

**SELECTION CRITERIA FOR WELLS SUITABLE FOR
ELECTRICAL SUBMERSIBLE PUMP (ESP) IN
THE GULF OF THAILAND**

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A Thesis Submitted in Partial Fulfillment of the Requirements
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เกณฑ์การเลือกหลุมที่เหมาะสมในการใช้ปุ๋ยมแบบ ESP ในอ่าวไทย

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งานวิจัยนี้กระทำโดยการเลือกหลุมทดลองที่จะช่วยทำการผลิตด้วยวิธีการใช้ปั๊มแบบ ESP ในการผลิตน้ำมันขึ้นมาซึ่งผิวดิน ซึ่งงานวิจัยนี้ใช้โปรแกรมเพื่อสร้างแบบจำลองสภาพแหล่งกักเก็บน้ำมันในลักษณะต่างๆ เพื่อศึกษาถึงความเป็นไปได้ในแต่ละรูปแบบ มีการศึกษาเปรียบเทียบความสามารถในการเพิ่มการผลิตระหว่างวิธีการของสูบน้ำมันด้วยปั๊มไฟฟ้าและวิธีการอัดแก๊สเข้าไปในหลุมผลิต เนื่องจากปริมาณแก๊สของแหล่งผลิตที่สามารถใช้ได้ ในกระบวนการอัดฉีดแก๊สมีอยู่อย่างจำกัด จึงจำเป็นต้องมีการใช้ปั๊มไฟฟ้าในการช่วยเพิ่มการผลิต การทดลองเพื่อหารูปแบบในการช่วยผลิตที่มีประสิทธิภาพมากที่สุดนั้น ได้มีการปรับเปลี่ยนตัวแปรเพื่อดูผลกระทบและประสิทธิภาพของแต่ละวิธี โดยตัวแปรที่สนใจได้แก่ ปริมาณก๊าซที่ละลายอยู่ในน้ำมัน ความลึกที่ทำการติดตั้งปั๊มไฟฟ้าและความลึกที่ทำการอัดแก๊ส ความสามารถในการไหลของน้ำมันเข้ามายังหลุมผลิต ปริมาณแก๊สที่อัดเข้าไปในหลุมผลิต

ผลการวิจัยที่ได้จะนำไปเป็นแนวทางในการเลือกติดตั้งอุปกรณ์การผลิตให้เหมาะสมแก่การผลิตต่อไป และเพื่อเป็นแนวทางในการเลือกลักษณะหลุมผลิตที่เหมาะสมกับการเพิ่มการผลิตแบบใช้ปั๊มไฟฟ้าหรือการอัดแก๊ส

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HOMME HANSRA: DESIGN CRITERIA FOR ELECTRICAL
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The research conducted will achieve criteria by which the candidate ESP wells will be selected and these criteria which will be developed by running reservoir simulation for different types of reservoir behavior. The potential ESP candidate wells will need to perform better by ESP as comparative to the gas lift and simulation runs will be made in order to observe these performances. The field has very limited gas availability for injection and hence the contrast needs to be set between gas lift and the ESP. To reach the conclusions sensitivities such as solution GOR, artificial lift setting depth, relative permeability and injection rate will be varied to see their effects on the cumulative oil recovered by each artificial lift.

The results will be used to construct a surface response using design of experiments which will help us see a broader picture of the trend and hence we can maximize efficiency by choosing the wells that deserve using ESP than gas lift based on the qualities it posses.

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NOMENCLATURE

| | | |
|------------|---|---|
| A | = | flow area of conduit, ft ² |
| B_g | = | gas formation volume factor |
| B_o | = | oil formation volume factor |
| B_w | = | water formation volume factor |
| C_w | = | water compressibility |
| c_f | = | rock pore volume compressibility |
| E_o | = | expansion of oil |
| E_g | = | gas cap |
| $E_{f,w}$ | = | expansion of connate water |
| F | = | underground withdrawal |
| G | = | initial gas in place |
| G_{pc} | = | cumulative gas-cap gas produced |
| γ_g | = | gas gravity |
| h | = | zone height, feet |
| J' | = | productivity coefficient |
| k_o | = | oil relative permeability, md |
| m | = | ratio of gas cap pore volume to oil pore volume |
| n | = | reciprocal slope of best fit plot of q vs. $(\bar{p}^2 - p_{wf}^2)$ |
| N_p | = | cumulative oil production |
| N | = | initial oil in place |
| \bar{p} | = | shut in reservoir pressure |
| p | = | average reservoir pressure |
| p_{wf} | = | well intake pressure |
| P_i | = | initial pressure |
| P_R | = | reservoir pressure |
| q | = | flow rate |
| q_c | = | critical gas flow rate |
| q_m | = | producing rate when $p_{wf} = 0$ |
| R_p | = | cumulative production gas-oil ratio |
| R_s | = | solution gas-oil ratio |
| S_w | = | water saturation |

| | | |
|---------|---|---------------------------|
| T | = | temperature, °R |
| μ_o | = | oil viscosity, cp |
| v_t | = | terminal velocity, ft/sec |
| W_e | = | cumulative aquifer influx |
| W_p | = | total water produced |
| Z | = | gas deviation factor |