Title: Catalytic Down-Hole Upgrading of Heavy Oil

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As oil prices escalate in global markets, heavy oil and bitumen become attractive alternatives to satisfy the world's growing needs. However, difficult extraction prospects and stringent pre-refining requirements to upgrade these oils to meet refining specifications affect the economics of their commercialization. Extremely high viscosity and abundant amounts of contaminants such as sulfur, nitrogen and metals in the structure of heavy oil molecules are examples of the challenges in their transportation and processing. The search for more integrated approaches for "conventionalization" of bitumen and heavy oil has already started. The attempt of performing in-situ upgrading during the production of oil is one of these activities. In this study, process simulations are conducted to produce a model for the down-hole (wellbore) upgrading of heavy oil as an attempt to integrate exploitation with in-situ upgrading. This model is based on some modifications to the Steam Assisted Gravity Drainage (SAGD) method and can also be extended to Cyclic Steam Stimulation (CSS).

The proposed model contains a well with both horizontal and vertical sections. The horizontal section serves to collect the oil/water mixture via the perforations on its surface, with the vertical segment serving as a reactor. The feed is directed to the vertical section, where its temperature is increased by the heat flow introduced to the body of the well. There it mixes with hot hydrogen or hydrogen donors injected to the system and enters the catalytic chamber where reactivity occurs. More simply, the vertical well acts as a plug flow reactor for upgrading reactions, mostly hydrotreating. The extent of conversion depends strongly and proportionally to the temperature and residence time. The other influential factor is the presence of steam in the system, which has a detrimental effect on the level of conversion.

Based on the results generated with this preliminary simulation, a partially upgraded crude oil product with lower amounts of contaminants and enhanced transporting properties appears promising. The main advantages of down-hole upgrading will be reduction in refinery and upgrading costs, reduction in size of surface upgrading facilities and utilization of the pre-introduced heat from the SAGD process.