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Report of the Initial Visit to Du Pont's Acrylic Fiber Plant in Waynesboro, Virginia, Regarding the Development of New Source Performance Standards for the Synthetic Fibers Industry

Place and Date

E.I. Du Pont de Nemours, Incorporated
Acrylic Fibers Division
Waynesboro, Virginia

May 1, 1980/Revised Version

Attendees

Tom Mullen	Du Pont
Ed Ruehl	Du Pont
Don Sheperd	Virginia State Air Pollution Agency
Roy Manley	Pacific Environmental Services, Inc.
Robert Zerbonia	Pacific Environmental Services, Inc.
Greg Lathan	Pacific Environmental Services, Inc.

Discussion

Prior to the plant tour, a meeting was held among various Du Pont personnel and the PES project team. Mr. Tom Mullen, Du Pont Environmental Supervisor, opened the meeting with a discussion of the objectives of the EPA/PES information gathering effort. Robert Zerbonia provided a general overview of the objectives and purposes of the information gathering program and its overall relationship to New Source Performance Standard (NSPS) development.

Tom Mullen commented on the various fibers produced at Du Pont's Waynesboro facility in addition to Du Pont's T-42 Basic Dyeable Acrylic Fiber; Lycra spandex and Permasep are also produced. "Lycra" spandex is a dry solvent-spun fiber. Ninety-nine percent of the solvent used in the "Lycra" process is recovered; emissions of solvent from the "Lycra" process are approximately 35 to 40 tons/year. This fiber is used in the production of foundation garments, swimsuits and pantyhose. Du Pont's Permasep hollow-filament, reverse osmosis products are used for water purification (desalination).

Mr. Ruehl next provided a detailed review of the agenda, previously sent to Du Pont. The agenda contained numerous questions concerning the Du Pont acrylic fiber process. A copy of the agenda along with information and data provided by Du Pont is contained in Appendix A.

After a thorough discussion of the agenda, Mr. Mullen referred to a publication that was submitted to OSHA by Environmental Control, Incorporated, titled "Economic Impact Assessment for Acrylonitrile." Mr. Mullen suggested that this document would be valuable in the economic study and development of model plant parameters during Phase II of the NSPS. Another suggestion was that PES should obtain Du Pont product bulletins for all solvents and fiber types under study.

Plant Tour

After the initial meeting discussion, a plant tour was conducted. The tour of the acrylic manufacturing facility was began at the polymer preparation area. The polymer is filtered and the slurry is blended and stored. The blended polymer is extruded in the form of noodles and dried on a hot air dryer. The polymer noodles are pulverized and stored.

At the mixing stage, pulverized polymer falls down a tube into a Marco screw-type mixer. Before entering the mixing tank, DMF is sprayed onto the pulverized polymer in a spray chamber. After being thoroughly mixed, the resulting solution of polymer in DMF falls down into a blending tank or storage vessel where the solution is agitated. The spinning dope is pumped through a heat exchanger which heats the polymer solution to lower the viscosity prior to filtering. The heated solution is filtered through plate and frame filter presses. These frame press filters are hooded to prevent DMF exposure during the time when the filter media is being changed (respiratory protection is also required when changing the filter press media). The used filter media (cellulose) is placed in bins and is repeatedly leached with water until the water used for leaching contains less than a cut-off percent of DMF. The water used for leaching is sent to the weak feed line of the DMF recovery system.

The spinning solution is then pumped through spinnerets (containing several hundred holes) using a metering device. The head of the spinnerets are kept hot by a steam jacket. Kemp gas enters at the top of the spinning cell and moves concurrently with the emerging filaments. The DMF is volatilized or extracted by the Kemp gas from the emerging filaments as they travel down the length of the spinning cell. The individual filaments are brought together at the bottom of the spinning cell. Water is applied to the fiber at two points, and the excess run-off water is drained and processed for recovery of DMF. The spun fiber travels to a set of pull rolls which pull the fiber away from the spinning cells. Multiple spinning positions converge to form a single rope or tow which is piddled into cans for storage. Here the fiber is sampled for H_2O and DMF content. Covers are placed on top of the cans to prevent occupational exposure to DMF. All gases originating from the piddling operation are vented to the atmosphere.

The cans containing the spun fiber are transported to subsequent washing and drawing operations. Hot water extracts DMF residual and is sent to the dilute DMF (weak stream) recovery system.

From the drawing operation, the fiber or tow moves up a semi-enclosed incline. Excess water is drained from the tow before it is crimped. At the top of the conveyor, the tow is crimped. After the crimping operation the fiber contains some residual DMF. After crimping, air is pulled into the covered conveyor belt to cool the crimped fiber. From here, the tow is piddled into a creel can. After the creel operation, the tow is cut wet to form staple prior to drying or is sent directly to a drying operation uncut. The steam and hot air from the drying operation are exhausted to the atmosphere. After drying, the tow is placed in cartons.

Three work areas are monitored for DMF concentration at a total of 42 points. Samples from these points are fed into three centralized Miran Infrared Gas Analyzers. These points are monitored on a continuous basis.

Recovery System

DMF and nitrogen, vented from the spinning cell, are routed to a condenser. The Kemp gas from the condenser is sent back to the top of the spinning cell where it is reheated and is again used in evaporating the DMF from the extruded filaments. The condensed solvent is sent to a "strong feed" holding tank (termed "strong feed" because this portion of the recovery stream is very high in DMF concentration). The liquid stream from the strong feed holding tank is next routed to the bottom of a large distillation column where the DMF is recovered.

Aqueous DMF streams from the spinning, washing, and drawing operations are sent to a weak feed holding tank (termed weak feed because these liquid waste streams contain low concentrations of DMF). In addition, the gaseous exhaust (emissions) from the end or bottom of the spinning lines is sent to a scrubber. The scrubber solution containing DMF and H_2O is also fed into the previously mentioned weak feed line. The liquid from the weak feed holding tank is vaporzied and sent to the top of the distillation column.

Pure DMF recovered from both the strong and weak feed streams from the distillation column is sent through a cooler (heat exchanger) and solvent deionization process. It is subsequently stored in a solvent storage tank along with any make-up solvent needed in the process. The stored DMF is then used in the dissolving stage to dissolve the powdered polymer. Additional information on the recovery system can be found in the Descripton of Solvent Recovery System (appendix) provided by Du Pont.

After the plant tour a final meeting between representatives of Du Pont and Pacific Environmental Services was conducted to answer questions concerning the plant tour.

Mr. Mullen discussed improvements which had been made in the past 7 years at the Waynesboro acrylic fiber plant. These include the installation of enclosures, the increasing of air flow rates and the monitoring of DMF levels, all which have been directed to reduce occupational exposure to DMF. Mr. Mullen stated that any future facilities would have separate ventilation systems for high and low concentration DMF streams and also probably would modify the can creel operation to reduce fugitive emissions.

Action to be Taken

The PES project team noted that additional cost data may be necessary to supplement the data provided at the time of the plant visit. PES will examine the data provided by Du Pont and then make a determination regarding the need for more specific information. It was also noted that any further cost data required would likely concern the capital and annualized cost of the process enclosures which serve the fiber spinning and processing lines.

Appendix A

Plant Agenda for Acrylic Fiber Process

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SYNTHETIC FIBER INDUSTRY

NSPS STUDY - EPA AND PACIFIC ENVIRONMENTAL SERVICES

DU PONT - WAYNESBORO PLANT - WAYNESBORO, VA.

MAY 1, 1980

SOLVENT EMISSION DATA, CONTROL AND RECOVERY OPERATIONS

ACRYLIC FIBER