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Final Report

Organic Molecules in the Atmosphere of Jupiter

Contract NAS5-20834

Simulation of the organic synthesis in the primitive solar system has been conducted by Fischer Tropsch type experiments. In these experiments a particular attention was paid to the formation of lower molecular weight hydrocarbons.

In a gas-flow experiment, a gas mixture of H_2 and CO was introduced into a heated reaction tube at a constant flow rate and passed through a catalyst (powdered Canyon Diablo). The products emerged from the reaction tube were directly analyzed by GC. In order to examine various factors on the hydrocarbon formation, the following parameters were selected for the experiments and all the reactions were performed for 6 minutes:

1. Gas mixing ratios (H_2/CO = 1~10)

   All the mixing ratios produced C_2 to C_6 alkanes and alkenes. The result showed the predominance of the C_4 and C_5 alkanes over the corresponding alkenes in general. However, propane was produced greatly over propylene only at the higher mixing ratios (H_2/CO = 9 and 10). It seems both the C_3 hydrocarbons were intermediate for the production of the larger hydrocarbons.

2. Reaction temperatures (190, 250, 300, and 350° C)

   The hydrocarbons were formed at all the temperatures. At 300° C, the reaction possibly proceeded readily, since the pronounced propylene formation was observed, which reflects an intense intermediate formation.

3. Gas-catalyst contact time (expressed by total flow rate: 13, 25, 40, 60, and 80 ml/min)

In this experiment, the faster flow rate indicated the shorter gas-catalyst contact time. The result showed the shorter contact time produced a more reactive intermediate than stable products as seen on the predominant formation of propylene over propane.

In a gas-closed experiment, the gas mixture was sealed in a reaction tube with the catalyst at various gas mixing ratios (H_2/CO = 1 ∿ 94, mostly 1, 10, and 20). The reaction tube was heated at 250, 300, and 315° C for 1 ∿ 83 days (mostly 22 and 23 days). The hydrocarbons produced by such longer reaction time were probably equilibrated and, therefore, analyzed for a comparative purpose with those produced by the gas-flow experiment.

The results of 21 runs under various above conditions showed the predominance of the saturated hydrocarbon formation at C_4 and C_5 over the unsaturated ones (saturate/unsaturate ratios were mostly less than 0.4 and none showed over 0.8). This finding was predicted by the results of the gas-flow experiment for the extrapolation to the longer reaction time.