5. High Pressure Runs

The effect of higher operating pressure (69 atm as opposed to 35 atm) was investigated only with the G-87P catalyst. The thermodynamic carbon formation isotherms are relatively insensitive to pressure with the Lurgi gas composition. Therefore, these tests were primarily intended to examine the influence of pressure on the kinetics of carbon formation.

Run 6; Lurgi Gas/G-87P (69 atm, 480°C, 0% steam, 500 hours)

Run 6 was identical to Run 1 except the pressure was increased in order to study the effect of higher pressure operation on carbon formation. It was found that the feed inlet pressure had dropped below 69 atm during a weekend and that the reactor had been at a standstill, with no inlet or outlet streams. The temperature profile was very stable over the entire 500-hour period with the hot spot located two inches below the top of the catalyst bed, as shown in Figure IV-D-28. The temperature rise in the bottom section of the bed was caused by a faulty temperature controller.

The conversion was monitored daily over the run period. Results indicate that full equilibrium conversion was achieved throughout the run. The results from spent catalyst analyses are given in Table IV-D-4.

Run 7; Lurgi Gas/G-87P (69 atm, 480°C, 5% steam, 500 hours)

Run 7 was identical to Run 2 except the pressure was 69 atm. The temperature profile exhibited two distinct patterns as shown in Figure IV-D-29. One pattern was evident before the feed pressure drop, which

FIGURE IV-D-28

TEMPERATURE PROFILE OF RUN #6

LURGI / G-87P (69 ATM., 480 °C, 500 HRS., NO STEAM)

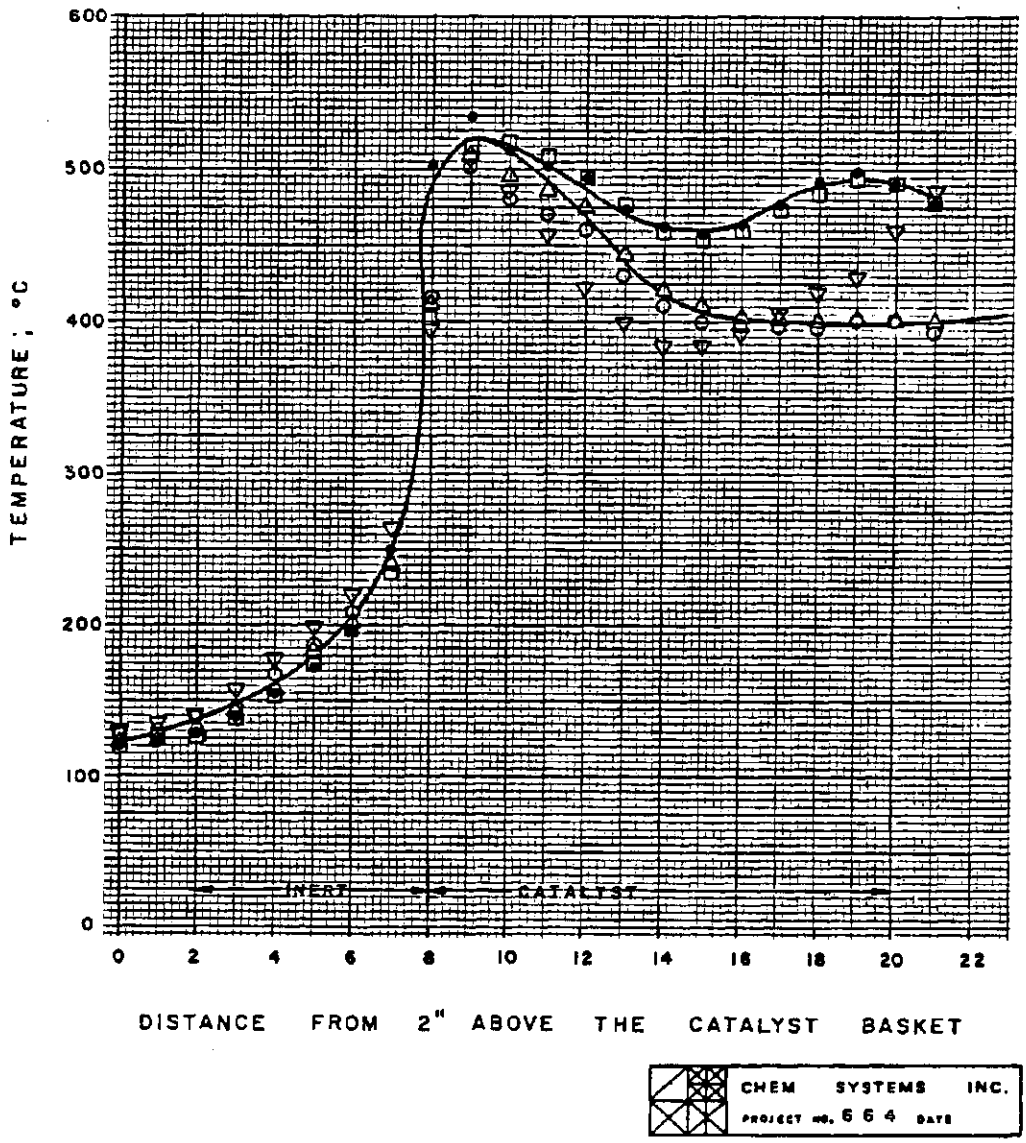
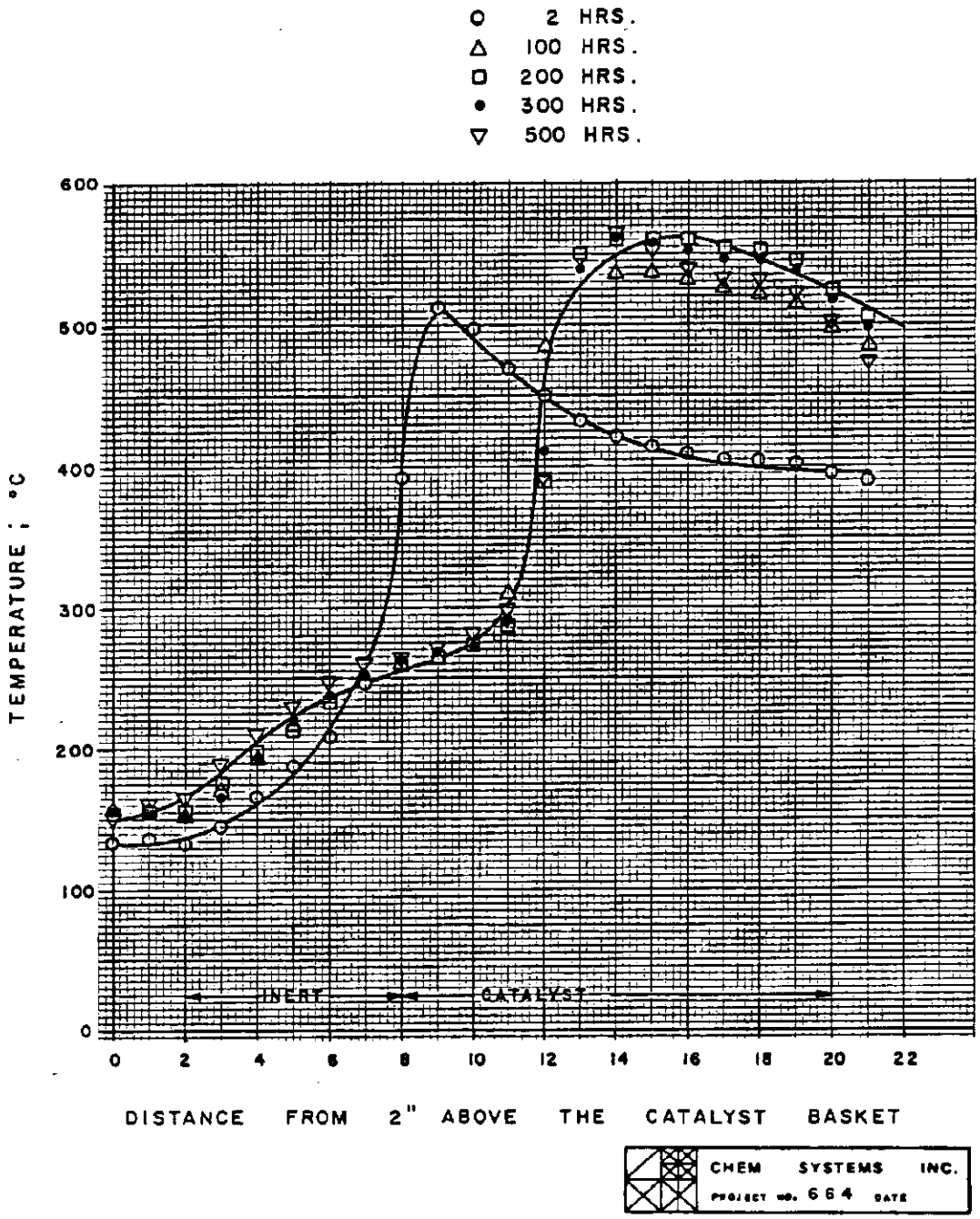


FIGURE IV-D-29

TEMPERATURE PROFILE OF RUN #7

LURGI / G-87 P (69 ATM., 480 °C, 500 HRS., 5% STEAM)



occurred in the same way as for Run 6. The other showed up after pressure had been restored. For an unknown length of time, no feed gas was flowing into the reactor, although water was continuously pumped in. This caused the hot spot to move down 4 inches and raised its temperature to 560°C. When the feed inlet pressure was restored, the new profile remain unchanged until the end of the run.

The conversion results seemed close to equilibrium values despite the pressure upset. Conversion is evidently dictated more by the temperature of the hot spot than by its location. The results from spent catalyst analyses are given in Table IV-D-4.

Examination of the catalyst samples indicated that, for Run 6, all parameters were within normal limits. However, it should be noted that the carbon deposition levels were measurably lower than those obtained in Run 1 at 35 atm, especially in the first section of the bed where Run 6 had only 4 percent carbon, while Run 1 had over 9 percent carbon. The differences were less significant for the other sections. In the catalyst samples of Run 7, especially from the deactivated inlet section, there were marked morphological and chemical changes. Nearly 70 percent of the non-cement alumina was hydrated forming large crystals of Alpha-$Al_2O_3 \cdot H_2O$ (1800°A), with a resultant loss in substantially all the micropore structure and its associated surface area. In addition, carbon levels were slightly higher than those found in Run 6 samples, in spite of the presence of steam in Run 7, and somewhat lower than the carbon levels found in Run 2, operating at 35 atm.

Based on these results, it does appear that increased operating pressure reduces the level of carbon deposition. However, operating difficulties during the runs make these findings somewhat tentative in nature. Further work would be necessary in order to corroborate these findings.