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Design of a New Pump Jack for Continuous Sucker Rod Pumping Systems

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Abstract

In this paper, different hydraulic pumping units are initially studied and analyzed. Inspired by these technologies, a hydraulic unit is designed and simulated using Simulink/Matlab software with the aim of saving input energy.

Sucker rod pumping is the most widely used artificial lift method in oil wells. The surface component of this unit is the pumpjack, which is designated to impart the reciprocating motion onto the polished rod and rod string. However, traditional beam unit is subjected to over torque and structural loading which can be drastically damaging. Moreover, conventional pumpjacks pose many challenges in terms of energy consumption, large footprint, stroke length and speed control. Hence, considering hydraulic pumping units as an alternative can improve the production operations and reduce energy requirements and HSE concerns.

The various components of the unit were independently designed to optimize the performance and reduce the energy consumption. The unit was then simulated with MATLAB's Simulink to activate a wire rope string as well as a conventional sucker rod string and their performance were compared with equivalent scenarios using a conventional Pump jack. The results show that the unit allows for more precise control of the pumping cycle in terms of pumping speed and stroke length. The energy consumption of the unit is also compared to conventional sucker rod pumping units operating at the same wellbore conditions, leading to significantly better results despite the greater pumping activity and higher productivity.

This work provides a unique analysis of an alternate pumping unit working with a hydraulic pumpjack and a wire rope, which can replace conventional sucker rod pumps.