ESTABLISHING NEW SOURCE PERFORMANCE STANDARDS FOR AIR POLLUTANTS EMITTED FROM THE POLYMERS AND RESINS INDUSTRY

TRIP REPORT

FOR

MONSANTO TEXTILES COMPANY

Prepared for:

OFFICE OF AIR QUALITY PLANNING AND STANDARDS
U.S. ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NORTH CAROLINA

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1. PURPOSE OF PLANT VISIT

To gain a better understanding of the processes, pollutants and control techniques found in the polymers and resins industry and to observe actual plant operations, a series of plant visits have been planned and organized. These visits are an essential component in compiling information used to write a background information document (BID), which will be used to develop new source performance standards (NSPS) for this industry. This information, along with analogous information from other companies, will be used to assess the significance of emissions from the polymers and resins industry, to define the current status of emission control, and to assess the environmental, energy, and economic impacts associated with installation and operation of feasible emission control techniques.

The information will also be used for a preparation of a control techniques guideline (CTG) document for the industry. This document is intended to aid the States in the preparation of their State implementation plans (SIP's) in 1982 for compliance with the national ambient air quality standard (NAAQS) for ozone (O_3). As part of this study, 11 polymers facilities are being visited by Energy and Environmental Analysis, Inc. (EEA), personnel. The Monsanto Textiles Company's polyester plant was one of the facilities selected.

2. PLANT LOCATION AND PARTICIPANTS

2.1 PLACE AND DATE

On August 27, 1980, an EEA representative visited Monsanto Textiles Company's polyester resin plant at the following location:

Monsanto Textiles Company
Post Office Box 2204
Decatur, Alabama 35601
Telephone: (205) 552-2430

2.2 ATTENDEES

The following personnel participated in the meeting and plant tour during EEA's visit to Monsanto Textiles:

- Rick Bonci,
  Monsanto Textiles Company
- Asdakorn Limpiti,
  EEA
- William Matthews,
  Monsanto Textiles Company

3. DISCUSSION OF PLANT VISIT

3.1 PROCESS DESCRIPTION

Monsanto's polyester resin plant consists of three identical manufacturing process trains with a total design capacity of 45 Gg/yr (100 million lb/yr). The resin polymer is produced continuously from terephthalic acid (TPA), in a two-step process. In the reaction, esterification occurs first, followed by polymerization. Ethylene glycol (EG) is the other principal raw material involved in the process.

EG and TPA are stored in fixed-roof storage tanks. Along with certain catalysts and additives, they are all fed to a mixing tank at ambient temperature and pressure. The thoroughly mixed mixture from this tank is continuously charged to heated and slightly pressurized vessels (two esterifiers in series). The products of this esterification unit are water vapor and BHET (bis(2-hydroxyethyl)-terephthalate). BHET is actually the monomer created for the subsequent polymerization process.

The entire process train is contained in a building. The esterifiers, prepolymerization reactors and polymerization reactor are about the same size. The columns occupy two story of the process building; each reactor is about two meters (6.6 feet) in diameter. Each reactor has thick insulation to prevent heat loss.

Monomer BHET undergoes partial polymerization in two prepolymerization reactors in series. Both of these vessels are under vacuum and maintained at a constant temperature.

The reaction is further continued in a polymerization reactor at the same temperature but under a higher vacuum. It is brought to completion

and the discharge from this reactor is the product resin, polyethylene terephthalate (PET). PET is continuously fed to the melt spinning process for fiber production.

The esterifiers, and all polymerization reaction vessels are heated by "Thermanol," VP-1, heating system. Vacuum conditions are created by steam jet ejectors. By February 1981, water from cooling tower will be used to quench the vacuum exhaust and the overflow water will go back to waste water treatment. The exhaust from these ejectors is quenched with once-through passage of river water and then discharged to a hotwell from which overflow water goes back to the river.

Vent gases from the second esterifier, prepolymerization reactors, and polymerization reactor pass through spray condensers where they are scrubbed with contaminated ethylene glycol (CEG). The CEG is recirculated through the spray condensing system. All noncondensables are vented to the atmosphere.

3.2 VOC EMISSIONS

There are, in all, six possible sources of VOC emissions in Monsanto's polyester resin plant. The exact numerical figures of emission will not be available until the end of December 1980, but as discussed with the company officials and known from personal observation, it is expected to be very low. Six emission points are combined in groups as follows:

3.2.1 Raw Materials Storage Tank

Fixed roof tanks are used in storage facilities and these are satisfactory for ethylene glycol since its vapor pressure is low. The emissions are almost negligible from this source.

3.2.2 Esterification Reactors

This could be a major process emission source in the dimethyl terephthalate process chiefly because methanol is produced as a by-product. With the TPA process the main by-product is water vapor, and thus the only possible emissions from this source could be ethylene glycol vapors. Because of the vapor pressure of ethylene glycol, the emissions here would be expected to be low. Also, Monsanto uses spray condensers before the vents to recover most of the vapors. Hence, expected emissions are again very low. There are two vents from this unit.

3.2.3 Polymerization Reactors

In this group there are three vents, two from prepolymerization and one from the polymerization reactor, resulting from vacuum system discharge. Here also, spray condensers are used to recover EG for economic reasons as well as for removing as much vapor as possible from the vent stream.

3.3 VOC CONTROL

No major control devices are used for VOC emissions in this plant, except spray condensers. Monsanto claims the spray condensers recover most of the ethylene glycol vapors. These are used primarily for economic reasons.

4. GENERAL COMMENTS

It is well known that polyester fiber can also be produced from ethylene glycol and dimethyl terephthalate. This process is older and more entrenched.

Polyester fiber, manufactured by Monsanto, from TPA is preferred over DMT process because the recovery and purification of by-product methanol is avoided. In fact, this is the main reason why this plant is expected to have very low emissions. This process also eliminates by-product methanol storage vent.

The plant was fairly clean, but the sweet odor of EG was very noticeable, especially near the process area.