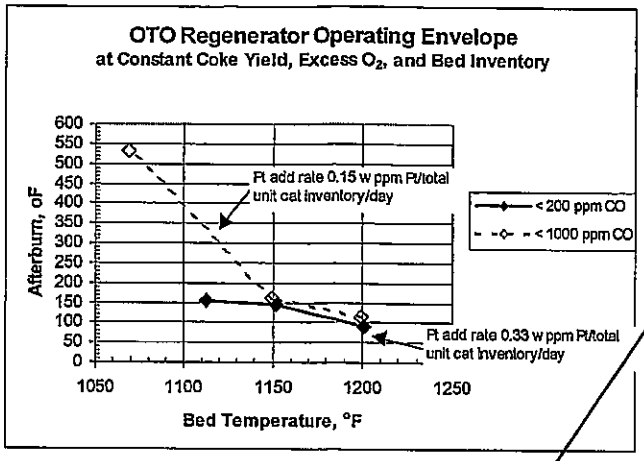

OTO Regenerator Operating Envelope
at Constant Coke Yield, Excess O_2, and Bed Inventory
Afterburn, oF
600
550
500
450
400
350
300
250
200
150
100
50
0
1050
1100
1150
1200
1250
Bed Temperature, °F
Pt add rate 0.15 w ppm Pt/total unit cat inventory/day
Pt add rate 0.33 w ppm Pt/total unit cat inventory/day
< 200 ppm CO
< 1000 ppm CO

FIG. 1

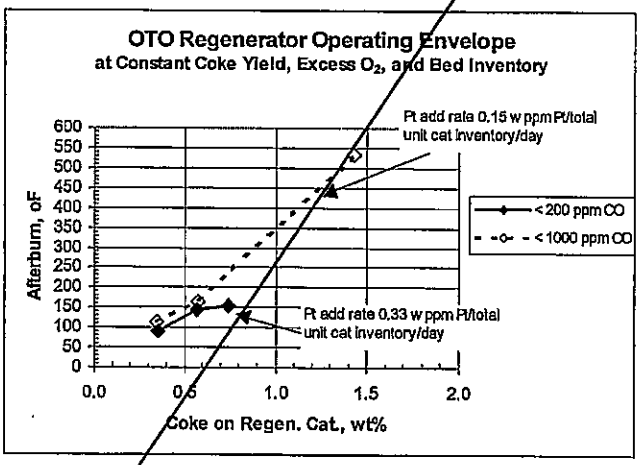

OTO Regenerator Operating Envelope
at Constant Coke Yield, Excess O_2, and Bed Inventory
Afterburn, oF
600
550
500
450
400
350
300
250
200
150
100
50
0
0.0
0.5
1.0
1.5
2.0
Coke on Regen. Cat., wt%
Pt add rate 0.15 w ppm Pt/total unit cat inventory/day
Pt add rate 0.33 w ppm Pt/total unit cat inventory/day
< 200 ppm CO
< 1000 ppm CO

FIG. 2

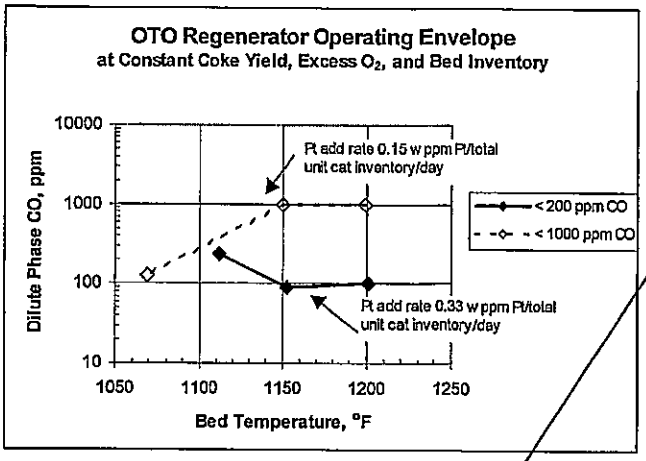

OTO Regenerator Operating Envelope
at Constant Coke Yield, Excess O_2, and Bed Inventory
Dilute Phase CO, ppm
10000
1000
100
10
1050
1100
1150
1200
1250
Bed Temperature, °F
Pt add rate 0.15 w ppm Pt/total unit cat inventory/day
Pt add rate 0.33 w ppm Pt/total unit cat inventory/day
< 200 ppm CO
< 1000 ppm CO

FIG. 3

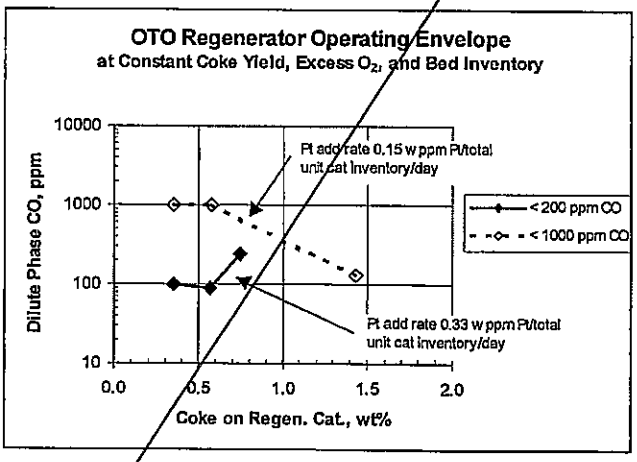

OTO Regenerator Operating Envelope
at Constant Coke Yield, Excess O_2, and Bed Inventory
Dilute Phase CO, ppm
10000
1000
100
10
0.0
0.5
1.0
1.5
2.0
Coke on Regen. Cat., wt%
Pt add rate 0.15 w ppm Pt/total unit cat inventory/day
Pt add rate 0.33 w ppm Pt/total unit cat inventory/day
< 200 ppm CO
< 1000 ppm CO

FIG. 4

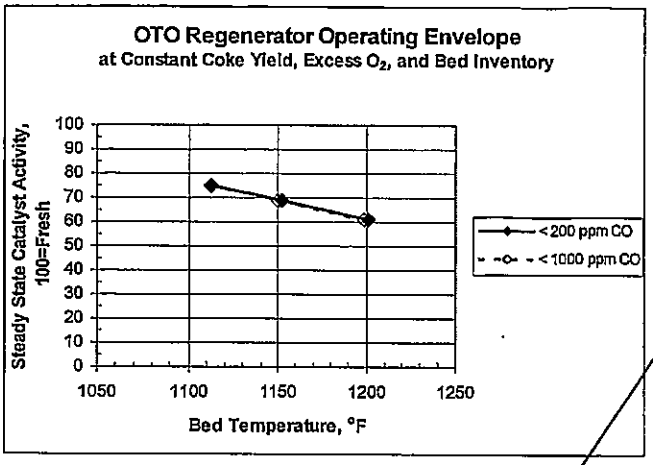

OTO Regenerator Operating Envelope
at Constant Coke Yield, Excess O_2, and Bed Inventory
Steady State Catalyst Activity, 100=Fresh
100
90
80
70
60
50
40
30
20
10
0
1050
1100
1150
1200
1250
Bed Temperature, °F
< 200 ppm CO
< 1000 ppm CO

FIG. 5

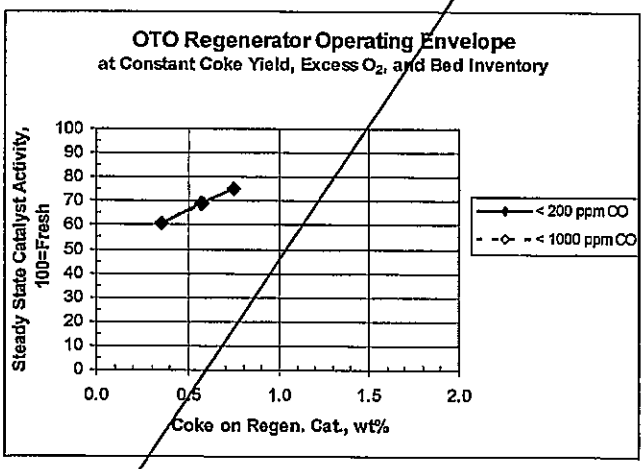

OTO Regenerator Operating Envelope
at Constant Coke Yield, Excess O_2, and Bed Inventory
Steady State Catalyst Activity, 100=Fresh
100
90
80
70
60
50
40
30
20
10
0
0.0
0.5
1.0
1.5
2.0
Coke on Regen. Cat., wt%
< 200 ppm CO
< 1000 ppm CO

FIG. 6

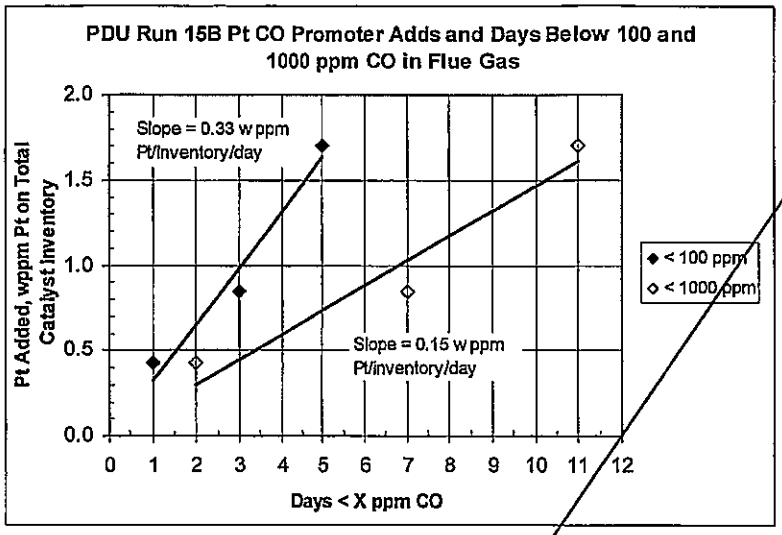

PDU Run 15B Pt CO Promoter Adds and Days Below 100 and 1000 ppm CO in Flue Gas
Pt Added, wppm Pt on Total Catalyst Inventory
Slope = 0.33 w ppm Pt/Inventory/day
Slope = 0.15 w ppm Pt/inventory/day
< 100 ppm
< 1000 ppm
Days < X ppm CO
2.0
1.5
1.0
0.5
0.0
0 1 2 3 4 5 6 7 8 9 10 11 12

FIG. 7

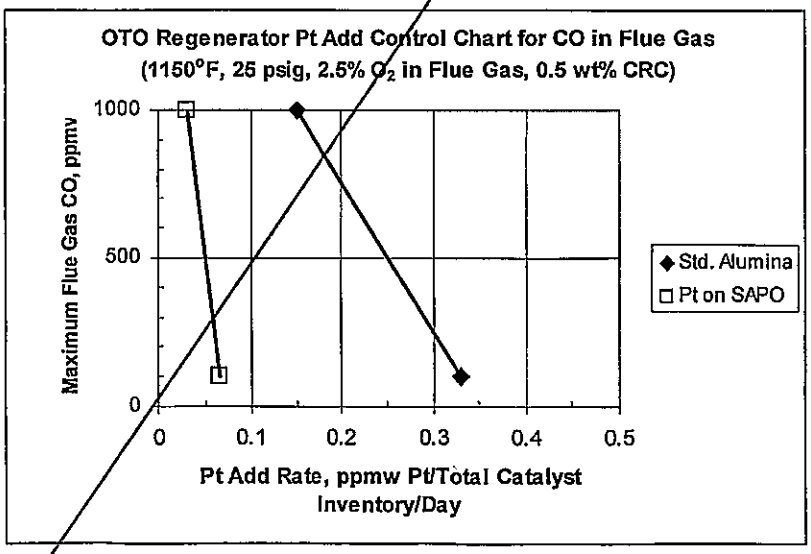

OTO Regenerator Pt Add Control Chart for CO in Flue Gas
(1150°F, 25 psig, 2.5% O2 in Flue Gas, 0.5 wt% CRC)
Maximum Flue Gas CO, ppmv
1000
500
0
0 0.1 0.2 0.3 0.4 0.5
Pt Add Rate, ppmw Pt/Total Catalyst Inventory/Day
Std. Alumina
Pt on SAPO

FIG. 8

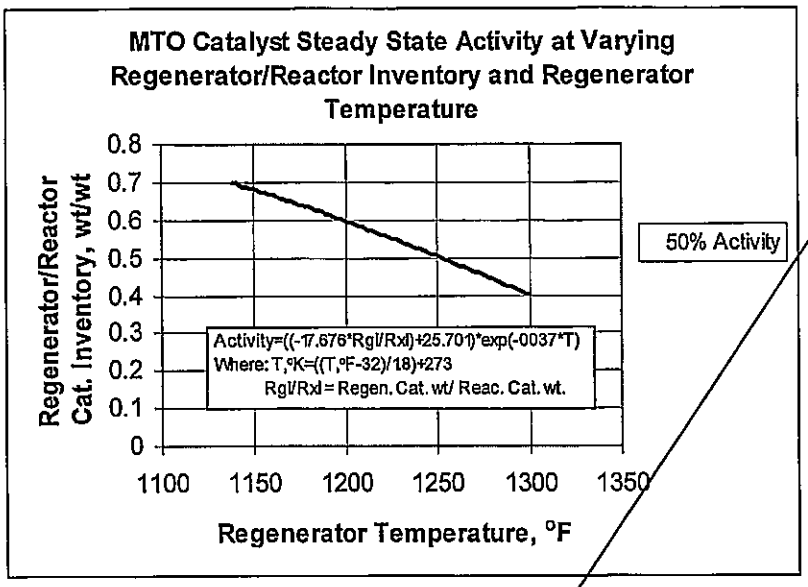

MTO Catalyst Steady State Activity at Varying Regenerator/Reactor Inventory and Regenerator Temperature
Regenerator/Reactor Cat. Inventory, wt/wt
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1100
1150
1200
1250
1300
1350
Regenerator Temperature, °F
50% Activity
Activity=((-17.676*Rgl/Rxl)+25.701)*exp(-0037*T)
Where: T,°K=((T,°F-32)/18)+273
Rgl/Rxl = Regen. Cat. wt/ Reac. Cat. wt.

FIG. 9

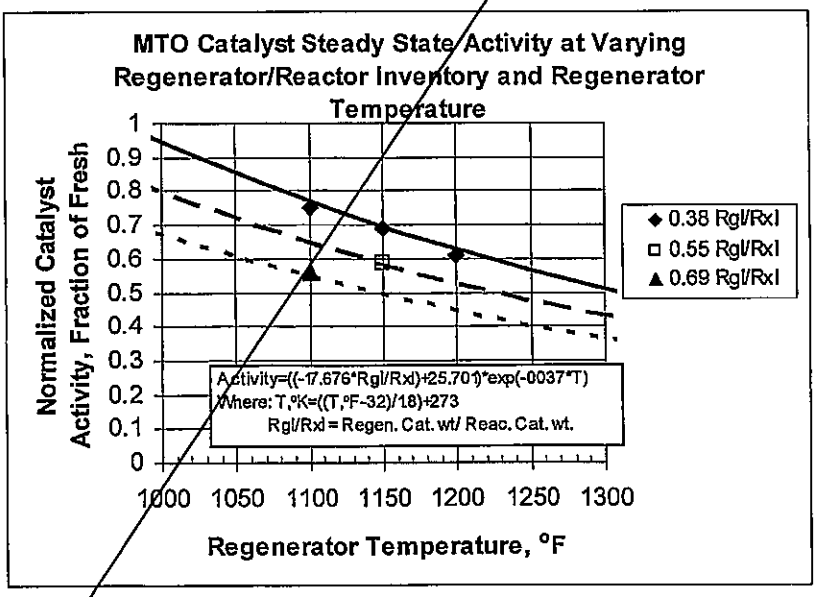

MTO Catalyst Steady State Activity at Varying Regenerator/Reactor Inventory and Regenerator Temperature
Normalized Catalyst Activity, Fraction of Fresh
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1000
1050
1100
1150
1200
1250
1300
Regenerator Temperature, °F
◆ 0.38 Rgl/Rxl
□ 0.55 Rgl/Rxl
▲ 0.69 Rgl/Rxl
Activity=((-17.676*Rgl/Rxl)+25.701)*exp(-0037*T)
Where: T,°K=((T,°F-32)/18)+273
Rgl/Rxl = Regen. Cat. wt/ Reac. Cat. wt.

FIG. 10

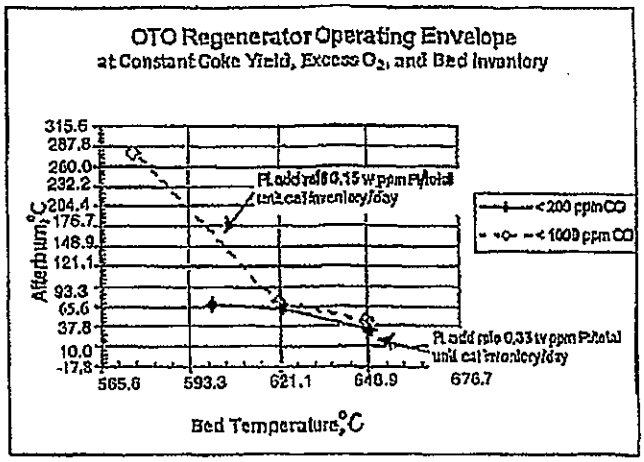

OTO Regenerator Operating Envelope
at Constant Coke Yield, Excess O_2, and Bed Inventory
315.6
287.8
260.0
232.2
204.4
176.7
148.9
121.1
93.3
65.6
37.8
10.0
-17.8
Afterburn, °C
565.6
593.3
621.1
648.9
676.7
Bed Temperature, °C
< 200 ppm CO
< 1000 ppm CO

FIG. 1

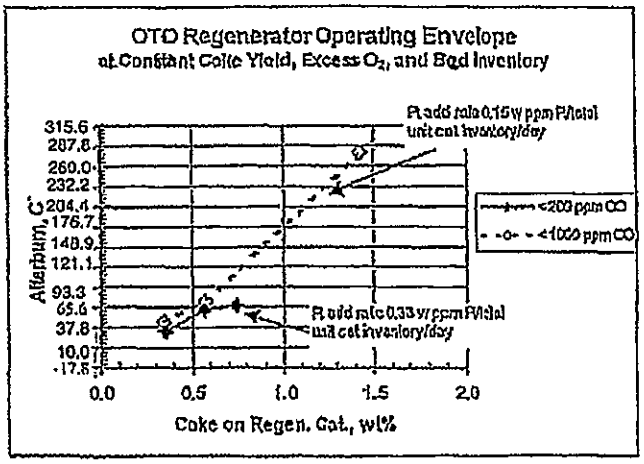

OTO Regenerator Operating Envelope
at Constant Coke Yield, Excess O_2, and Bed Inventory
315.6
287.8
260.0
232.2
204.4
176.7
148.9
121.1
93.3
65.6
37.8
10.0
-17.8
Afterburn, °C
0.0
0.5
1.0
1.5
2.0
Coke on Regen. Cat., wt%
< 200 ppm CO
< 1000 ppm CO

FIG. 2

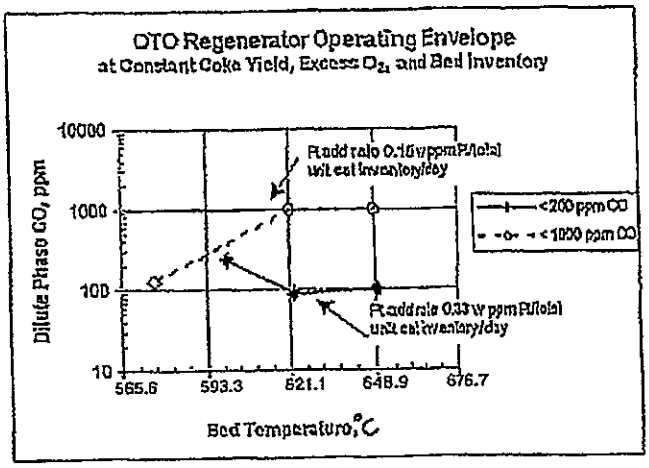

OTO Regenerator Operating Envelope
at Constant Coke Yield, Excess O_2, and Bed Inventory
Dilute Phase CO, ppm
10000
1000
100
10
Pt add rate 0.15 w ppm Pt/total unit cat inventory/day
Pt add rate 0.33 w ppm Pt/total unit cat inventory/day
<200 ppm CO
<1000 ppm CO
565.6
593.3
621.1
648.9
676.7
Bed Temperature, °C

FIG. 3

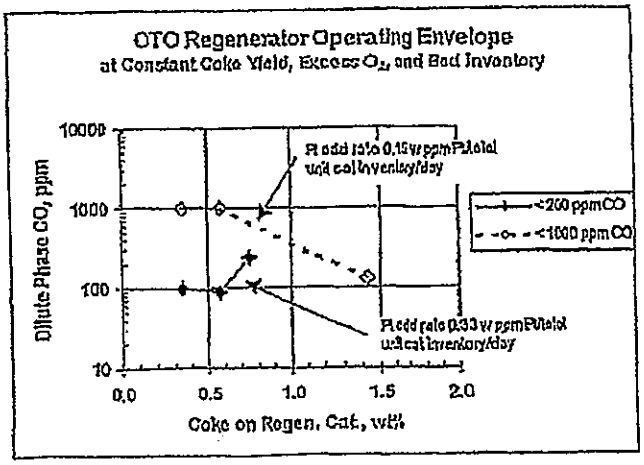

OTO Regenerator Operating Envelope
at Constant Coke Yield, Excess O_2, and Bed Inventory
Dilute Phase CO, ppm
10000
1000
100
10
Pt add rate 0.15 w ppm Pt/total unit cat inventory/day
Pt add rate 0.33 w ppm Pt/total unit cat inventory/day
<200 ppm CO
<1000 ppm CO
0.0
0.5
1.0
1.5
2.0
Coke on Regen. Cat., wt%

FIG. 4

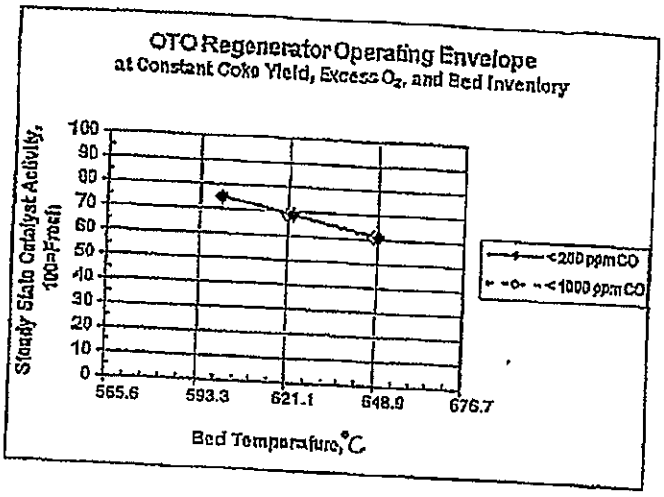

OTO Regenerator Operating Envelope
at Constant Coke Yield, Excess O2, and Bed Inventory
Steady State Catalyst Activity, 100=Fresh
100
90
80
70
60
50
40
30
20
10
0
565.6
593.3
621.1
648.9
676.7
Bed Temperature, °C
<200 ppm CO
<1000 ppm CO

FIG. 5

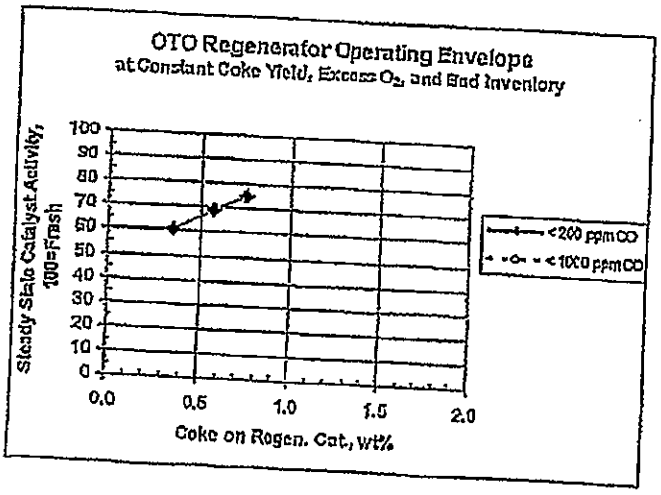

OTO Regenerator Operating Envelope
at Constant Coke Yield, Excess O2, and Bed Inventory
Steady State Catalyst Activity, 100=Fresh
100
90
80
70
60
50
40
30
20
10
0
0.0
0.5
1.0
1.5
2.0
Coke on Regen. Cat., wt%
<200 ppm CO
<1000 ppm CO

FIG. 6

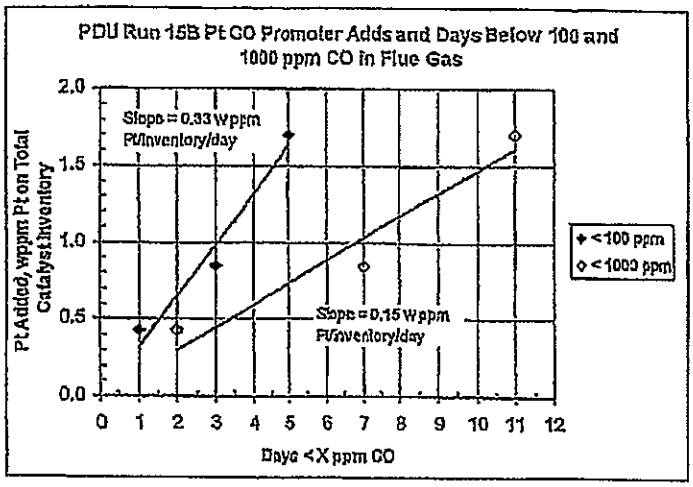

PDU Run 15B Pt CO Promoter Adds and Days Below 100 and 1000 ppm CO in Flue Gas
Pt Added, wppm Pt on Total Catalyst Inventory
2.0
1.5
1.0
0.5
0.0
Slope = 0.33 Wppm Pt/Inventory/day
Slope = 0.15 Wppm Pt/Inventory/day
0 1 2 3 4 5 6 7 8 9 10 11 12
Days <X ppm CO
< 100 ppm
< 1000 ppm

FIG. 7

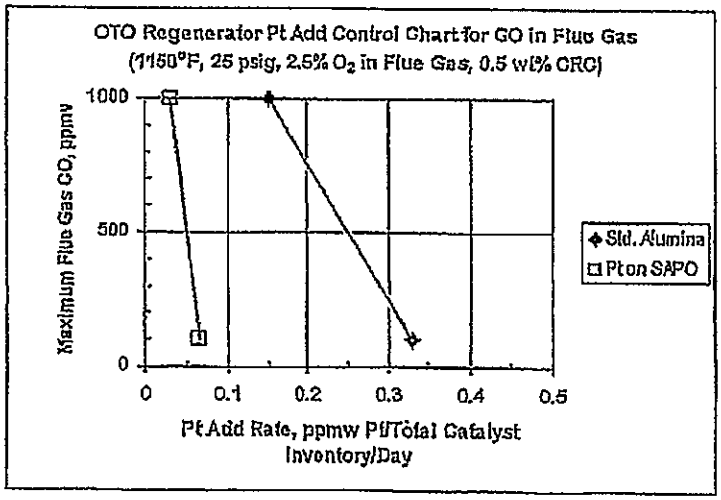

OTO Regenerator Pt Add Control Chart for CO in Flue Gas
(1150°F, 25 psig, 2.5% O2 in Flue Gas, 0.5 wt% CRC)
Maximum Flue Gas CO, ppmv
1000
500
0
0 0.1 0.2 0.3 0.4 0.5
Pt Add Rate, ppmw Pt/Total Catalyst Inventory/Day
Std. Alumina
Pt on SAPO

FIG. 8

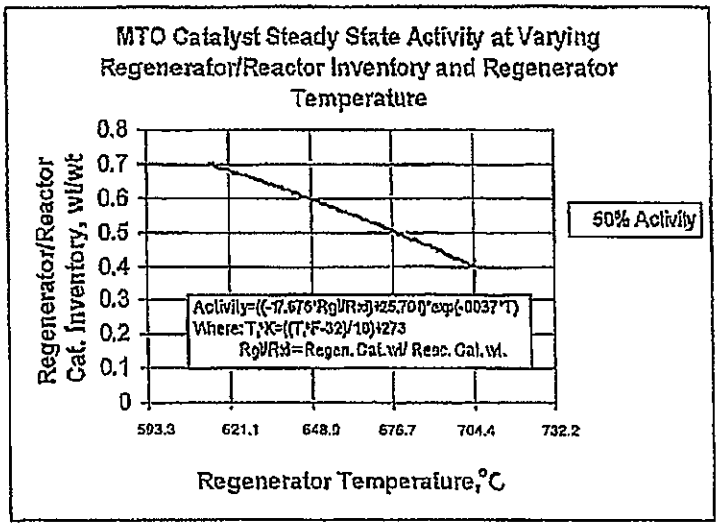

MTO Catalyst Steady State Activity at Varying Regenerator/Reactor Inventory and Regenerator Temperature
Regenerator/Reactor Cat. Inventory, wt/wt
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
593.3
621.1
648.9
676.7
704.4
732.2
Regenerator Temperature,°C
50% Activity
Activity=((-17.676*Rgl/Rxl)+25.70)*exp(-.0037*T)
Where: T,°K=((T,°F-32)/1.8)+273
Rgl/Rxl=Regen. Cat.wt/ Reac. Cat.wt.

FIG. 9

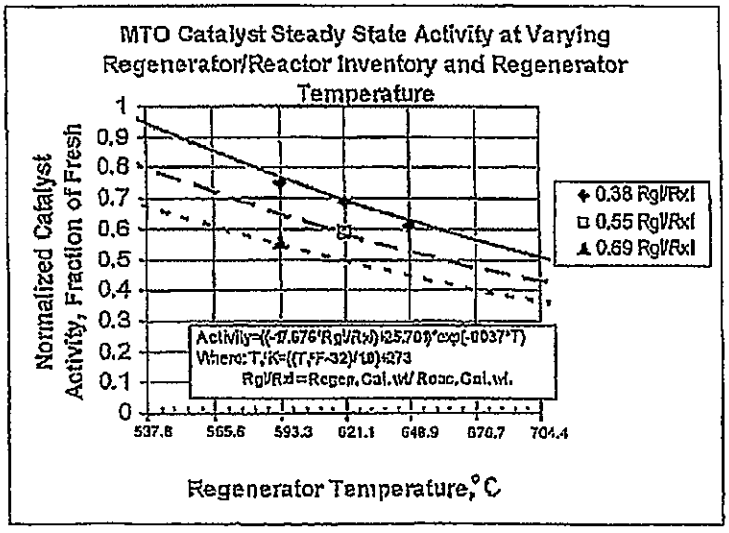

MTO Catalyst Steady State Activity at Varying Regenerator/Reactor Inventory and Regenerator Temperature
Normalized Catalyst Activity, Fraction of Fresh
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
537.8
565.6
593.3
621.1
648.9
676.7
704.4
Regenerator Temperature,°C
0.38 Rgl/Rxl
0.55 Rgl/Rxl
0.69 Rgl/Rxl
Activity=((-17.676*Rgl/Rxl)+25.70)*exp(-.0037*T)
Where: T,°K=((T,°F-32)/1.8)+273
Rgl/Rxl=Regen. Cat.wt/ Reac. Cat.wt.

FIG. 10