

**EFFECT OF MERCURY ON CORROSION IN PRODUCTION WELLS  
IN THE GULF OF THAILAND FIELDS |**

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**ABSTRACT**

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Studies of the corrosion of materials used for tubing in oil and gas production wells are important for cost minimization. In this work, 13%chromium stainless steel and L-80 carbon steel were selected for study by immersion testing and potentiodynamic polarization techniques. Simulated produced water with the composition obtained from the Gulf of Thailand field was used as a corrosive solution in order to investigate the effect of mercury at various conditions of temperature, chloride concentration, CO<sub>2</sub> partial pressure, and pH of the solution. Temperature was found to increase the corrosion reaction kinetically. Furthermore, chloride ions (0.1%NaCl-3.5%NaCl) and carbon dioxide were found to enhance the corrosion reaction by destroying the protective film, especially on 13Cr surface. Increasing the acidity of the solution causes the solution to be more aggressive due to the abundance of hydrogen ions to be consumed and generated H<sub>2</sub> in the cathodic reaction, while the steel material becomes more metal ions in the solution. In addition, mercuric chloride, as the representative of the mercury species in the production wells, with a concentration between 0-12 ppm does not cause any effect to both materials. Moreover, there is no synergistic effect between trace amount of mercury and temperature (30°C-60°C) or carbon dioxide. However, with a mercury concentration higher than 100 ppm, the corrosion rate was increased due to the increasing in reduction process.

## บทคัดย่อ

ชื่อ นามสกุล : การศึกษาผลกระทบของปรอทต่อการกัดกร่อนของหลุมผลิตก๊าซธรรมชาติในอ่าวไทย Effect of mercury on corrosion in production wells in a Gulf of Thailand fields อ. ที่ปรึกษา : รศ.ดร. จินตนา สายวรรณ ดร. คาร์เรล แอล แกลล์ป และ ดร.สุธา สุทธิเรือง วงศ์ 81 หน้า

การศึกษากัดกร่อนต่อวัสดุที่ใช้เป็นท่อในการผลิตก๊าซธรรมชาตินับว่ามีความสำคัญต่อการปรับลดค่าใช้จ่าย โดยในงานวิจัยนี้เลือกใช้เหล็กกล้าคาร์บอนชนิด L80 และ สเตนเลสสตีลชนิด 420 ซึ่งมีปริมาณธาตุโครเมียมเจืออยู่ 13% (โดยน้ำหนัก) เพื่อศึกษาโดยวิธีอิมเมอร์ชัน และ โพเทนทิโอสโคปิกซ์ โพลาริเซชัน สารละลายกัดกร่อนที่นำมาใช้เป็นสารละลายจำลองของน้ำที่ผลิตได้จากหลุมโดยใช้องค์ประกอบตามข้อมูลจากหลุมผลิตจริงจากอ่าวไทย นอกเหนือจากปรอทแล้วทำการศึกษผลกระทบของปรอทที่มีต่อสถานะต่างๆ ได้แก่ อุณหภูมิ ปริมาณความเข้มข้นคลอไรด์ ก๊าซคาร์บอนไดออกไซด์ และค่าพีเอช

พบว่าอุณหภูมิมีส่วนช่วยเร่งปฏิกิริยาในทางจลน์พลศาสตร์ ในขณะที่คลอไรด์อออน (1% - 3.5% โซเดียมคลอไรด์) และก๊าซคาร์บอนไดออกไซด์เร่งการกัดกร่อนโดยการทำลายฟิล์มที่ผิวหน้าของวัสดุ โดยเฉพาะกับเหล็กกล้า 13%โครเมียม การลดค่าพีเอชทำให้ปริมาณโปรตอนในสารละลายเพิ่มมากขึ้น ซึ่งเป็นการเสริมความรุนแรงของปฏิกิริยาการรับโปรตอนเกิดเป็นก๊าซไฮโดรเจนด้านคาโทด ในขณะที่วัสดุจะละลายออกมาในรูปของอออนโลหะมากขึ้น ปรอทที่ความเข้มข้นน้อยกว่า 12 ส่วนในล้านส่วน ไม่ส่งผลต่อการกัดกร่อนของวัสดุ และอุณหภูมิ (30 °C - 60°C) หรือความดันก๊าซคาร์บอนไดออกไซด์ไม่มีผลกระทบร่วมกับการกัดกร่อนของปรอท แต่หากความเข้มข้นเพิ่มมากขึ้นถึง 100 ส่วนในล้านส่วนแล้ว อัตราการกัดกร่อนจะเพิ่มขึ้นอย่างเห็นได้ชัด เนื่องจากปรอทมีค่าความต่างศักย์ขั้วไฟฟ้าสูงกว่าไฮโดรเจนอออน ซึ่งนับว่าเป็นการเพิ่มปฏิกิริยาด้านคาโทดอีกหนึ่งปฏิกิริยา

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