

LIGHT ENDS PRODUCT COMPOSITION

June - November 1970

Weight Per Cent

|                    | <u>Range</u> | <u>Typical</u> |
|--------------------|--------------|----------------|
| EDC                | 18.9 - 28.6  | 23             |
| VCM                | 1.0 - 6.1    | 1.2            |
| EtCl               | 24.2 - 38.8  | 29             |
| Vinylidene         | 0.6 - 1.9    | 0.9            |
| trans 1,2 DCE      | 3.7 - 4.9    | 4.2            |
| 1,1 Dichloroethane | 2.4 - 3.5    | 3.2            |
| Chloroform         | 17.2 - 31.4  | 29             |
| Carbon tet         | 6.7 - 10.6   | 9              |

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12/11/70

# Plant Losses Calculations

. Data Based on first 1/2 year of 1970.

Plant feedstocks used -  $C_2H_4 = 294,000,000 \text{ lb/yr}$  (Blue Book data)

$Cl_2 = 380,000,000 \text{ lb/yr}$  " "

Plant Production  $VCM = 581,070,000 \text{ lb/yr}$  " "

$EDC = 17,752 \text{ lb/yr}$  (above that required for VCM production)

$HCl^{(aq)} = 715,200 \text{ lb/yr}$  (loss of  $Cl^-$  in only)

$$\text{Plant Efficiency} = \frac{581,070,000 + 17,752 + 715,200}{(294 + 380)MM} \times 100\% = 88.95\% \left( \text{based on } \begin{matrix} Cl_2 + C_2H_4 \\ \text{feeds} \end{matrix} \right)$$

Byproducts Production = ~~674 MM~~

$$\text{Tars} = \frac{17,915,450}{674 MM} \times 100 = 2.66\% \text{ of feedstock}$$

$$\text{Light Ends} = \frac{6,866,720}{674 MM} \times 100 = 1.10\% \text{ of feedstock}$$

$$\text{Losses as } H^+ \text{ removed in oxy} = \frac{581 MM}{62.5} \times 100 = 1.38\% \text{ of feedstock}$$

by  $HCl$  reaction to  $H_2O$

$$\text{Loss in plant effluent water} = \frac{18,552 M}{674,000 M} \times 100 = 2.75\% \text{ of feedstock}$$

$$\text{Loss in C-500 vent stack} = \frac{16,994 M}{674,000 M} \times 100 = 2.52\% \text{ of feedstock}$$

Total Production and Losses = 99.36%

12/7/70

## Water Effluent System losses

$$\text{Flow rate} = 350 \text{ gpm (avg)} = 0.5004 \text{ MGD} \times 8.28 \frac{\text{lb}}{\text{gal}} \stackrel{110^\circ\text{F}}{\downarrow} = 4.145 \text{ MM lb/day}$$

$$\text{Organics} = 100 \text{ ppm EDC} \times 4.145 = 4.145 \text{ lb/day} = 173 \text{ lb/hr.}$$

$$30 \text{ ppm EDC} \times 4.145 = 1.244 \text{ lb/day} = 5.2 \text{ lb/hr.}$$

$$10 \text{ ppm UCM} \times 4.145 = .41 \text{ lb/day} = 1.7 \text{ lb/hr.}$$

~~300 ppm (other) EDC~~

$$300 \text{ ppm (other) EDC} \times 4.145 = 1.244 \text{ lb/day} = 51.8 \text{ lb/hr.}$$

$$\text{total organic (available)} = 231.7 \text{ lb/hr.}$$

$$\text{Liquid EDC removed from T-2 pot} \approx 700 \text{ gal/month} = 70,000 \text{ lb/month} = 973$$

## Acid losses down Sewer

$$75 \text{ gpm of pH 0.1 from T-252 pot} = 1058 \text{ lb/hr. Cl}^-$$

$$100 \text{ gpm of pH 1.5 from C-500 stack} = 56.4 \text{ lb/hr. Cl}^-$$

$$1114.4 \text{ lb/hr.}$$

$$\text{total effluent water losses} = 2319 \text{ lb/hr.} \times 8000 = 18,552,000 \text{ lb/yr.}$$

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12/7/70

## C-500 Stack Losses

Flow rate = 650,000 scfh (includes T-101 vent at 12,000 scfh) at 80°C avg.

$$\text{Impurities} = 1000 \text{ ppm EDC} \times .650/394 = 1.640 \text{ lbs/lb} \times 99 = 163 \text{ lbs/hr.}$$

$$2100 \text{ ppm Ethane} \times .650/394 = 0.165 \text{ " } \times 30 = 5 \text{ lbs/hr.}$$

$$2500 \text{ ppm ETC} \times .650/394 = 4.124 \text{ " } \times 62.5 = 258 \text{ lbs/hr.}$$

$$5000 \text{ ppm H(Cl)} \times .650/394 = 8.249 \text{ " } \times 35.5 = 293 \text{ lbs/hr.}$$

$$12,000 \text{ ppm CO} \times .650/394 = 19.800 \text{ " } \times 14.0 = 277 \text{ lbs/hr.}$$

$$15,000 \text{ ppm CO}_2 \times .650/394 = 24.746 \text{ " } \times 14.0 = 346 \text{ lbs/hr.}$$

$$10,000 \text{ ppm C}_2\text{H}_4 \times .650/394 = \frac{22.842}{19.055} \text{ " } \times 28 = 640 \text{ lbs/hr.}$$

$$500 \text{ ppm Others (as EDC)} \times .650/394 = 0.825 \text{ " } \times 99 = 82 \text{ lbs/hr.}$$

$$500 \text{ ppm VCM} \times .650/394 = 0.825 \text{ " } \times 62.5 = 52 \text{ lbs/hr.}$$

$$25 \text{ ppm Cl}_2 \times .650/394 = 0.0247 \text{ " } \times 71.0 = 2 \text{ lbs/hr.}$$

$$\text{total losses} = 2118 \text{ lbs/hr.}$$

$$\times 8000 = 16,944,000 \frac{\text{lb}}{\text{yr}}$$

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12/16/70

## 1970 Plant Losses Summary

|                                                                                                                  |             |
|------------------------------------------------------------------------------------------------------------------|-------------|
| Product VCM, EDC, and HCL (to Ancon)                                                                             | 89.0%       |
| Light Ends Hauled Away                                                                                           | 1.1%        |
| Tars Hauled Away                                                                                                 | 2.7%        |
| H <sup>+</sup> removed in C <sub>2</sub> H <sub>4</sub> or H <sub>2</sub> O                                      | 1.4%        |
| Water effluent losses                                                                                            | 2.7%        |
| C-500 Vent Gas Losses                                                                                            | 2.5%        |
| <u>Unknown losses</u>                                                                                            | <u>0.5%</u> |
| Total losses and Production<br>as % of C <sub>2</sub> H <sub>4</sub> and C <sub>2</sub> H <sub>2</sub> feedstock | 100%        |

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Pounds Losses Annualized to design VCM Production.

|                  |                                 |                       |
|------------------|---------------------------------|-----------------------|
| <u>Feedstock</u> | C <sub>2</sub> H <sub>4</sub> - | 303,594 M lbs.        |
|                  | Cl <sub>2</sub> -               | 392,400 M lbs.        |
|                  | <u>total feedstock</u>          | <u>695,994 M lbs.</u> |

|                 |                                                   |                       |
|-----------------|---------------------------------------------------|-----------------------|
| <u>Products</u> | VCM                                               | 600,000 M lbs.        |
|                 | EDC (Sold to Sales)                               | 18,331 M lbs.         |
|                 | HCL (Sold to Ancon)<br>(for Cl <sup>-</sup> imp.) | 695 M lbs.            |
|                 | <u>total products</u>                             | <u>619,026 M lbs.</u> |

|                   |                                                   |                      |
|-------------------|---------------------------------------------------|----------------------|
| <u>Byproducts</u> | Light Ends Hauled away                            | 17,742 M lbs.        |
|                   | Tars Hauled away                                  | 18,500 M lbs.        |
|                   | H <sup>+</sup> lost in exp. (as H <sub>2</sub> O) | 9,599 M lbs.         |
|                   | <u>total byproducts</u>                           | <u>36,041 M lbs.</u> |

|                         |                |               |
|-------------------------|----------------|---------------|
| <u>Pollution Losses</u> | Water Effluent | 18,552 M lbs. |
|                         | C-500 Vent gas | 17,497 M lbs. |
|                         | unknown losses | 4,878 M lbs.  |

## 1970-Plant Losses Calculation

## Source of Losses (total of 11.6%)

- 1). Oxy Losses - total of 6.24%
  - a) Poor Conversion - 2.43%
  - b) H<sup>T</sup> removed in oxy - 1.38%
  - c) Circulating - 0.74%
  - d) 1,1,2 trichloroethane - 0.74%
  - e) ETL - 0.63%
  - f) Chloroform - 0.32%
- 2). Cracking process Losses - Total of 0.43%
  - a) 1,1,2,2 tetrachloroethane - 0.013%
  - b) 1,5 dichloropentane - 0.11%
  - c) Hexachloroethane - 0.08%
  - d) Chloroacene - 0.01%
  - e) Carbon tetrachloride - 0.10%
- 3). Direct Chlorinator Losses - total of 0.43%
  - a) 1,1,2 trichloroethane - 0.32%
  - b) VCM, cis and trans dichloro - 0.11%
- 4). T-2 effluent pit EDC Losses - 1.15%
- 5). Tar Still EDC losses - 0.66%
- 6). Heavies and coke formation (in tar) - 0.61%
- 7). Light ends Column overhead EDC Losses - 0.24%
- 8). T-101 Vent EDC Losses - 0.21%
- 9). Wash System losses (than Steam Stripped) - 0.15%  
(being out of process)
- 10). Unknown Losses - 0.88%

12/16/76

# Summary of Byproduct Losses - 1970

## Light Ends Composition at 20°C - Early 1970 analysis

$$\begin{aligned}
 23\% \text{ EDC} & \times 1.243 \frac{\text{gms}}{\text{cc}} = 0.2857 \\
 2.3\% \text{ VENT} & \times 0.910 \frac{\text{gms}}{\text{cc}} = 0.0191 \\
 & \text{Vapor Pressure} \\
 29\% \text{ ETC} & \times 0.880 \frac{\text{gms}}{\text{cc}} = 0.2552 \\
 7.4\% \text{ Cations} & \times 1.270 \frac{\text{gms}}{\text{cc}} = 0.0939 \\
 29\% \text{ Cations} & \times 1.470 \frac{\text{gms}}{\text{cc}} = 0.4263 \\
 9\% \text{ CCl}_4 & \times 1.590 \frac{\text{gms}}{\text{cc}} = 0.1431 \\
 \hline
 99.5\% \text{ total} & = 1.2234 \frac{\text{gms}}{\text{cc}}
 \end{aligned}$$

$$\begin{aligned}
 \text{Average Specific Gravity} \\
 & = \frac{1.2234}{0.995} = 1.23
 \end{aligned}$$

$$\text{Density} = 1.231834 = 10.2 \text{ lb/gal}$$

$$1970 \text{ Light Ends Production (Jan to Nov 1970)} = \frac{673827}{1000000} \text{ gal.}$$

$$\text{Annualized Production} = \frac{7355034}{1000000} \text{ gal./yr.}$$

$$\text{Weight Production} = 7,497,857 \text{ lb./yr.}$$

$$\text{As a \% of Feedstock} = \frac{7,497,857}{6741114} \times 100 = 1.11\%$$

## Tars Composition at 20°C - Early 1970 analysis

$$\begin{aligned}
 25\% \text{ EDC} & \times 1.253 = 0.313 \\
 40\% \text{ 1,1,2 trichloroethane} & \times 1.488 = 0.595 \\
 3\% \text{ Hexachloroethane} & \times 2.041 = 0.063 \\
 5\% \text{ 1,5 Dichloropentane} & \times 1.050 = 0.052 \\
 4\% \text{ 1,1,2,2 tetrachloroethane} & \times 1.590 = 0.064 \\
 23\% \text{ Coke and Heavies} & \times 1.500 = 0.345
 \end{aligned}$$

100% total

$$1.432 \text{ Specific Gravity}$$

$$\begin{aligned}
 \text{Density} & = 1.432 \times 8.34 \frac{\text{lb}}{\text{gal}} \\
 & = 11.9 \text{ lb/gal}
 \end{aligned}$$

$$1970 \text{ Tars Production (Jan to Nov 1970)} = 1,375,425 \text{ gal.}$$

$$\text{Annualized Production} = 1,500,500 \text{ gal.}$$

$$\text{Weight Production} = 17,915,450 \text{ lb./yr.}$$

$$\text{As a \% of Feedstock} = \frac{17,915,450}{6741114} \times 100 = 2.66\%$$

## Sources of Yield Losses. (Davis 1970)

1). T-252 Steam Stripper  $\text{put} = 175 \text{ gpm}$  of  $3500 \text{ ppm EDC} = 130 \frac{\text{lb}}{\text{hr}}$  EDC loss  
 when stripper is operational will recover 99% of the stream  $= 128 \frac{\text{lb}}{\text{hr}}$   
 $\% \text{ Yield Loss Recoverable} = \frac{128 \times 100}{84,250} = 0.15\%$

### 2). Oxy Yield Losses

a) Overburning  $\left( \begin{array}{l} \text{CO loss as } \text{C}_2\text{H}_4 \\ \text{CO}_2 \text{ loss as } \text{C}_2\text{H}_4 \end{array} \right) = \frac{277 \text{ lb/hr.} + 346 \text{ lb/hr.}}{623 \text{ lb/hr.}} = \frac{623(100)}{84,250} = 0.74\%$

b) ParConversions  $\left( \begin{array}{l} \text{H}_2 \text{ in vent} \\ \text{HCl in vent} \\ \text{HCl in H}_2\text{O} \\ \text{C}_2\text{H}_4 \text{ in vent} \end{array} \right) = \frac{2 \text{ lb/hr.} + 293 \text{ lb/hr.} + 1114 \text{ lb/hr.} + 640 \text{ lb/hr.}}{2049 \text{ lb/hr.}} = \frac{2049(100)}{84,250} = 2.43\%$

c).  $\text{H}^+$  removed as  $\text{H}_2\text{O}$  in oxy (not recoverable)  $= 1.38\%$

d). E+Cl Byproduct  $\left( \begin{array}{l} \text{ETCl in vent} \\ \text{ETCl in water} \\ \text{ETCl in Liquid Ends} \end{array} \right) = \frac{258 \text{ lb/hr.} + 5 \text{ lb/hr.} + 271339 \text{ lb/hr.}}{534602 \text{ lb/hr.}} = \frac{534602(100)}{84,250} = 0.63\%$

e). 1,1,2 trichloroethane byproduct  $- 10\% \times 2239 = 223.9 \frac{\text{lb}}{\text{hr.}} = 1.06\% \text{ total}$   
 $70\% \text{ due to oxy} = 156.73 \frac{\text{lb}}{\text{hr.}} = 0.18\%$

f) EDC vented from PRC-309  $= 313 \frac{\text{lb}}{\text{hr.}}$  (theoretically)

3). T-101 Vent Losses as EDC  $= 5\% (227 \text{ cfm}) \times \frac{99}{379} = 29.6 \frac{\text{lb}}{\text{hr.}} = 1.78 \frac{\text{lb}}{\text{hr.}}$   
 $\% \text{ loss} = \frac{198 \times 100}{84,250} = 0.23\%$

4). ~~Handwritten scribbles and crossed-out text.~~

~~Handwritten scribbles and crossed-out text.~~

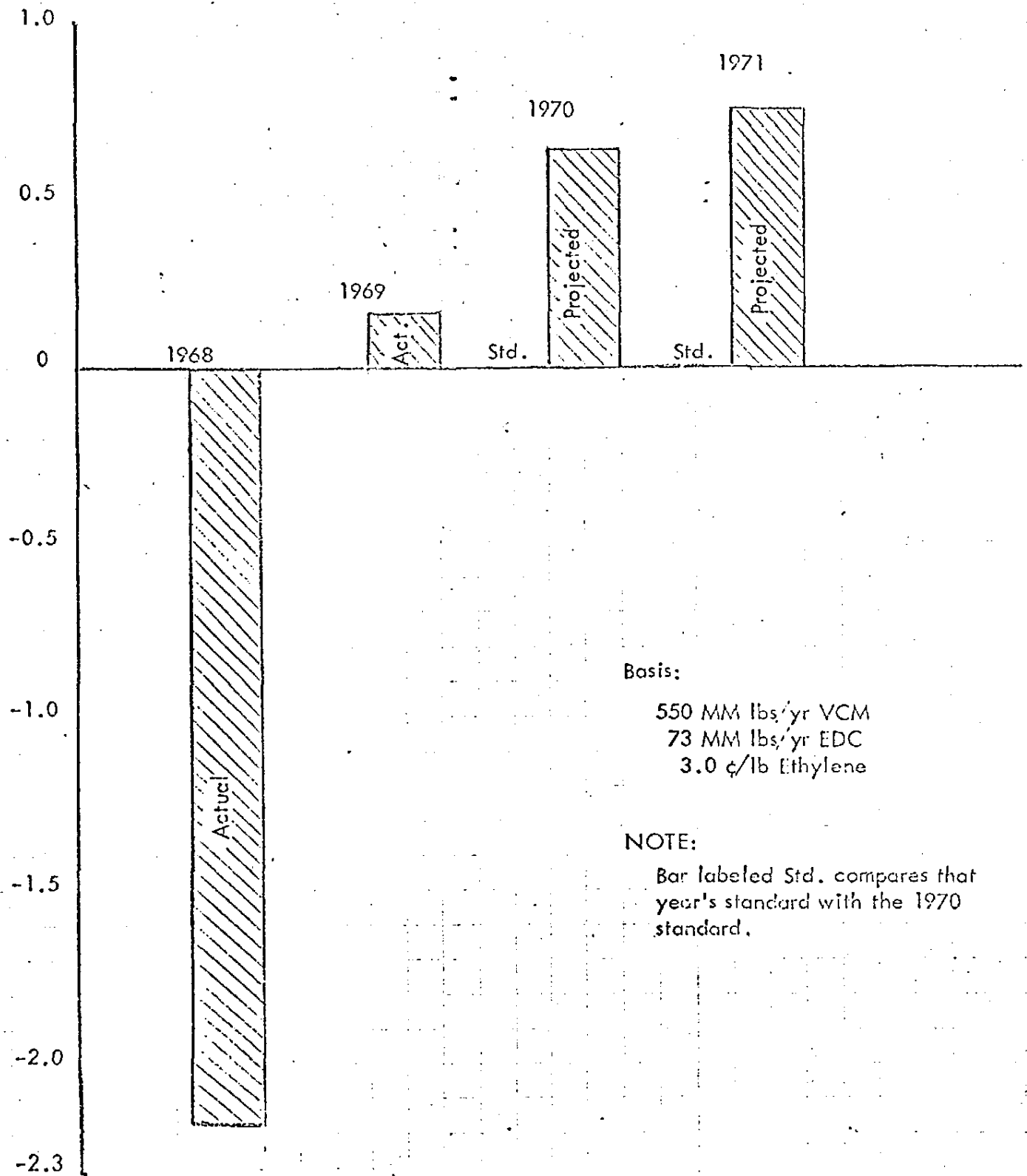
CCR 000006865

6). Tar Still EDC losses  $= 560 \frac{\text{lb}}{\text{hr.}} = \frac{560 \times 100}{84,250} = 0.664\%$

7). EDC Column over head EDC losses  $= 206 \frac{\text{lb}}{\text{hr.}} = \frac{206 \times 100}{84,250} = 0.245\%$

Variance From 1970 Standard

\$ MM



CCR 000006866