Table 1: Rate of Change of Reactor Temperature
For Three Power Inputs

Run	Average Temperature (K)	Power Total Time (min)	Input (W)	Slope (K/hr)
1	541.3	480.0	0.0	-0.78
2	535.1	530.0	0.0	-0.97
3	531.1	480.0	0.0	-0.87
4	542.7	120.0	0.0	-0.42
5	542.6	60.0	2.0	1.88
6	543.7	80.0	4.2	1.51
7	540.9	120.0	0.0	-0.50
8	541.2	60.0	4.2	0.24
9	550.1	60.0	0.0	-0.47
10	550.4	60.0	2.0	-0.23
11	555.6	80.0	4.2	2.61
12	549.0	150.0	0.0	0.43
13	550.5	60.0	4.2	1.94

Table 2

Summary of Reported Fischer-Tropsch Catalyst Studies in the Slurry Phase

CATALYST USED	REFERENCE
pptd Fe Catalyst	Schlesinger et al. (1951)
Fused Fe Catalyst	Hall et al. (1951)
Nitrided Fused Fe Catalyst	Schlesinger et al. (1954)
Unsupported pptd Fe Catalyst	Kölbel and Ackermann (1956), Kölbel and Ralek (1980)
pptd Fe Catalyst	Mitra and Roy (1963)
pptd Fe Catalyst	Farley and Ray (1964)
pptd Fe Catalyst	Kunugi and Sakai (1968)
pptd Fe Catalyst	Forney et al. (1975)
"I-A" ($Fe/Cu/K_2CO_3$) Mobil (1982)	
"I-B" and "I-C"	Kuo et al. (1983)
Sintered Fe Catalyst	Bauer et al. (1983)
Fused Fe Catalyst	Satterfield and Huff (1982)
Mn/Fe Catalyst	Satterfield and Stenger (1983)
Precipitated Fe Catalyst	Dictor and Bell (1983)
Supported Ruthenium Catalyst	Bell and Heinemann (1983)

Table 3 Typical Chemical and Physical Properties of Catalysts Used

Fused Iron Catalyst (Supplied by United Catalyst Inc.)

Catlayst Type	C73-1-01
Size	-150 +250 Mesh
Density	170 ± 10

Chemical Analyses (weight percent):

Fe	30-37	CaO	0.7-1.2
Fe_2O_3	65-68	SiO_2	<0.4
Free Fe	<0.5	P	<0.015
Total Fe	67-69	S	<0.001
Al_2O_3	2.0-3.0	Cl	<0.002
K_2O	0.5-0.8	Fe^{++}/Fe^{+++}	.45-.65

Supported Ruthenium Catalysts (Supplied by Engelhard Inc.)

Lot#	29561
Catalyst Metal:	Ruthenium
Support:	-Al_2O_3
Metal Loading:	5.0%
Support Form:	Powder (< 0.5 mm)
Support Surface Area (m^2/g)	100-250
Free Bulk Density (g/cc)	0.6-0.9

Table 4. Properties of the Liquid Carrier

Pour Point, °C	< -54
Flash Point, °C	243.3
Fire Point, °C	268
Flash Autogeneous Ignition °C	360
Evaporation Loss, Wt. % 6.5 Hrs. @ 204.4°C (400°F)	5.4
Total Acid No.	0.03
Specific Gravity, 15.6/15.6°C (60/60°F)	0.8285
Water PPM	8
Appearance, 24 Hr., 0°C (32°F)	Bright
Bromine Index	824
C_{30}(%) -	28.04
C_{40}(%) -	53.22
C_{50}(%) -	15.58
C_{60}(%) -	3.11

Table 5

Summary of Experimental Results with Fused Iron Catalyst
Pressure = 0.69 MPa, Stirrer Speed = 2300 rpm, Feed CO = 44.50%
Catalyst Weight = 80 gms

Run	Temperature (K)	Feed Flow Rate (scc/min)	CO Conversion (%)	Micro moles CO Consumed /hr gm Catalyst	Micro moles CH_4 Produced /hr gm Catalyst	Micro Moles CO_2 produced /hr gm Catalyst	Rate of Temperature Rise K/hr	Rate of Heat Generation kJ/mol CO Converted	Rate of He Generation mW/gm Catalyst
1	556.6	575.9	8.59	737.5	20.67	146.56	0.87	122.93	33
2	556.7	573.9	6.55	560.0	14.36	74.74	0.33	125.52	19
3	527.5	555.2	2.13	176.2	9.11	67.72	-0.36	50.74	2
4	573.7	560.1	7.81	651.2	34.44	176.73	0.71	161.59	26
5	549.4	541.1	7.21	581.2	13.03	95.11	0.69	86.61	14
6	534.3	548.1	4.73	386.2	13.23	53.11	0.09	127.49	13
7	543.2	541.4	4.66	376.2	14.84	60.61	-0.067	93.29	10

Table 6 Range of Parameters Studied for Three-Phase Fischer-Tropsch Reaction with Supported Ruthenium Catalyst

Temperature:	510 - 580 K
Pressure:	0.80 - 2.2 MPa
Space Velocity:	600.0 - 1200.0 (based on bulk density of the catalyst)
Catalyst Loading:	50 g catalyst/ ℓ slurry
Feed CO (%):	20.0 - 62.0
H_2/CO ratio:	4.0 - 0.60

Table 7: Effect of Changes in Reactor Operating Conditions on Reactor Performance

Operating Conditions			Percent Change					
	Base	Perturbed	X_{CO}	N_{CO}	n_{CH_4}	N_{CH_4}	Q_R	Q_G
Variable	Value	Value (+)	(84.42)*	(8.46)	(61.0)	(5.15)	(146.5)	(0.37)
T (K)	550.00	560.00	8.0	5.0	16.0	16.0	22.0	20.0
n_g (rpm)	2300.00	200.00	5.0	5.0	10.0	10.0	20.0	20.0
S_V (hr^{-1})	606.82	907.58	-9.0	40.0	17.0	50.0	13.0	50.0
P (MPa)	1.46	2.14	12.0	12.0	-10.0	-8.0	-25.0	-25.0
f_{CO} (mole percent)	21.31	61.62	-10.0	70.0	-40.0	60.0	-60.0	-10.0

* Base values for each variable are given in parenthesis.
\+ Effects of process variables were studied by changing one variable at a time. The number in the columns represent percent changes from the baseline conditions.

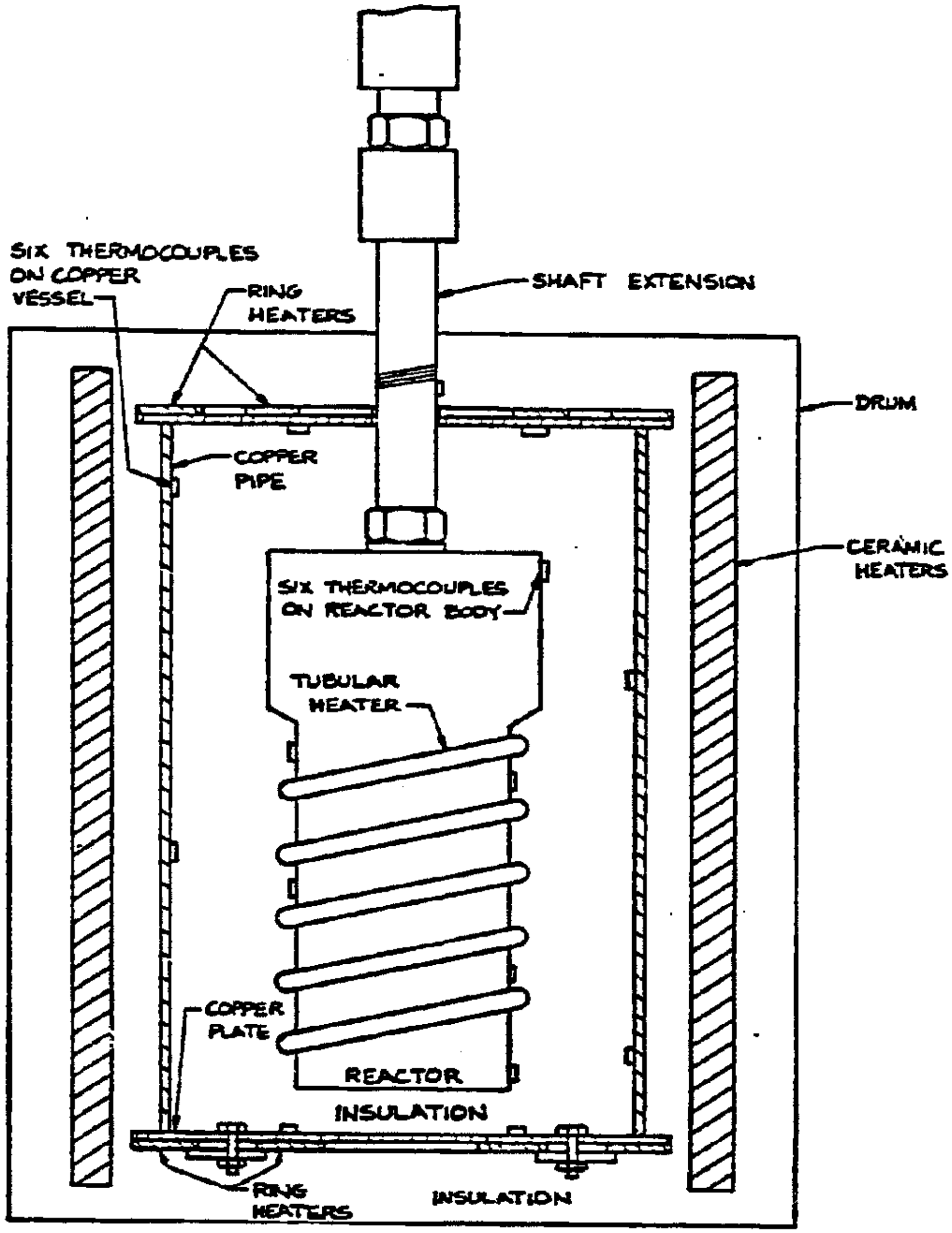

Figure 1: Cross-section of the Reactor Assembly

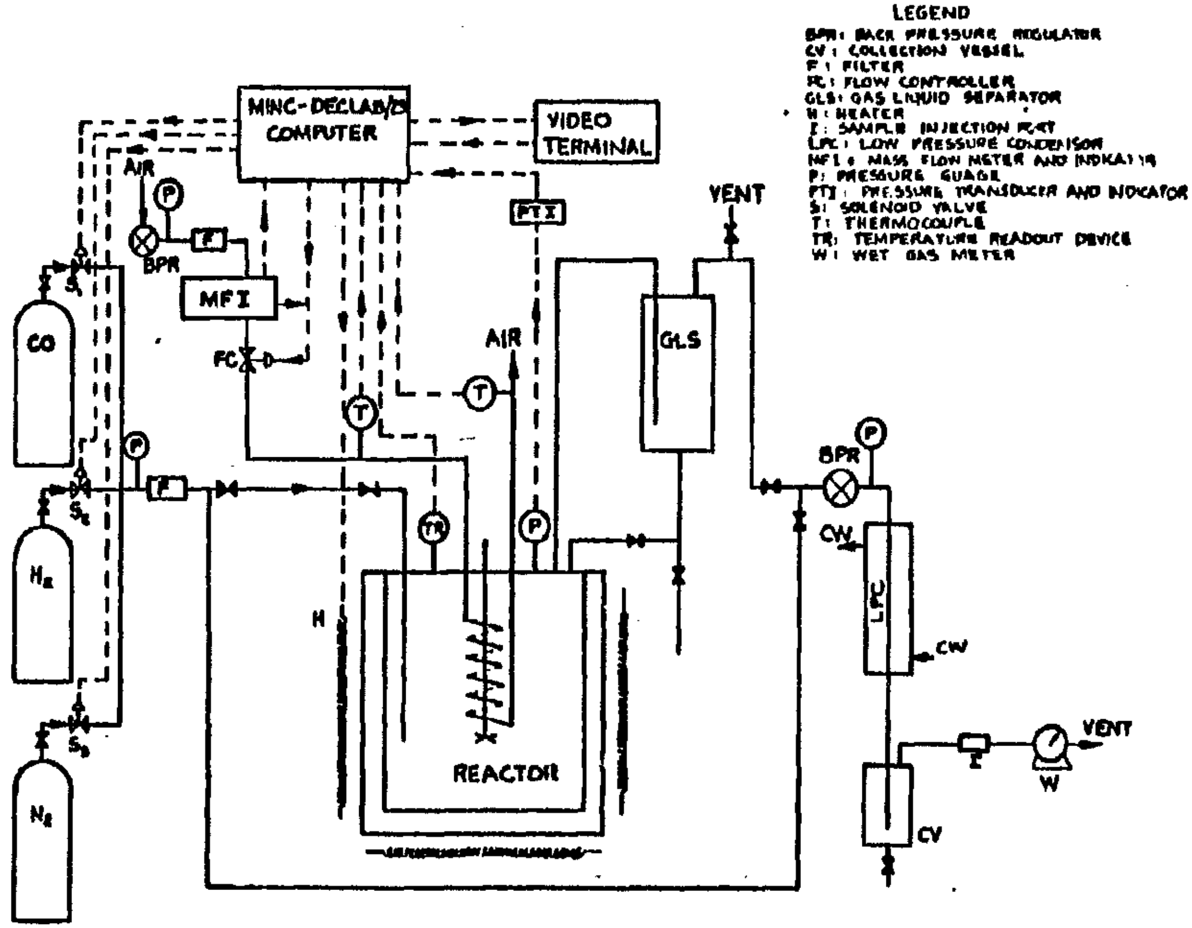

Figure 2: Process Flow Diagram for Slurry Reactor with Fischer-Tropsch Reaction

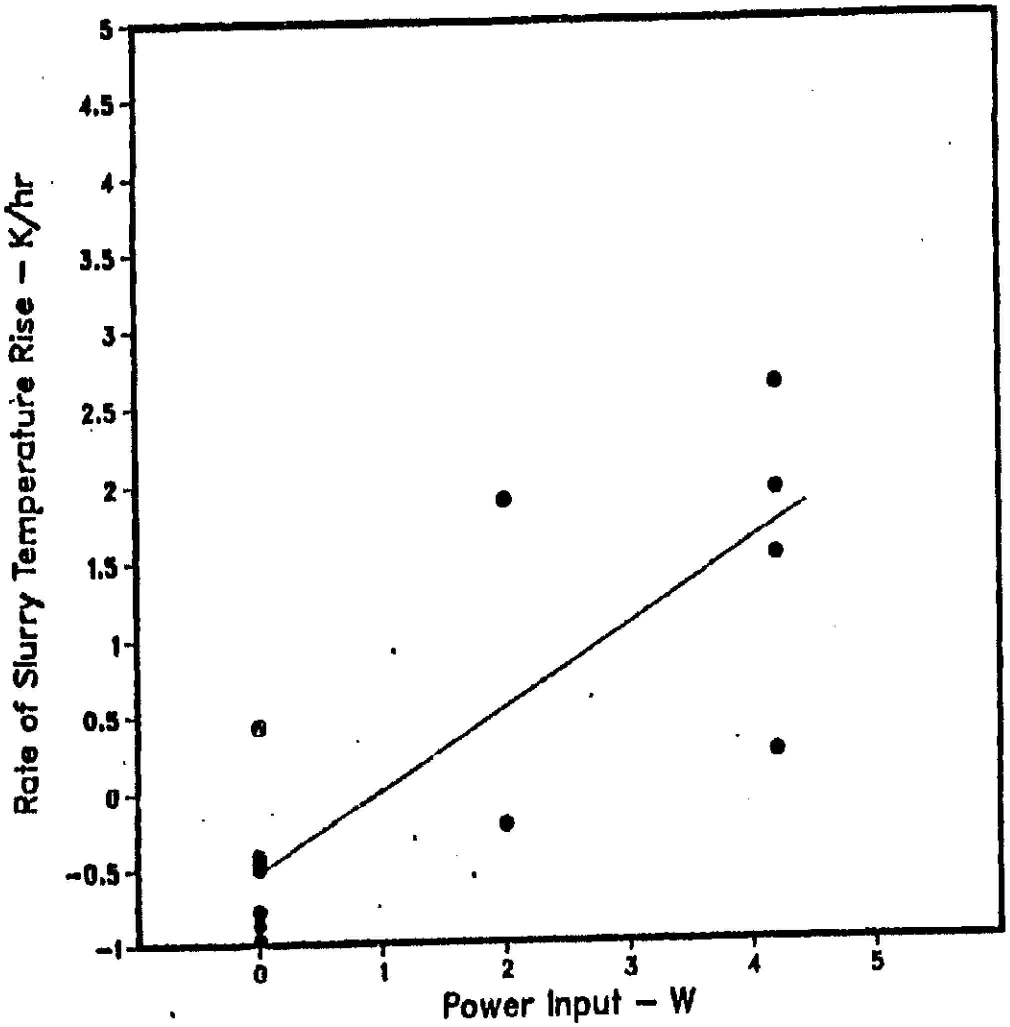

Figure 3 Rate of Temperature Rise of Reactor as Function of Power Input. Used to calculate Heat Losses.

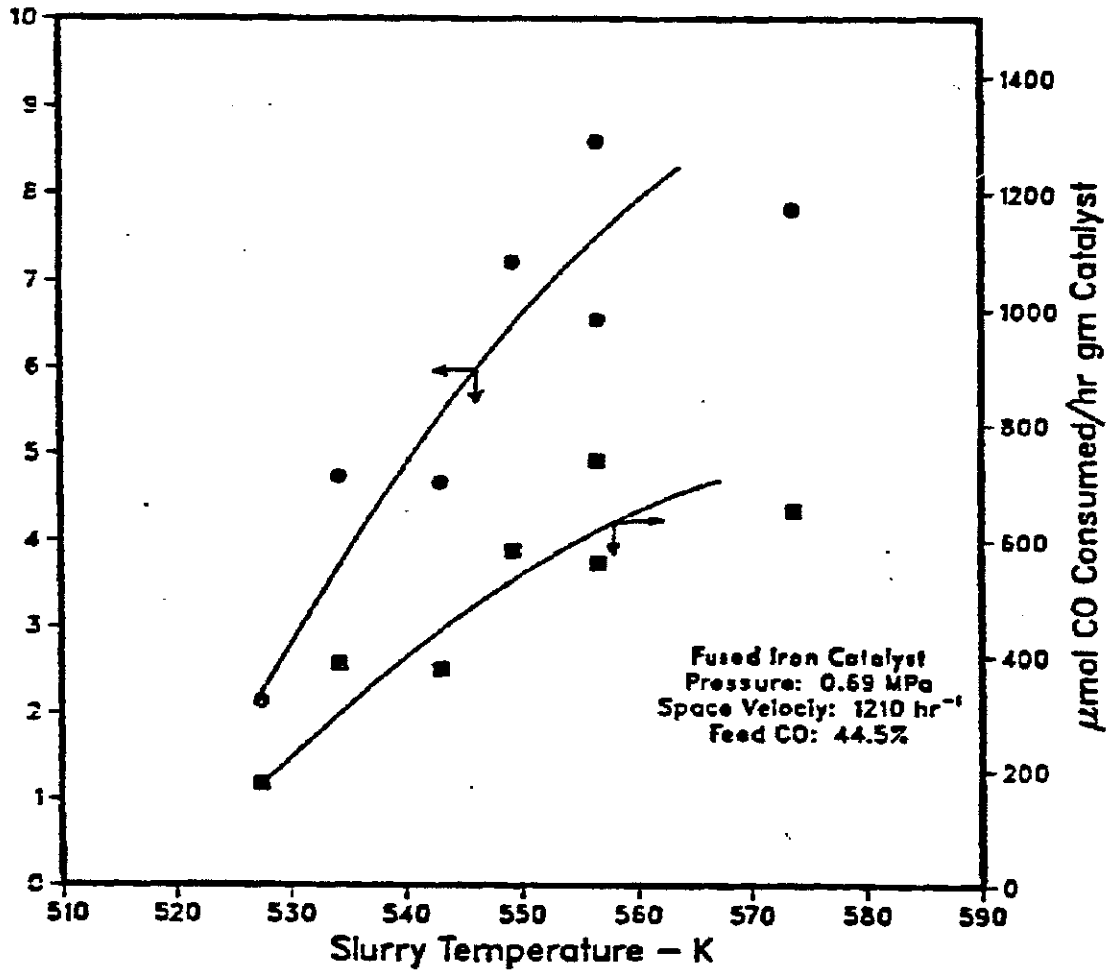

Figure 4: Effect of Slurry Temperature on Conversion and Rate of Consumption of Carbon Monoxide for Fused Iron Catalyst.

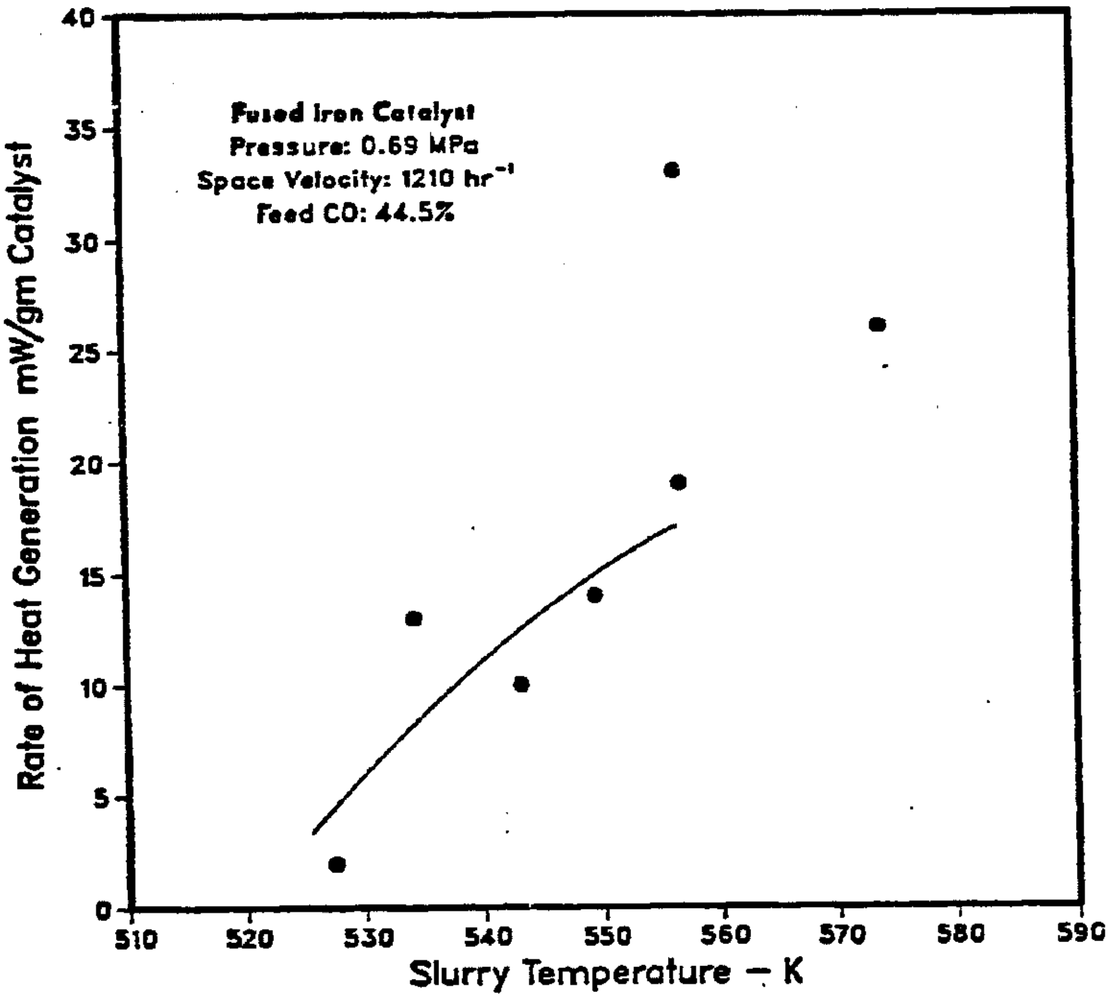

Figure 5: Effect of Slurry Temperature on Rate of Heat Generation for Fused Iron Catalyst

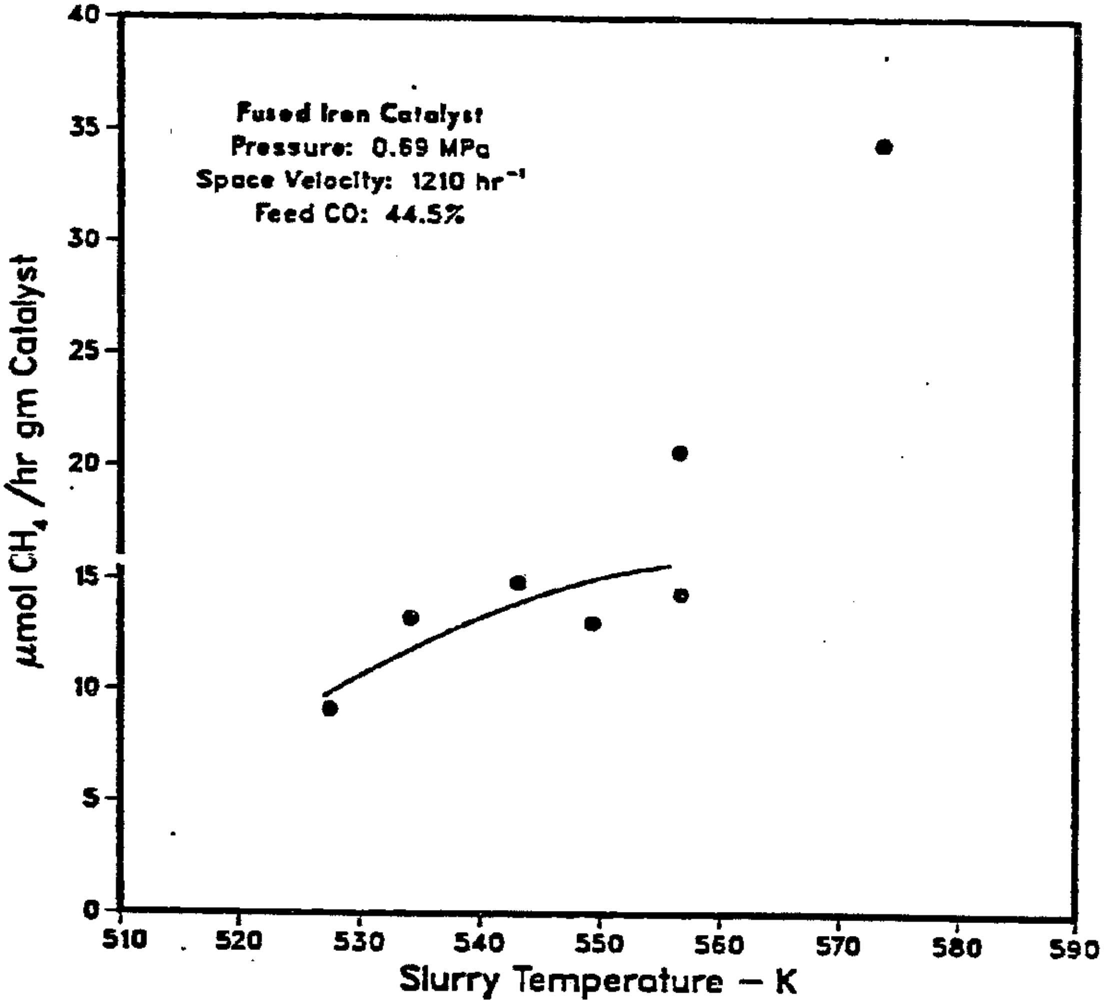

Figure 6: Effect of Slurry Temperature on Rate of Production of Methane for Fused Iron Catalyst

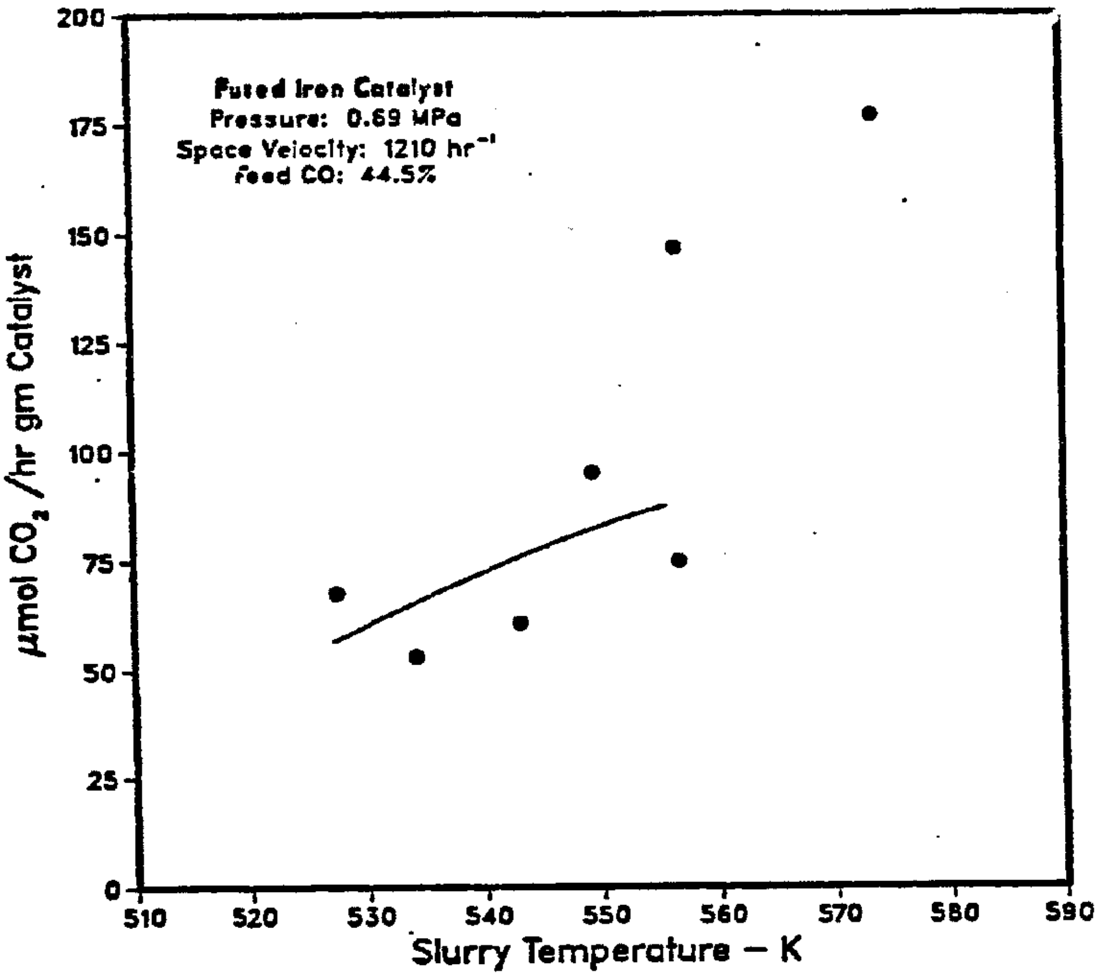

Figure 7: Effect of Slurry Temperature on Rate of Production of Carbon Dioxide for Fused Iron Catalyst

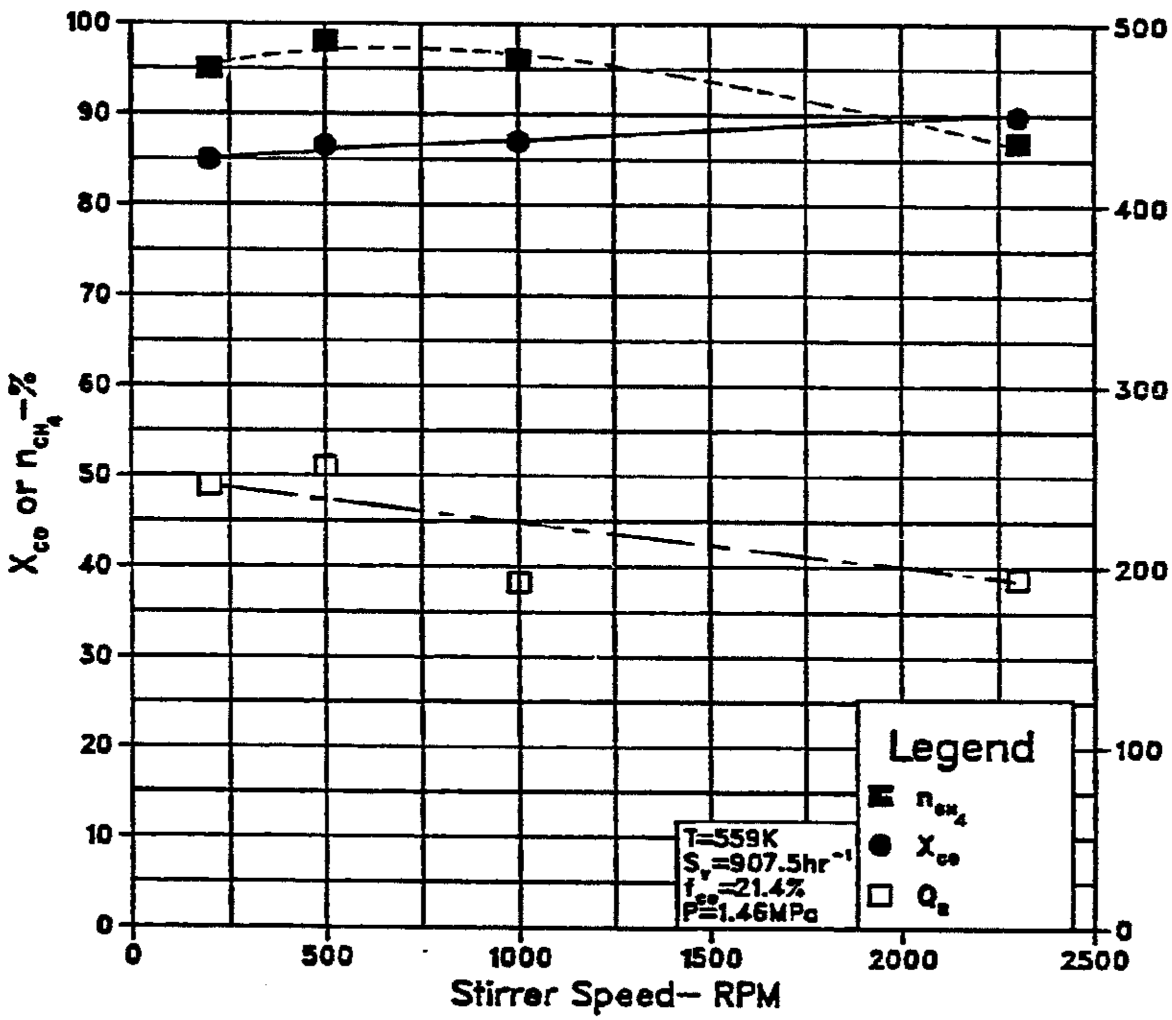

Figure 8: Effect of Stirrer Speed on Reactor Performance for FT Reaction in a Slurry Reactor

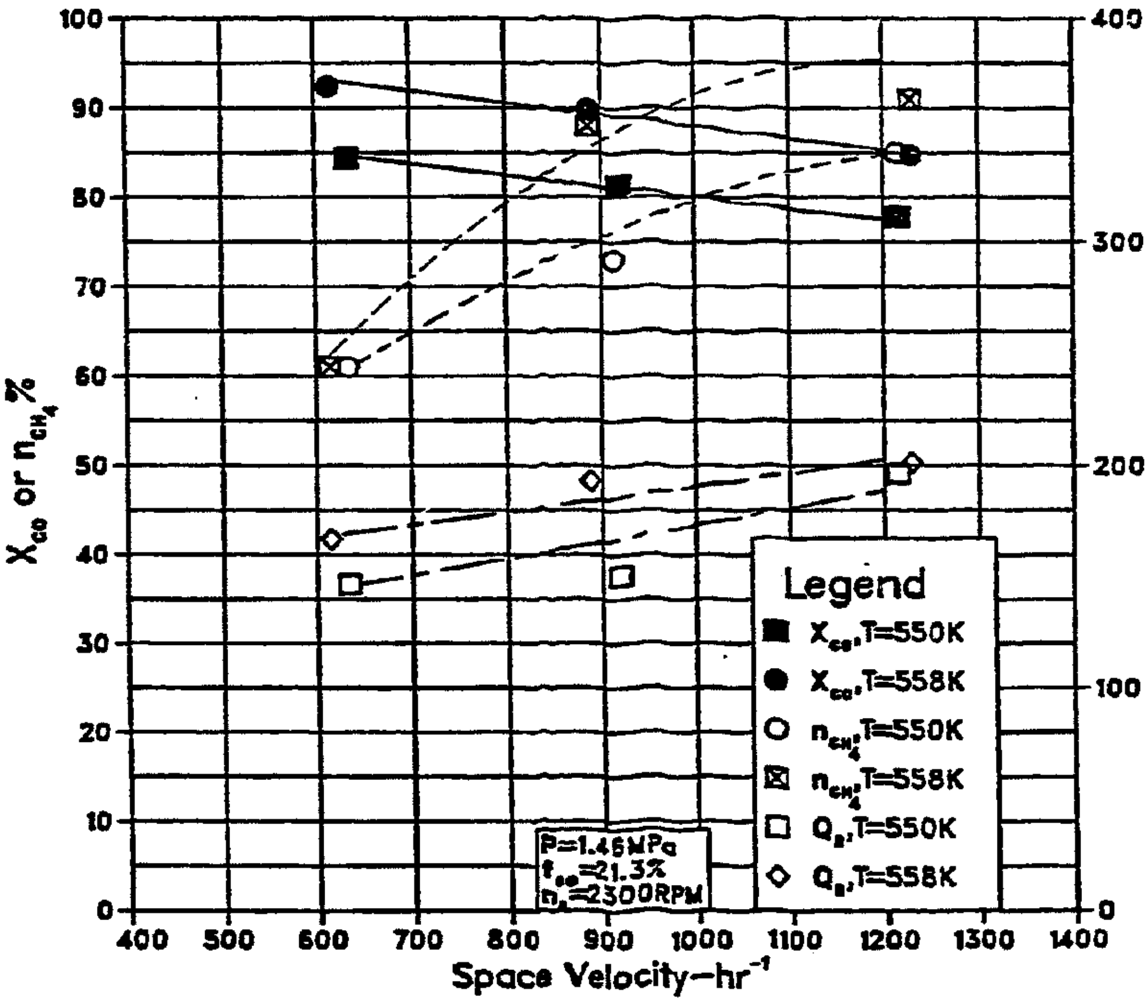

Figure 9: Effect of Space Velocity on Reactor Performance for FT Reaction in a Slurry Reactor

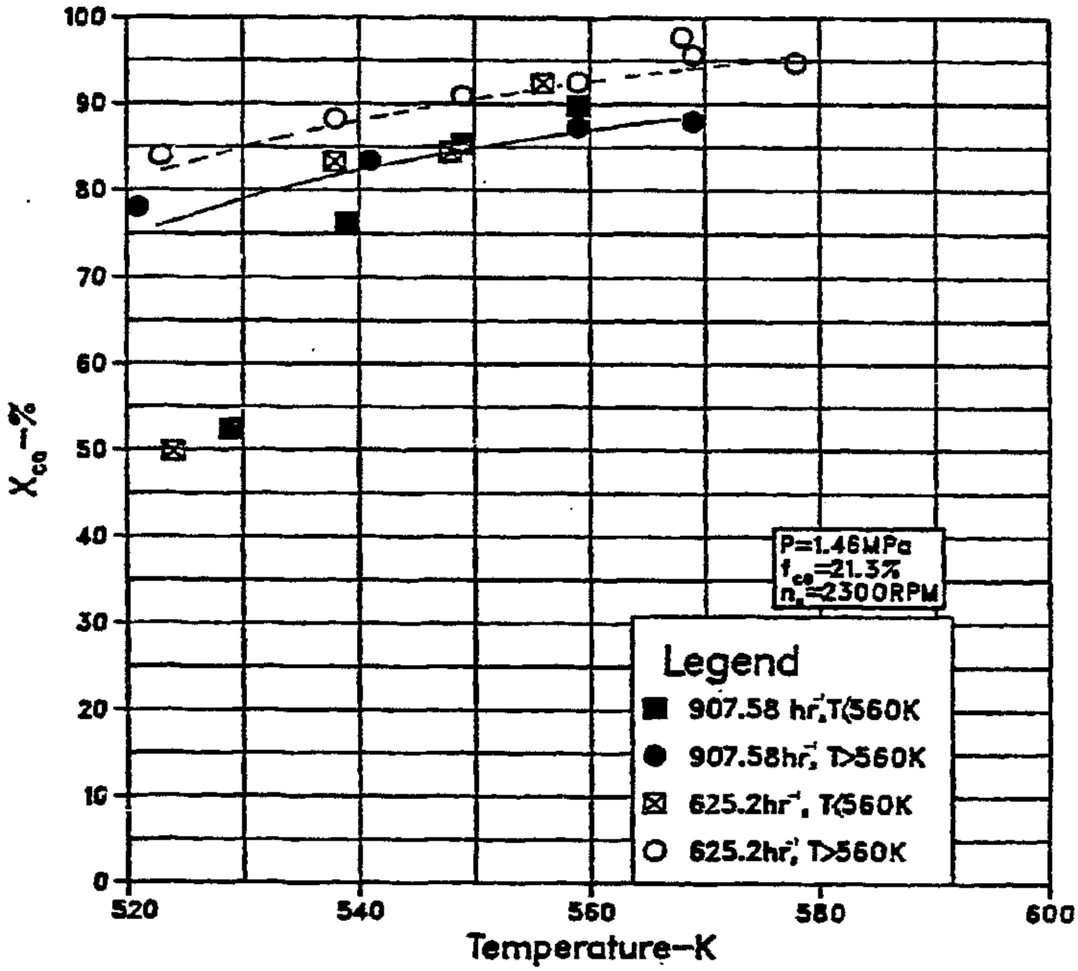

Figure 10: Effect of Space Velocity on Steady State Multiplicity; Conversion as a Function of Temperature

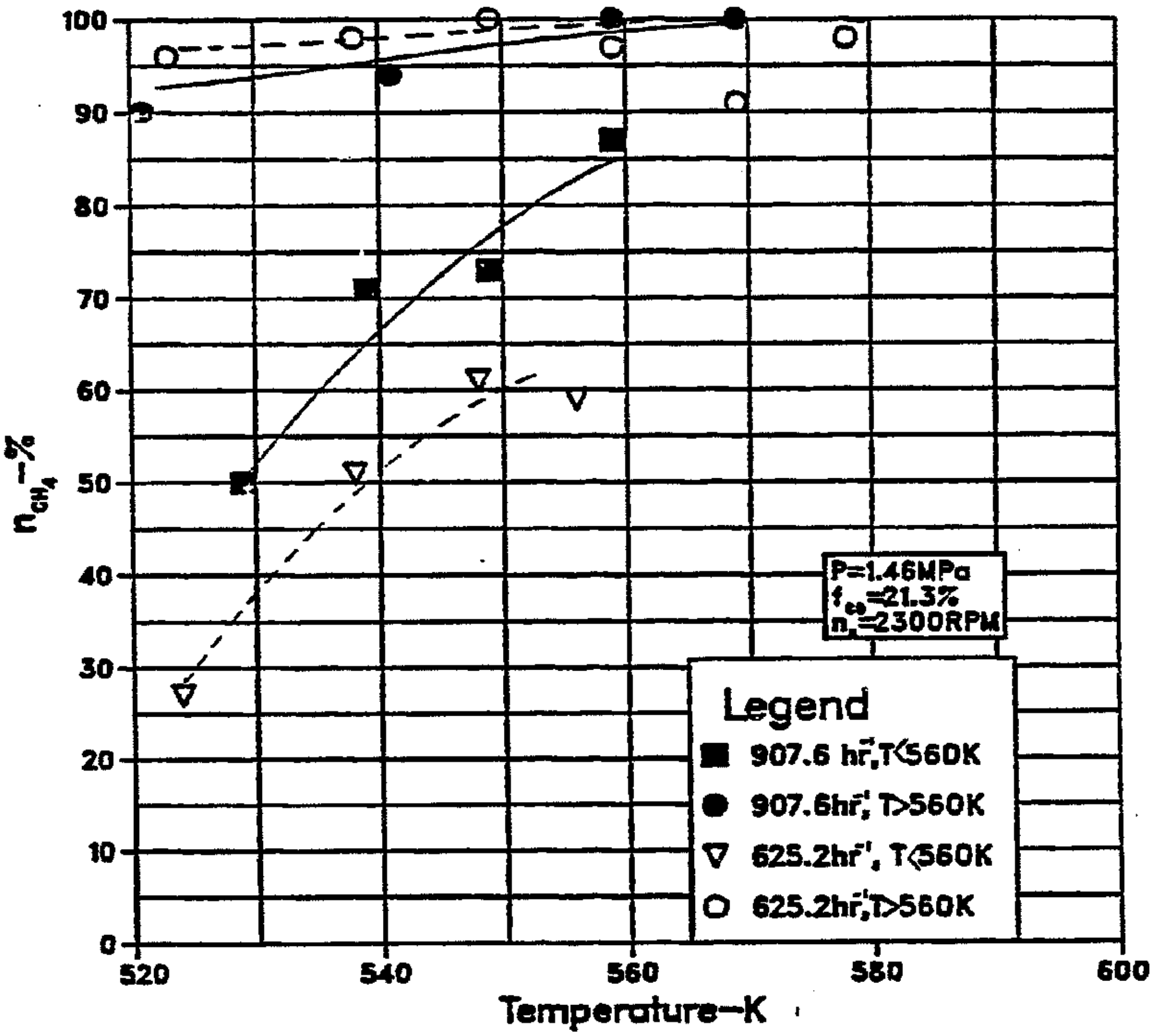

Figure 11: Effect of Space Velocity on Steady State Multiplicity; Mole Percent Methane Formed as a Function of Temperature

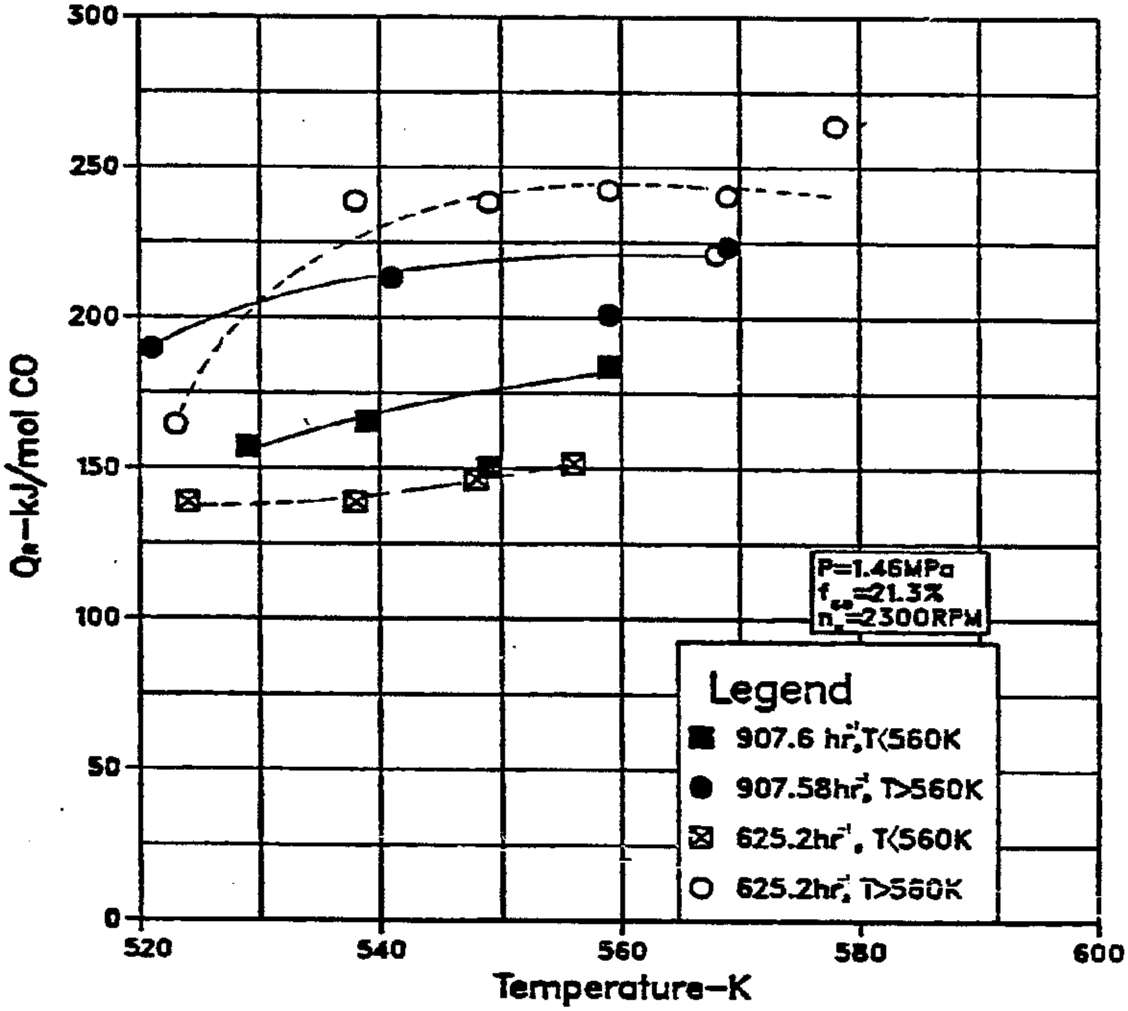

Figure 12: Effect of Space Velocity on Steady State Multiplicity; Heat of Reaction as a Function of Temperature

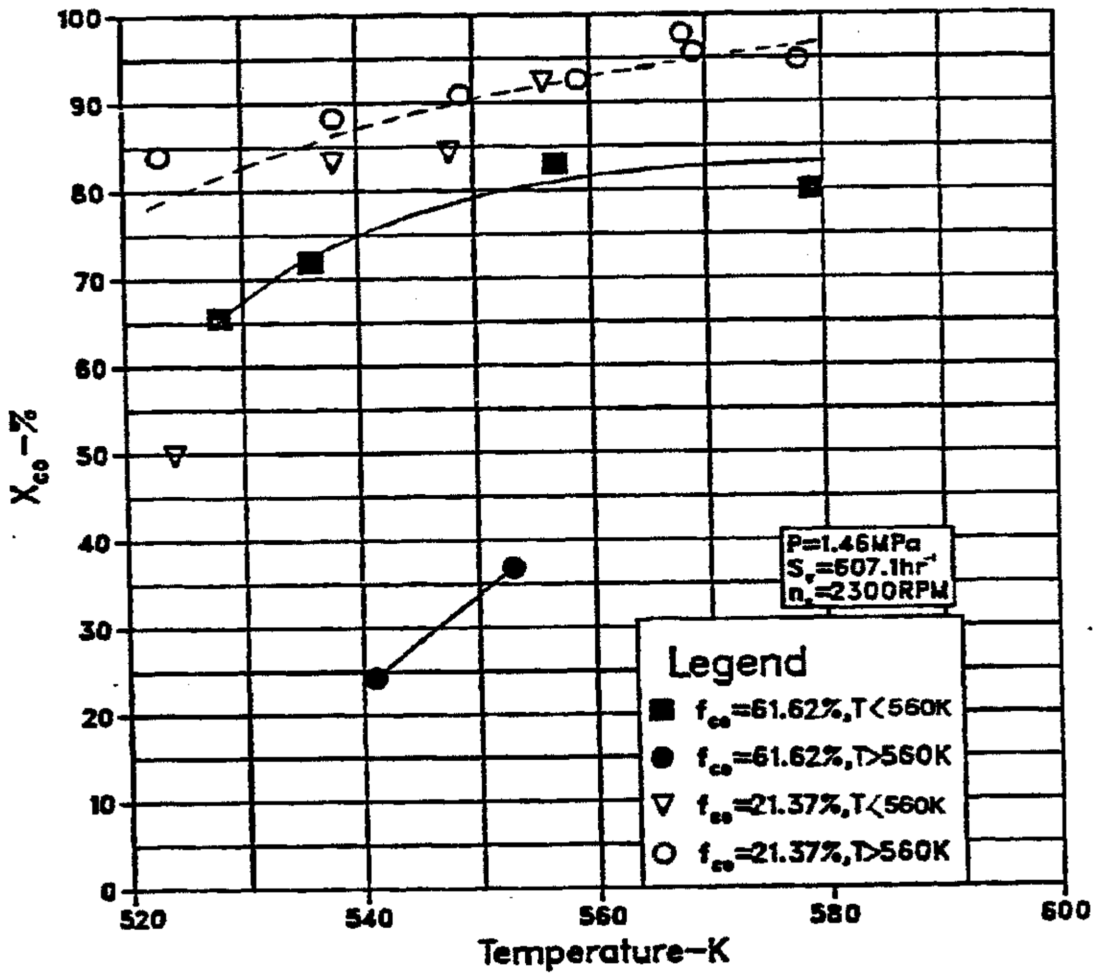

Figure 13: Effect of Feed Composition on Steady State Multiplicity; Conversion as a Function of Temperature

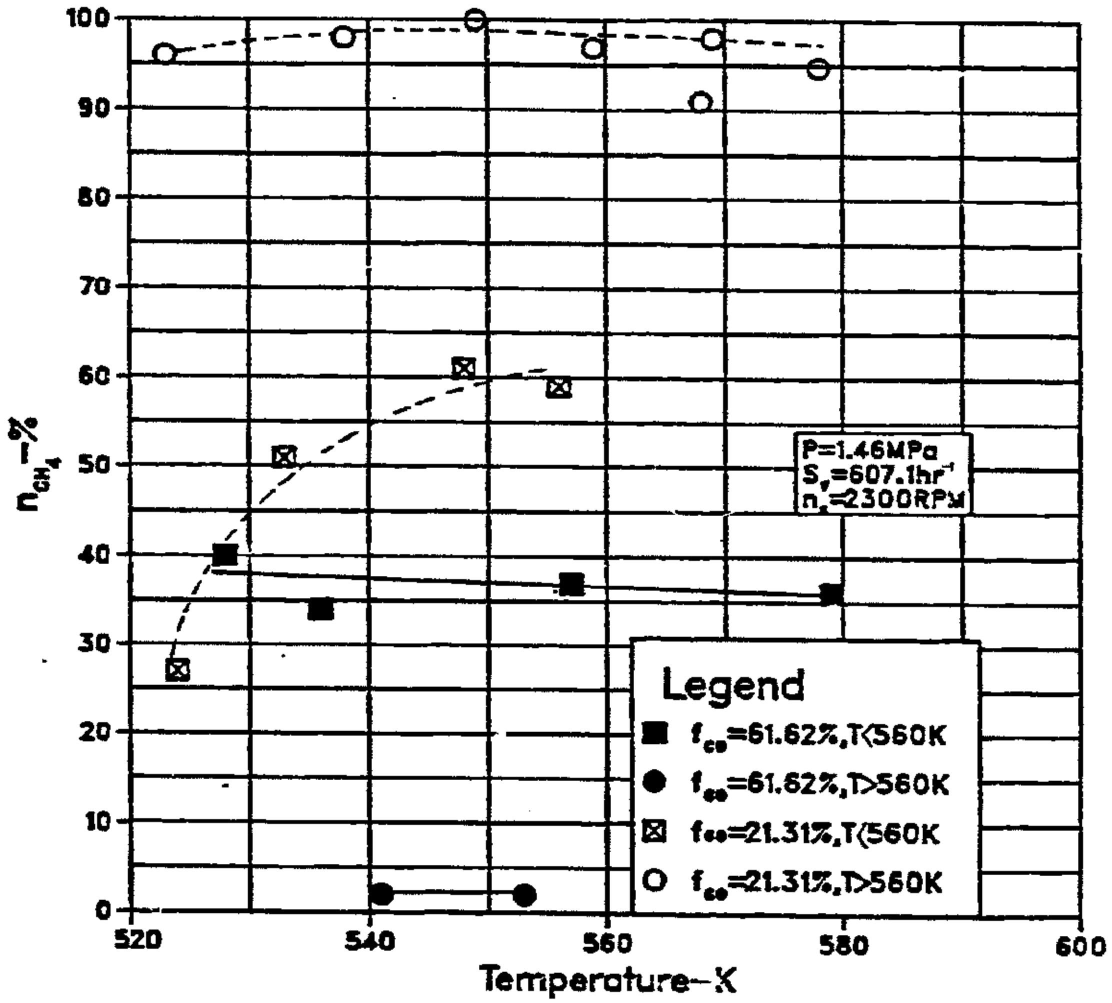

Figure 14: Effect of Feed Composition on Steady State Multiplicity; Mole Percent Methane Formed as a Function of Temperature

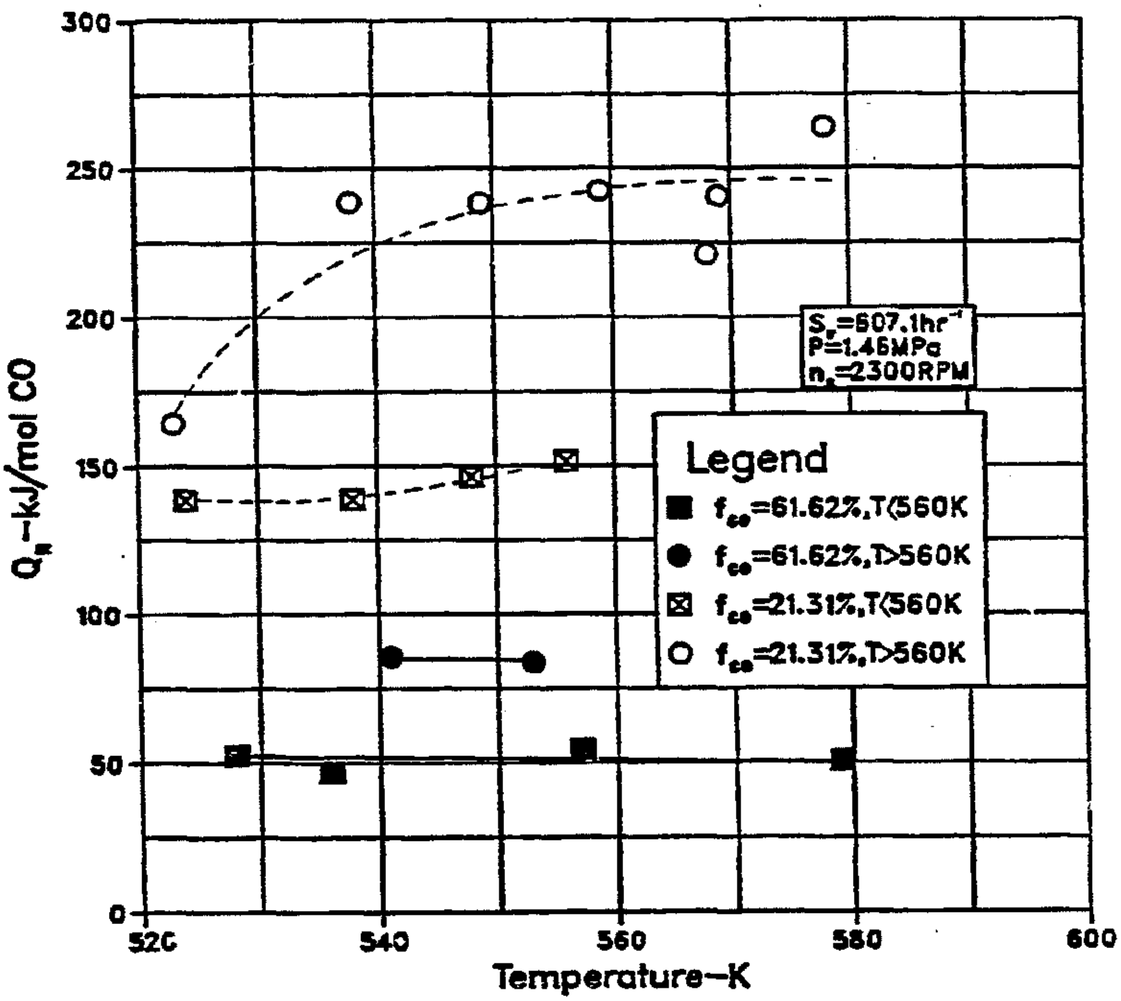

Figure 15: Effect of Feed Composition on Steady State Multiplicity; Heat of Reaction as a Function of Temperature

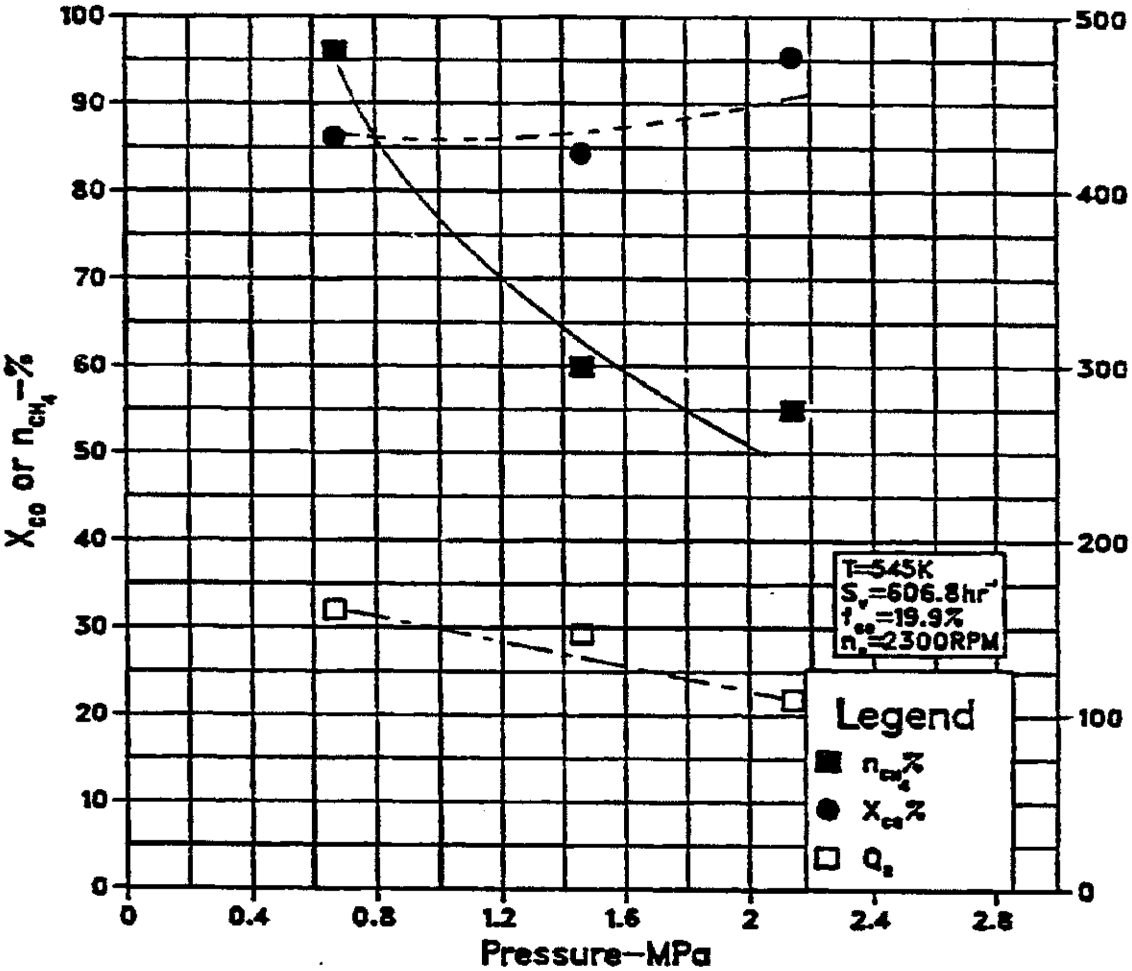

Figure 16: Effect of Pressure on Reactor Performance for FT Reaction in a Slurry Reactor

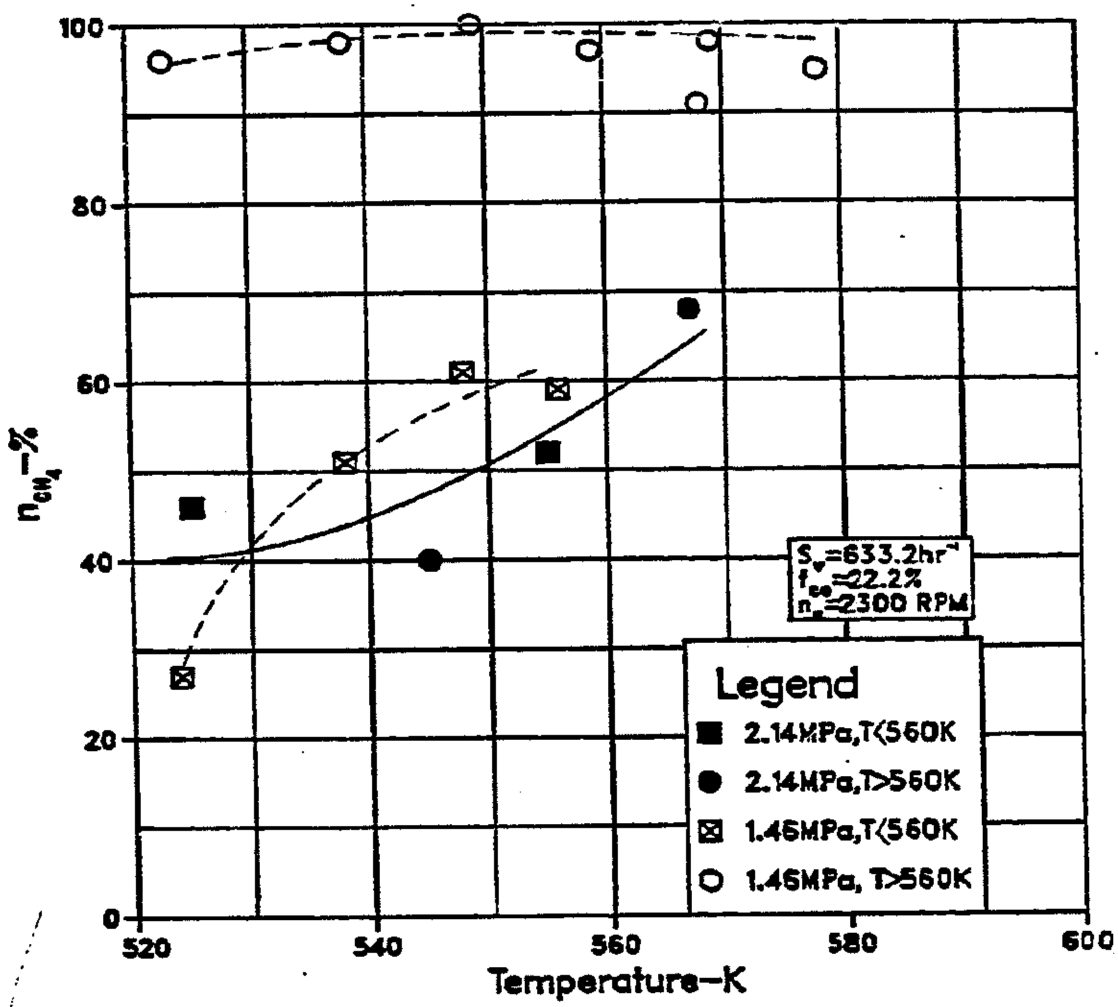

Figure 17: Effect of Pressure on Multiplicity of Steady States; Mole Percent Methane Formed as a Function of Temperature

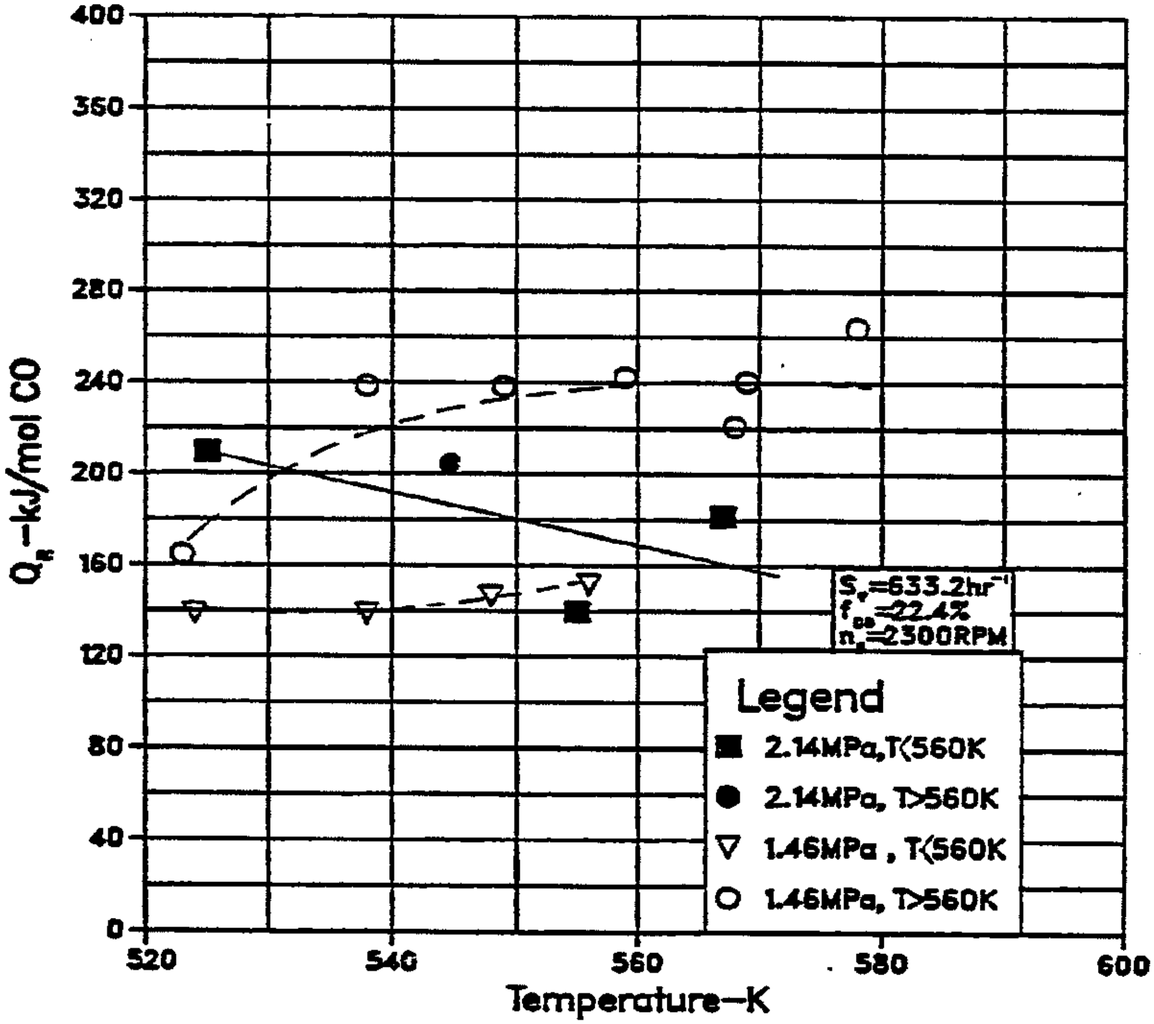

Figure 18: Effect of Pressure on Multiplicity of Steady States; Heat of Reaction as a Function of Temperature