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Scalability of Nanosecond Pulsed Non-Equilibrium Plasma Reactor for Heavy Oil Upgrading[1] SHARIFUL ISLAM BHUIYAN, KUNPENG WANG, Texas AM University, HOWARD JEMISON, LTEOIL LLC, MD ABDULLAH HIL BAKY, JAMIE KRAUS, CHRISTOPHER CAMPBELL, DAVID STAACK, Texas AM University, TEXAS AM UNIVERSITY COLLABORATION, LTEOIL LLC COLLABORATION — New technologies developed in the laboratory often need to be scaled up to pilot scale and additional investigations are required to ensure that the large-scale unit is still able to replicate the results produced in the lab. A multi-phase non-thermal plasma reactor was developed by LTEOIL that uses nanosecond pulsed electrical discharges to partially upgrade oil with methane and hydrogen at ambient pressure. The single gap reactor was then extended to a continuous flow reactor by adding multiple spark gaps. The reaction in the plasma reactor is governed by the direct reaction of species on the interface and mass transfer between gas and liquid modeled by chain scission reaction. Mass and heat transfer processes are highly scale-dependent but since reaction kinetics and thermodynamics are relatively size independent and the reaction zones are identical in the scale up process, the hypothesis is such that the conversion will also be similar. A mathematical model has been developed to calculate the number of reactors required to process X BBL/day by controlling the input parameters. Results show that to process 1BBL/day with a specific energy input of 500KJ/Kg and 10% conversion, 7 reactors are required with each containing 20 spark gaps and pulsing at a frequency of 200Hz.

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