

WRITTEN BY: FSN
DATE: 10/16/89
APPROVED BY: *[Signature]*
DATE:

SOP # 5602-101.SOP
OHC REACTOR PLUGGING PROGRAM

CONTROL "X" CALLS REACTOR PLUGGING PROGRAM

NOTE: DATA PRINTED FOR THE OHC REACTOR #1

DATE: TIME

TE 9676 = TEMPERATURE OF THE O2 HEATER OUTLET
PT 9490 = OHC REACTOR PRESSURE
FT 9056 = HCL FLOW RATE
FT 9066 = ETHYLENE FLOW RATE
FT 9076 = O2 FLOW RATE
FT 9087 = RECYCLE GAS FLOW RATE

ENTER OHC REACTOR NO.1 O2 HEADER PRESSURE

XX.X

OHC REACTOR NO.1 O2 FEED HEADER % OPEN = XXX.X %

ENTER OHC REACTOR NO.1 MIX FEED HEADER PRESSURE

XX.X

ENTER OHC REACTOR NO.1 MIX FEED TEMPERATURE

XX.X

OHC REACTOR NO.1 MIX FEED HEADER % OPEN = XXX.X %

NOTE: DATA PRINTED FOR THE OHC REACTOR #2

TE 9776 = TEMPERATURE OF THE O2 HEATER OUTLET
PT 9590 = OHC REACTOR PRESSURE
FT 9156 = HCL FLOW RATE
FT 9166 = ETHYLENE FLOW RATE
FT 9176 = O2 FLOW RATE
FT 9187 = RECYCLE GAS FLOW RATE

ENTER OHC REACTOR NO.2 O2 HEADER PRESSURE

XX.X

OHC REACTOR NO.2 O2 FEED HEADER % OPEN = XXX.X %

ENTER OHC REACTOR NO.2 MIX FEED HEADER PRESSURE

XX.X

ENTER OHC REACTOR NO.2 MIX FEED TEMPERATURE

XX.X

OHC REACTOR NO.2 MIX FEED HEADER % OPEN = XXX.X %

NOTE: 1. THESE % OPEN CALCULATIONS ARE BASE ON THE SAME EQUATION AND FIGURES USED IN THE HAND CALCULATION METHOD . ANY DIFFERENCES WILL BE DUE TO ROUND OFF ERROR INTRODUCED BY THE COMPUTER.

2. ALSO THE RESULTS FROM THESE CALCULATION MAY SHOW THE HEADER OVER 100% OPEN. THESE VALUES ARE NOT ACCURATE AS ABSOLUTE VALUES, BUT A TREND MAY BE SEEN TO INDICATE WHEN REACTORS ARE BEGINNING TO PLUG.

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Reactor No. 4

Date 06/12/81

Time 9:00 AM

Mixed Feed Hydrogen Phosphoryl Chloride

Data needed:

Completely clean

Reactor Temp. 19.9 + 19.7 = 39.6 Pos. in

Hot Flow 172900 SCFH

Recycle Flow 62680 SCFH

Ethylene Flow 89010 SCFH

Mixed Feed Hydrogen Pressure 35 + 14.7 = 49.7 PSIA = UPS

Catalyst bed Pressure drop (Assumed) $\Delta P = 9$ PSI

DNS = Reactor Temp. 39.6 + 4 = 43.6

$$\Delta P = (UPS - DNS) \times 144 = \left(\frac{49.7}{14.7} - \frac{43.6}{14.7} \right) \times 144 = 9.78$$

$$W_{H_2} = \frac{1 \text{ kmol H}_2 \times 2.016}{1366.432.6} = 4.618$$

$$W_{C_2H_4} = \frac{1 \text{ kmol C}_2\text{H}_4 \times 28}{1366.432.6} = 1.824$$

$$W_{N_2} = \frac{1 \text{ kmol N}_2 \times 28}{1366.432.6} = 1.422$$

$$W_{TOTAL} = 7.864$$

$$Y = \frac{DNS}{UPS} = \frac{43.6}{49.7} = 0.8773$$

$$Y = 1 - \left(\frac{1-Y}{1.51} \cdot (.41) \right) = 1 - \left(\frac{1-0.8773}{1.51} \cdot (.41) \right) = 0.9616$$

$$P = \frac{UPS \times 2.31}{10.73 \times (\text{Mixed Feed Temp} + 460)} = \frac{49.7 \times 2.31}{10.73 \times (235 + 460)} = 0.2266$$

$$A_g = \frac{W}{C \times Y \times \sqrt{2 \times Y \times \Delta P}} = \frac{7.864}{0.8 \times 0.9616 \times \sqrt{2 \times 0.9616 \times 0.2266}} = 113.22$$

$$A_g = 0.0903$$

$$A_g = 0.0910 \text{ sec}^2$$

$$\% = \frac{A_g \times 100}{0.0903} = 98.6$$

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Sample Calculation

Date 06/16/81

Reactor No. 1

Time 9:00 AM

Oxygen Transfer Plugging Calculations

Data Needed:

Wide Open

Reactor Press 19.9 + 14.7 = 34.6 Psia

Oxygen Flow 46560 lb/day

Oxygen chamber press 36 + 14.7 = 50.7 Psia = UP

Catalyst bed pressure drop (ΔP_{bed}) = 4 mm

DNS press = Reactor Press Psia 34.6 + 9 = 43.6

Calculation

$$\Delta P = (UP - DNS) \times 144 = (50.7 - 43.6) \times 144 = 1022.4$$

$$\text{Flow Rate } \frac{\text{lb}}{\text{sec}} \longrightarrow W_{\text{oxygen}} = \frac{46560 \times (.32)}{1366432.6} = 1.0904$$

$$v = \frac{UP - DNS}{UP - DNS} = \frac{43.6}{50.7} = .85926$$

$$y = 1 - \left(\frac{1-v}{1.31} (.41) \right) = 1 - \left(\frac{1-.85926}{1.31} (.41) \right) = .95662$$

$$p = \frac{UPS \times 32}{(10.73) \times (\text{Oxygen Temp} + 460)} = \frac{50.7}{(10.73) \times \left(\frac{260 + 460}{720} \right)} = .2100$$

$$A_f = \frac{W}{C \times y \times \sqrt{2 \times g \times \rho \times \Delta P}} = \frac{1.0904}{.8 \times .95662 \times \sqrt{2 \times 32.2 \times .2100 \times 1022.4}} = \frac{1.0904}{117.59} = .0121$$

$$A_f = .0121$$

$$A_{f_{\text{clean}}} = .0116 \text{ ft}^2$$

$$\% \text{ Oxygen transfer open} = \frac{.0121}{.0116} \times 100 = 104\%$$

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Reactor No. 2

Date 08/12/81

Time 9:00am

Hand Feed Reaction Mixing Calculations

Draw needed:

Reactor In 22.1 + 19.7 41.8 PPM

Hot Flow 191.710 SCFH

Recycle Flow 237.80 SCFH

Ethylene Flow 96.690 SCFH

Mixed Feed Reaction Press. 48.5 + 14.7 = 63.2 PPS = UPS

Catalyst Bed Pressure drop (Assume) $\Delta P = 9$ PPS

DNS - Reaction Press. 41.8 + 9 = 50.8 PPS

Calculations:

$$\Delta P = (UPS - DNS) \times 144 = \left(\frac{63.2}{1.31} - \frac{50.8}{1.31} \right) \times 144 = 1277$$

$$1 \text{ lbm Water } W/\text{sec} \rightarrow W_{\text{H}_2\text{O}} = \frac{1440 \text{ SCFH} \times 1.31}{1366.82 \times 6} = 5.1209$$

$$\rightarrow W_{\text{C}_2\text{H}_4} = \frac{1440 \text{ SCFH} \times 1.31}{1366.82 \times 6} = 1.9813$$

$$\rightarrow W_{\text{Recy.}} = \frac{1440 \text{ SCFH} \times 1.31}{1366.82 \times 6} = 1.6738$$

$$W_{\text{LOCAL}} = 8.776$$

$$Y = \frac{DNS}{UPS} = \frac{50.8}{63.2} = .8038$$

$$Y = 1 - \left(\frac{1-Y}{1.31} \right) (.41) = 1 - \left(\frac{1-.8038}{1.31} \right) (.41) = .93857$$

$$P = \frac{UPS \times 2.4}{10.23 \times (\text{Mixed Feed Temp} + 460)} = \frac{63.2 \times 2.4}{10.23 \times \left(\frac{235}{695} + 460 \right)} = .28817$$

$$A_f = \frac{W}{C \times Y \times \sqrt{2 \times g_c \times \Delta P}} =$$

$$A_f = .0682$$

$$A_{f, \text{local}} = 0.0915 \text{ sec}^2$$

%

$$.8 \times .9386 \times \sqrt{2.4 \times 2881.7} = 182.015$$

$$.0682 \times 182.015 = 12.41$$

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sample of calculation

Date 06/12/81

Reactor No 2

Time 9:00 AM

Oxygen Header Plugging Calculations

Data Needed:

Reactor Press 22.1 + 14.7 = 41.8 Psia

Oxygen Flow 53.090 scfh

Oxygen chamber press 43 + 14.7 = 57.7 Psia = UPS

Catalyst bed pressure drop (Assume) = 9 Psi

DNS press = Reactor Press Psia 41.8 + 9 = 50.8

Calculation

$$\Delta P = (UPS - DNS) \times 144 = (57.7 - 50.8) \times 144 = 993.6$$

$$\text{Flow Rate } \frac{W}{\text{Sec}} \longrightarrow W_{\text{oxygen}} = \frac{1 \text{ lbm/min} \times (52)}{1366.432.6} = 1.2433$$

$W_{\text{chamber}} = W_{\text{reactor}}$

$$r = \frac{DNS}{UPS} = \frac{50.8}{57.7} = .8804$$

$$y = 1 - \left(\frac{1-r}{1.31} (.41) \right) = 1 - \left(\frac{1-.8804(.41)}{1.31} \right) = .9626$$

$$P = \frac{UPS \times 32}{(10.73) \times (Oxygen \text{ flow}) \times (T + 460)} = \frac{57.7 \times 32}{(10.73) \times (1.2433 \times 717)} = .2399$$

$$A_f = \frac{W}{Z \times y \times \sqrt{2 \times g_c \times P \times \Delta P}} = \frac{1.2433}{.8 \times .9626 \sqrt{64.4 \times .2399 \times 993.6}} = \frac{1.2433}{122.35}$$

$$A_f = .013197 \text{ ft}^2$$

$$A_{f_{\text{chamber}}} = .0116 \text{ ft}^2$$

$$\% \text{ Oxygen side open} = \frac{.013197}{.0116} \times 100 = 113.7\%$$

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WRITTEN BY:RLD
DATE:3/1/90

SOP # 5602-116.SOP
(TROUBLE SHOOTING REACTOR PROBLEMS)

TROUBLE SHOOTING

POOR QUALITY CRUDES (LOW %EDC)

HIGH LEVELS OF TCE, TETRA, AND PENTA.

- CAUSES -
1. HIGH REACTOR BED TEMPERATURE.
 2. HIGH C₂H₄ CONVERSION.
 3. COMBINATION OF HIGH BED TEMPERATURE AND HIGH C₂H₄ CONVERSION.
 4. HIGH EDC IN RECYCLE.
 5. HIGH VC IN HCL FEED.

CORRECTIVE ACTION:

1. LOWER REACTOR BED TEMPERATURE. IF RATES CANNOT BE MAINTAINED, REACTOR MAY BE LOW ON CATALYST.
2. LOWER THE C₂H₄ CONVERSION. (INCREASE C₂H₄ COMPOSITION IN RECYCLE BY INCREASING C₂H₄ MAKE-UP)
3. LOWERING THE REFRIGERATED CONDENSER TEMPERATURE WILL DECREASE EDC IN RECYCLE. INCREASING C₂H₄ COMPOSITION IN RECYCLE WILL DECREASE THE AMOUNT OF EDC IN RECYCLE.

HIGH LEVELS OF TCE, TETRA, PENTA, AS WELL AS HIGH DICHLOROETHYLENES AND OR VINYL CHLORIDES.

CAUSE:

1. DEFINITE INDICATION OF HIGH REACTOR BED TEMPERATURE.

CORRECTION:

1. LOWER REACTOR BED TEMPERATURE.

HIGH LEVELS OF CCL₄ (CARBON TET) AND CHLORAL.

CAUSE:

1. HIGH EXCESS OXYGEN

CORRECTION:

1. LOWER EXCESS OXYGEN, MAINTAIN A GOOD CHLORIDE YIELDS (ACID STRENGTH).

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HIGH LEVELS OF TRICHLOROETHYLENE.

CAUSE:

1. IMPURITIES IN HCL FEED, MAINLY ACETYLENE.
2. IF ACCOMPANIED BY HIGH BURNING AND POOR CRUDE:
 - A. MALDISTRIBUTION OF REACTOR FEED GASES
 - B. LOCALIZED HOT SPOTS
 - C. CLINKERS

CORRECTIVE ACTION:

1. CAUSE OF IMPURITIES WILL BE CHECKED.
2. CONSIDERATION OF REACTOR SHUTDOWN WILL BE TAKEN (NOTIFY SUPERVISION).

LOW CHLORIDE UTILIZATION.

CAUSES:

1. INSUFFICIENT OXYGEN FEED.
2. HIGH C₂H₄ CONVERSION
3. LOW CATALYST LEVEL
4. HIGH REACTOR BED TEMPERATURE

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CORRECTIVE ACTION:

1. INCREASE OXYGEN WHILE CHECKING ACID STRENGTH
2. LOWER C₂H₄ CONVERSION. (INCREASE C₂H₄ RECYCLE COMPOSITION BY INCREASING C₂H₄ MAKE-UP)
3. ADD CATALYST
4. LOWER REACTOR BED TEMPERATURE

LOW CARBON UTILIZATION.

LOSS OF C₂H₄ IN VENT .

CAUSES:

1. BURNING CAUSED BY HIGH TEMPERATURE AND/OR HIGH OXYGEN RESULTS IN CO & CO₂ IN VENT. (REQUIRING MORE PURGING AND ADDITIONAL LOSS OF C₂H₄, AND CONSUMPTION OF C₂H₄)
2. HIGH UNREACTED C₂H₄ , NORMALLY DUE TO INERTS ENTERING THE SYSTEM.

CORRECTIVE ACTION:

1. LOWER OXYGEN WHILE CHECKING CHLORIDE YIELD OR LOWER

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TEMPERATURE.

2. LOOK FOR N2 OR OTHER INERTS ENTERING THE SYSTEM AND CORRECT.

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