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Submerged Electrical Discharge for Heavy Oil Upgrading and Conversion KUNPENG WANG, SHARIFUL BHUIYAN, MD. ABDULLAH BAKY, CHRISTOPHER CAMPBELL, Texas AM University, HOWARD JEMISON, LTEOIL, DAVID STAACK, Texas AM University — We investigated a submerged spark discharge under liquids, characterized by nanosecond pulse duration and low energy per pulse, to generate reactive species at the gas liquid interface to convert heavy hydrocarbons to light hydrocarbons. High purity (>99%) n-hexadecane was tested in this spark gap reactor. Discharge gas composition was changed between methane, hydrogen and inert gas. Pulsing energy was controlled by changing the capacitor size which varied between 20, 50 and 100 pF. SEI was controlled for each test and remained at 500kJ/kg. Breakdown voltage, spark gap power and total number of pulses were estimated in real time based on the total voltage and current measured. Total solid formation in processed samples was estimated. Solids production predominately depend on pulsing energy and carrier gas. Increasing the pulsing energy also increased the solids formation. Discharges with 100 pF capacitor yields more than 5% total solids, while discharges with 20 pF capacitor only generates 1% total solids. Analysis by GC-FID and TGA showed that more than 10% hexadecane compound in each sample were converted to new compounds assisted by the plasma discharge process. GC-MS was further used to identify the new compounds. Inert gas discharges in hexadecane seem to produce more reactive species based on GC-MS signals because they strongly interact with the GC column. Methane and hydrogen produced more stable species due to their high reactivity of plasma species.

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