UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DATE: ... 1981

SUBJECT: Trip Report - Plant Visit to Globe Manufacturing Company

FROM: Dennis Crumpler
Chemical Applications Section, CPB (MD-13)

TO: James Berry, Chief
Chemical Applications Section, CPB (MD-13)

I. Purpose

To observe the VOC emission control system for reaction-spun urethane fiber and to discuss the technical and economic problems of operating such a system.

II. Place and Date

Globe Manufacturing Company
Gastonia, N.C.
September 16-17, 1981

III. Attendees

Dennis Crumpler, EPA
Gene Smith, EPA
Fred Keener, Globe Manufacturing Company
Richard Legendre, Globe Manufacturing Company

IV. Discussion

Globe Manufacturing Company (henceforth referred to as "Globe") invited EPA to their plant at Gastonia, N.C. to discuss the technical problems and exorbitant costs of controlling VOC emissions from the reaction spinning of spandex fibers. Mr. Keener and Mr. Legendre also led us on a very informative plant tour.

Globe is one of two U.S. producers of spandex fiber. Spandex is a generic name for polyurethane fiber. Urethane is the product of reacting a polyester prepolymer with a diamine crosslinking agent. Globe manufactures their own prepolymer at the plant.

Globe forms their fiber by pumping a polyester prepolymer through spinnerets at a constant rate into a 2-4 percent solution of ethylenediamine in toluene. A chemical reaction precipitates the polymer which is withdrawn from the bath and laid on a heated conveyor belt. The crosslinking reaction continues for the duration of the process. Fiber sizes range from 10-7000 denier.

From the heated conveyor the fiber is drawn through a two-stage oven. The first stage is heated wth steam coils to about 300°F. The second stage is heated with infrared heaters to over 400°F. After drying the fiber is wound on packages.

Potential VOC emissions originate at the spin bath, the heated conveyor belt and in the oven. Essentially all air that enters the spinning room is sucked into the hooding that surrounds the spin bath and conveyor belt. This stream is ducted to a carbon adsorption (CA) system. The first stage of the oven is also vented to the carbon adsorber. The second stage exhaust has been shown to have a maximum of 30 ppm solvent so it is not vented to the CA system. The gas streams from the spinning room and oven are combined and cooled in a heat wheel-type exchanger to less than 100°F prior to entering the bed. (Globe uses six carbon beds at Gasonia and is planning to add two more. Their plant in Fall River, Massachusetts, uses 16.)

The carbon is regenerated with steam. Steam consumption is about 2,000 pounds per hour. Regeneration is on a time cycle because severe carbon-fouling reduces the bed efficiency in a few weeks to the point that a breakthrough cycle would be steaming the bed much too frequently. Condensed steam and solvent is sent to solvent recovery. There is some diamine and prepolymer in the aqueous phase of the condensate. After decantation of the toluene, gentle agitation causes the remaining organics to globulate which make them easy to separate from the aqueous phase. The toluene is purified in a flash distillation column.

The concentration of the exhaust stream to the CA unit is always less than 25 percent LEL. The spinning room toluene concentration is maintained around 50-60 ppm. The oven exhausts are designed to never exceed 25 percent LEL.

Globe's overall solvent recovery is not as high as they would like it to be. They make daily readings of recovered solvent and total solvent feed. The problem is centered around the performance of the CA system. Apparently unreacted prepolymer and diamine cause severe carbon fouling. The nature of the fouling is such that the carbon pellets are cemented into a hardened asphalt-like solid. The carbon has to be removed from the beds at least every 18 months. The operation is manual (picks and axes) and requires two weeks to complete. The carbon must then be shipped to Union Carbide or another supplier to be reactivated in a furnace. The calcining process is not effective.

Globe has had several bed firest but these were attributed to inadequate sensing instrumentation. They have recently solved this problem, however, by installing CO monitors in the beds and exhaust ducts.

Globe loses a large percentage of the carbon during each reactivation. The actual amount was discussed in our conversation concerning the cost of emission control. Globe's average losses of carbon are 44 percent. Their attempts to control emissions is costing them an estimated $247,092 per year for two plants. This data is attached. Globe is considering an on-site reactivation process which should result in a considerable savings if successful. Globe considers incineration to be too expensive and a waste of energy. They also think there could be severe corrosion problems.

V. Summary

In most industrial processes the key to reducing VOC emissions is improving the capture of would-be fugitive vapors. Subsequent control device efficiencies routinely operate at 95 percent efficiency and higher. Globe's situation is the opposite. Over 99 percent of the organic vapors evolved in their reaction spun process are captured and sent to solvent recovery. A rather complex fouling phenomenom in the carbon bed, however, decreases the emission control efficiency to less than 90 percent rather quickly. The consequential removing, shipping, and reactivating of the carbon is a large expense to the company. There are not any short-term solutions although Globe is investigating sacrificial beds and on-site carbon reactivation.

Attachment

OAQPS:ESED:CPB:CAS:DCrumpler:tec:MU:1033:x5605:MD-13:11/30/81:File NO______

Estimated Annualized Costs Summary

	Sent in Per B.I.D. & Adjustments	Adjusted Labor Per B.I.D.	Adjusted Maint Matl To Actual	Adjusted Labor To Actual
Direct Operating Cost				
Operators (3)	324000	108000	108000	⑤ 102368
Supervision	48600	16200	16200	15355
Operating Materials ①	156378	156378	156378	156378
Maintenance Labor	324000	63000	108000	⑦ 130657
Maint. Material	46450	46455	⑤ 117399	117399
Electricity ②	193332	193332	193332	193332
Steam ③	414892	414892	414892	414892
Waste Disposal	15483	15483	15483	15483
	1522135	1063335	1135184	1141364
Indirect Operating Cost				
Overhead	564250	217250	290699	296319
Property Tax	15483	15483	15483	15483
Insurance	15483	15483	15483	15483
Administration	30966	30966	30966	30966
Capital Recovery Cost	185801	185801	185801	185801
	812583	466983	538432	544052
Total Cost	2340718	1530718	1673616	1685416
Credits				
Recovered Solvent ④	1438323	1438323	1438323	1438323
Net Annual Loss	902395	92395	235293	247093

① Cost of Carbon Replacement & Reactivation
② Based on Actual Usage & \$0.0635 in MA. & \$0.0263 in N.C.
③ Based on Usage & Actual Cost of \$7.00/1000 LB
④ Based on Projected Cost of \$1.77/GAL
⑤ Actual Material Cost
⑥ Based on Wages of \$13.39/HR
⑦ Based on Actual Maintenance Labor Charges

DIRECT OPERATING COSTS

OPERATORS

WAGES OF $11.16 PER HOUR, 52 HRS/WK, 49 WKS/YR FOR 3 MEN.
($11.16 × 52 × 49 × 3) = $85307
ADD 10% PER YEAR FOR INCREASES (85307)(1.2) = $102,368

SUPERVISION

AT 15% OF DIRECT LABOR ($102,368)(0.15) = $15,355

OPERATING MATERIALS

WILL LIMIT THIS ITEM TO CARBON REPLACEMENT COSTS PLUS CARBON REACTIVATION COSTS.

HISTORICAL LOSSES:

1977 =	78,000 LB REACTIVATED W/LOSSES OF	23,400 LB
1978 =	78,000 " " "	52,260 LB
1980 =	84,000 " " "	29,400 LB
	240,000	105,060

AVG. LOSSES = (105060) ÷ (240,000) = 43.78%

PROJECTED LOSSES:

STARTING IN JULY 1983 WE WILL BE REACTIVATING 144,000 LB OF CARBON EVERY 18 MONTHS, OR AN AVERAGE OF 96,000 LB/YR. AT THE PRESENT RATE OF LOSSES, WE EXPECT TO REPLACE (96,000)(0.4378) = 42,029 LB/YR OR 21 TONS.

REPLACEMENT COSTS:

CARBON COST HAS RISEN FROM $0.80/LB IN 1976 TO $1.30/LB IN 1981 OR APPROXIMATELY 12.5% PER YEAR. IF WE CONSERVATIVELY ASSUME THE RATE DROPS TO 10% PER YEAR, CARBON WILL COST $1.56/LB IN 1983. REPLACEMENT COST IS THEN
(42,000)($1.56) = $65,520 PER YEAR

REACTIVATION COSTS:

UNION CARBIDE'S CHARGES FOR REACTIVATION IN 1981 WERE \$91 PER 55 GAL DRUM. IF WE ASSUME A 10% ANNUAL INCREASE CHARGES WOULD BE \$109.20/DRUM IN 1983.

SINCE 96,000 LBS IS EQUIVALENT TO 540 DRUMS, THE CHARGES WOULD BE (540)(\$109.20) = \$58,968 PER YEAR.

TRANSPORTATION IS ESTIMATED AT \$10,965 PER YEAR

REPLACEMENT DRUM COST = (540)(\$15)(0.45) = \$3645

LABOR TO UNLOAD & LOAD TANKS REQUIRES 8 MEN FOR 16 DAYS WORKING 10 HR/DAY

COST IS (8)(16)(10)(\$13.39) = \$17,139 PER YEAR

TOTAL OPERATING MATERIALS COST IS

REPLACEMENT CARBON	= \$65,520
REACTIVATION CHARGES	= 58,968
TRANSPORTATION CHG.	= 10,965
REPLACEMENT DRUMS	= 3,645
LABOR	= 17,139
	\$156,378

MAINTENANCE LABOR

DIRECT WAGES PAID FROM 1977 TO 1981 WERE \$109,130 OR \$21,826 PER YEAR IN FALL RIVER

DIRECT WAGES PAID FROM 1976 TO 1981 WERE \$126,753 OR \$21,126 PER YEAR IN GASTONIA.

FALL RIVER SYSTEM SIZE DOUBLED IN JULY 1980 SO COSTS SHOULD DOUBLE BY 1983 TO \$43,652 PER YEAR

GASTONIA SYSTEM EXPANSION IN DEC 1981 WILL INCREASE COST TO (21,126)(8/6) = \$28,168 PER YEAR

DIRECT WAGES ARE THEN \$71,820/YR

WITH FRINGES & INCREASES IN 1983 THIS WILL AMOUNT TO

(71,820)(1.4)(1.2) = \$120,657 PER YEAR

Material Claimed Confidential
By Company And Therefore
Deleted From Inclusion
In The Public Record

As requested in Docket Item Number IV-D-9 and consistent with 40 CFR Part 2, page 4 of the 4 page attachment to this trip report has been withdrawn from the docket and placed in the Emission Standards and Engineering Division confidential files.