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1P60 - DETAILED GAS ANALYSIS IN NANO SECOND PULSED NON-EQUILIBRIUM PLASMA PROCESSING OF HYDROCARBONS FOR MASS BALANCE

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Low temperature atmospheric pressure non-equilibrium plasma was generated in liquid hydrocarbon with gas bubbles to characterize the reformed gases formed by hydrocarbon processing. A 10g sample of hexadecane was used as liquid hydrocarbon while 90% CH₄, 10% H₂ gas bubbles of 50 sccm was flown throw it. A RC circuit was used to generate nano-second pulsed plasma with 20pF capacitor and 1.5M ohm resistor. Energy deposited was 500KJ/kg over a duration of 3 hours. The electrodes were on a pin-plate configuration with the top being a quarter inch rod and the bottom electrode being the capillary. The bottom electrode was set to high voltage while the top electrode acted as ground. A closed system loop was developed that recirculated the gases through the plasma reactor and into a gas chromatography in real time to characterize and analyze them. Preliminary results show that 3.9% of the gases captured were reformed gases formed from methane, hydrogen and hexadecane cracking by plasma reaction. The rest of the gas sample was Methane and hydrogen whose percentage concentration will be quantified in future. Of the 3.9% reformed gases, Ethane is 10%, Ethylene 15%, Propane 1%, Propylene 2%, Acetylene 40%, C₄ -3%, C₅ -15%, and C₆+ 14%. To quantify the above results, an independent fast refinery gas analysis method was created to detect hydrocarbons in vapor phase using Shimadzu gas chromatography 2014. A complete mass balance is required to understand the thermodynamics and reaction kinetics of non-equilibrium plasma processing and reforming of hydrocarbons.

Authors: Mr BHUIYAN, Shariful Islam (Texas A&M university); STAACK, David A. (Texas A&M university)

Co-authors: WANG, Kungpeng (Texas A&M university); CAMPBELL, Christopher (Texas A&M university); BAKY, Abdullah Hil (Texas A&M university)

Presenter: Mr BHUIYAN, Shariful Islam (Texas A&M university)

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