตะกรันแบเรียมซัลเฟต สารยับยั้งตะกรันที่ใช้ในการศึกษานี้ได้แก่ Aminotri(methylene phosphonic acid) (ATMP), Diethylenetriaminepenta(methylene phosphonic acid) (DTPMP), และ Phosphinopolycarboxylic acid polymer (PPCA) แนวความคิดเกี่ยวกับอัตราส่วนเนื้อความอิมัตว์วิกฤตได้ถูกพัฒนาขึ้น เพื่อนำมาใช้ในการจำแนกประสิทธิภาพในการยับยั้งการเกิดตะกรันแบเรียมซัลเฟตของสารยับยั้งตะกรันต่างๆ อัตราส่วนเนื้อความอิมัตว์วิกฤต ณ จุดที่เกิดการตกตะกอนของแบเรียมซัลเฟตในช่วงเวลาที่ใช้ในการทดสอบต่างๆ ได้ถูกนำมาศึกษา และใช้เป็นกรณีในการประเมินผลกระทบของสภาวะของการตกตะกอนที่มีต่อการยับยั้งการเกิดตะกอนแบเรียมซัลเฟต จากผลการศึกษาพบว่า เมื่อเพิ่มเวลาที่ใช้ในการทดสอบ อัตราส่วนเนื้อความอิมัตว์วิกฤตมีค่าลดลงจนกระทั่งมีค่าคงที่ค่าหนึ่งในที่สุด แต่จะมีค่าเพิ่มขึ้น เมื่อเพิ่มความเข้มข้นของสารยับยั้งตะกรัน และค่าความเป็นกรดต่างเริ่มต้นของสารละลาย การเพิ่มความเข้มข้นของสารยับยั้งตะกรัน และค่าความเป็นกรดต่างเริ่มต้นของสารละลาย ส่งผลให้ตะกอนแบเรียมซัลเฟตที่เกิดขึ้นมีขนาดเล็กลง และมีความเป็นทรงกลมมากขึ้น นอกจากนี้ยังพบว่า การเพิ่มเวลาที่ใช้ในการทดสอบ, ความเข้มข้นของสารยับยั้งตะกรัน, ค่าความเป็นกรดต่างเริ่มต้นของสารละลาย, และจำนวนโปรตอนที่สามารถแตกตัวเป็นไอออนได้ ส่งผลทำให้อนุภาคของแบเรียมซัลเฟตที่เกิดขึ้น มีการกระจายตัวของขนาดอนุภาคกว้างขึ้น และเส้นผ่านศูนย์กลางเฉลี่ยของอนุภาคลดลง การสังเกตนี้พบว่า PPCA มีประสิทธิภาพในการยับยั้งการเกิดตะกรันแบเรียมซัลเฟตสูงกว่า DTPMP หรือ ATMP

ACKNOWLEDGEMENTS

This thesis could not have been completed without all invaluable helps of the following individuals and organizations.

First of all I would like to express my sincere gratitude to Professor H. Scott Fogler, my US advisor, Associate Professor Sumaeth Chavadej and Dr. Pomthong Malakul, my Thai advisors, for their invaluable guidance, understanding, and constant encouragement throughout the course of this research and the great opportunity to perform the research at the University of Michigan, Ann Arbor, USA. Their positive attitude significantly contributed to inspiring and maintaining my enthusiasm in the field.

I would like to express my special thanks to Professor Somchai Osuwan and Assistant Professor Pramoch Rangsunvigit for serving on my thesis committees. Their sincere suggestions are definitely imperative for accomplishing my thesis.

My gratitude is absolutely extended to all of the US Professors and all staffs of the Petroleum and Petrochemical College, Chulalongkorn University, for all necessary knowledge and their kind assistance and cooperation. I am always very proud to be their student.

My gratefulness is conveyed to all members of the Porous Media Group and Thai Ph.D. students at the University of Michigan, especially Veerapat Tantayakom (Five), Piyarat Wattana (Ann), and Duc Anh Nguyen (Duc) for generously providing me great welcome and warm-heartedness during nine months of my stay there.

My thankfulness is also offered to Monsanto Chemical Company and Bio-Lab, Inc. for their supports on the essential chemicals used in the research.

Furthermore, I would like to take this important opportunity to thank all of my graduate friends for their unforgettable friendship and hospitality.

Finally, my deepest appreciation and whole-hearted gratitude are everlastingly dedicated to my beloved family whose endless love, support, motivation, and understanding play the greatest role in my success.

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