7. Catalyst Regeneration Test

Run 13; Lurgi Gas/Regenerated G-87P (35 atm, 480°C, 3.85% steam)

This run was designed to test the ability to regenerate in situ a spent catalyst containing carbon. Portions of spent catalysts from Runs 2, 8, and 9 (all operated at 35 atm, 480°C, and 5 percent steam) were collected and well mixed prior to loading into the reactor. The reactor was slowly heated under a low flow (500 v/v/hr) of 2 percent O_2 and 98 percent N_2 mixture. The final temperature was adjusted to 250°C for the entire catalyst basket and maintained at that temperature for 16 hours. The effluent was checked for CO_2 and then the catalyst was unloaded for examination.

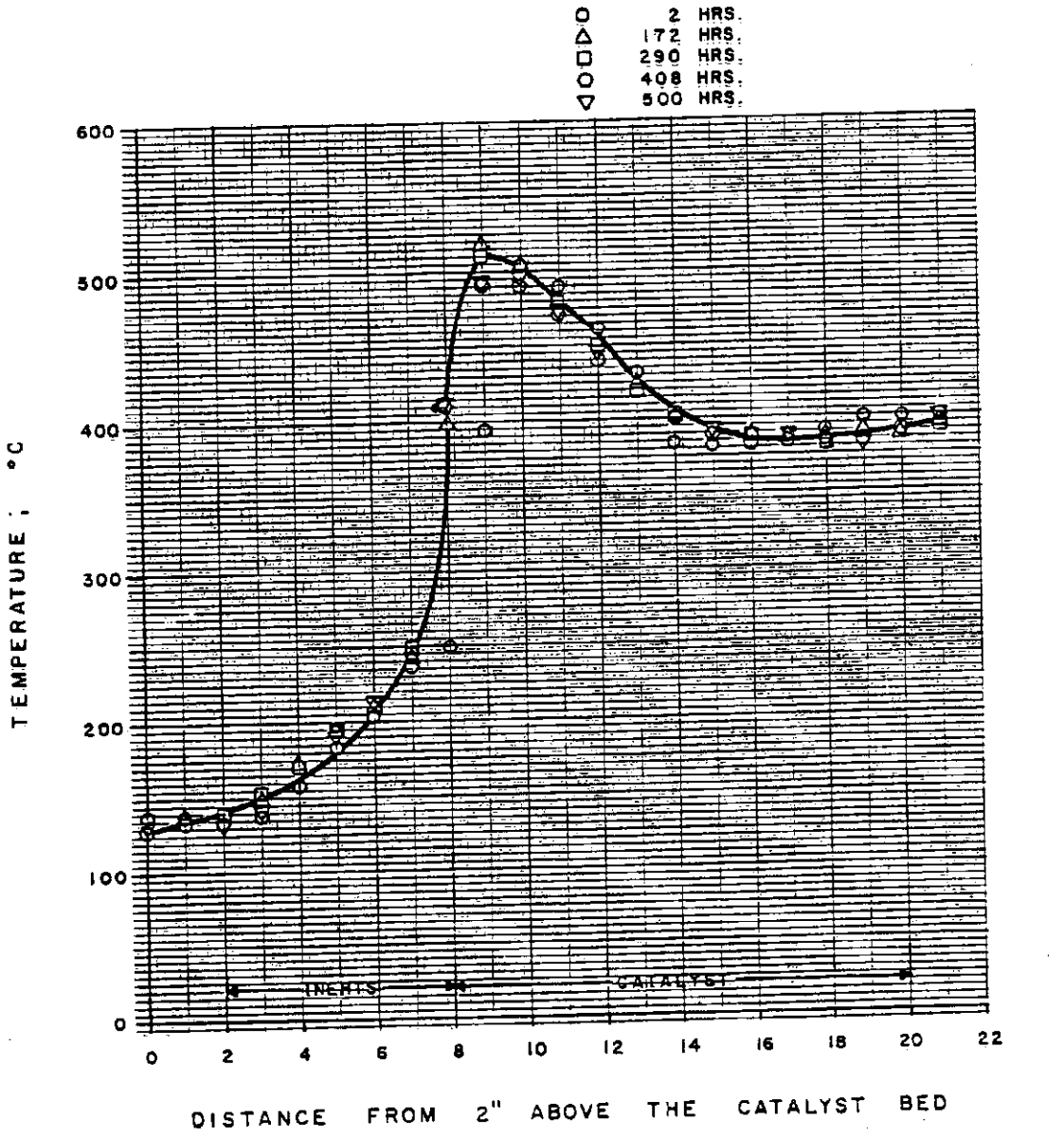
The oxidized catalyst appeared gray, similar to fresh catalyst, and seemed structurally weak and easily crushable while the spent catalyst prior to oxidation appeared black due to heavy carbon deposition averaging 5.1 wt percent. The carbon level of the oxidized catalyst was determined to be 2.5 percent. The catalyst was reloaded into the reactor and reduced in the routine manner for G-87P.

When the Lurgi feed gas was introduced, the reaction began immediately. Water was pumped in at 0.13 ml/min to constitute 5 percent of the total reactable feed. As the temperature profile history on Figure IV-D-47 indicates, the hot-spot location remained exceptionally stable throughout the run, at a value of 500°C, located 1 inch in from the start of the bed. Gas chromatographic analysis of the effluent indicated equilibrium conversion was attained at all times.

When the catalyst was removed from the reactor at the end of the test, some structural weakness was noted. While the 8.5 percent carbon level in the inlet section is slightly higher than 7.4 percent found in Run 2, the remaining sections all had lower carbon levels (See Table IV-D-4).

FIGURE IV-D-47

CARBON FORMATION STUDY
TEMPERATURE PROFILE OF RUN # 13
LURGI / G-87 P (35 ATM, 480°C, 5% STEAM, 500 HRS.)



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Surface area, pore volume and crystallographic measurements were all within normal ranges.

Thus, it appears that controlled oxidation can be utilized to remove deposited carbon without altering catalyst activity, but some question remains as to the effect of multiple reduction-run-oxidation cycles on particle physical properties.