G-613

E. I. DU PONT DE NEMOURS & COMPANY
INCORPORATED
WILMINGTON, DELAWARE 19898

SYNTHETIC FIBERS
AP-42 Section 5.19
Reference Number
26

October 17, 1978

Mr. Wayne Talbert
Research and Development Center
Pullman-Kellogg
16200 Park Row-Industrial Park Ten
Houston, Texas 77084

Dear Mr. Talbert:

In response to Mr. D. R. Goodwin's (EPA) letter of August 21, 1978, we have prepared a summary of VOC emission information from the production of nylon 66 fiber at our plants located in Chattanooga, Tennessee; Martinsville, Virginia; Seaford, Delaware; Richmond, Virginia, Camden, South Carolina; and Waynesboro, Virginia.

It must be recognized that these plants practice technolgoy that spans 40 years (1938-1978) and employ a wide spectrum of equipment (batch and continuous polymerization, fine denier textile and heavy denier industrial yarns, high and low tenacity yarns, high and low speed spinning, etc.) Also polymers of varying viscosity are produced to which minor amounts of modifiers are added. All of these give rise to significant variations in points of emission and quantities of materials emitted.

Attached are write ups which, to the best of our ability, characterize the processes and emissions at each plant site. Also included in a separate enclosure is confidential information concerning nominal production capacity at each site. In accordance with the agreement signed between Pullman-Kellogg and Du Pont dated September 22, 1978, this information is not to be disclosed or used except in accordance with that agreement.

R. B. Hayden
Senior Staff Engineer
Environmental Control

RBH:rlm
Attachments

cc: J. I. Reilly
Director Environmental Affairs

D. W. Smith
Administrative Assistant

CORPORATION E. I. DU PONT DE NEMOURS & CO.

PLANT MARTINSVILLE

CITY MARTINSVILLE, STATE VIRGINIA

more volatile than adipic acid — goes to air & reacts w CO_2 & forms diamine carbonate — particulate emission — blue haze

NYLON 66 FIBER MANUFACTURING PROCESS DESCRIPTION

eliminate by scrubbing.

Nylon 66 fiber is manufactured from polymer formed by reacting two petrochemical derived raw materials, adipic acid $[(CH_2)_4 - (COOH)_2]$ and hexamethylene diamine $[(CH_2)_6 - (NH_2)_2]$. The adipic acid is supplied to the process as a powdered crystalline solid and the diamine as a water solution. There are no vapor losses from diamine solution storage since the storage tank is inert gas blanketed with vapor displacement back to the shipping tank car during raw material unloading.

Adipic acid, diamine, and water are combined to form a salt solution which is fed to a batch polymerization process. This polymerization is carried out under elevated pressure and temperature with vented off-gases consisting of evaporated water of solution, water of polymerization, volatized hexamethylene diamine, and traces of volatile, but water-soluble, ingredient impurities. The vented off-gases go to spray condensers where total condensation occurs; the condensate goes to a biological waste treatment system.

Molten polymer from the batch polymerization process is extruded, cooled, flaked, stored/blended, and then fed as needed to remelters which supply fiber spinning machines.

2

Oil based finishes are applied to the fiber in the spinning step to provide the lubrication and static suppression needed for subsequent fiber processing operations. Air exhausts from the spinning rooms contain volatized and atomized water and mineral/vegetable oils from the finishes lost in processing. These exhausts go to air conditioning units which remove about 70% of the hydrocarbons before discharging the residual gases to the atmosphere.

A process diagram showing hydrocarbon atmospheric emission points is given in Attachment 1. Attachment 2 is an atmospheric vent inventory giving emission details.

Confidential Enclosure No. 1, which gives resin and fiber production statistics supporting and supplementing the other emission data, is enclosed under separate cover.

HBH/abb
10/16/78

2

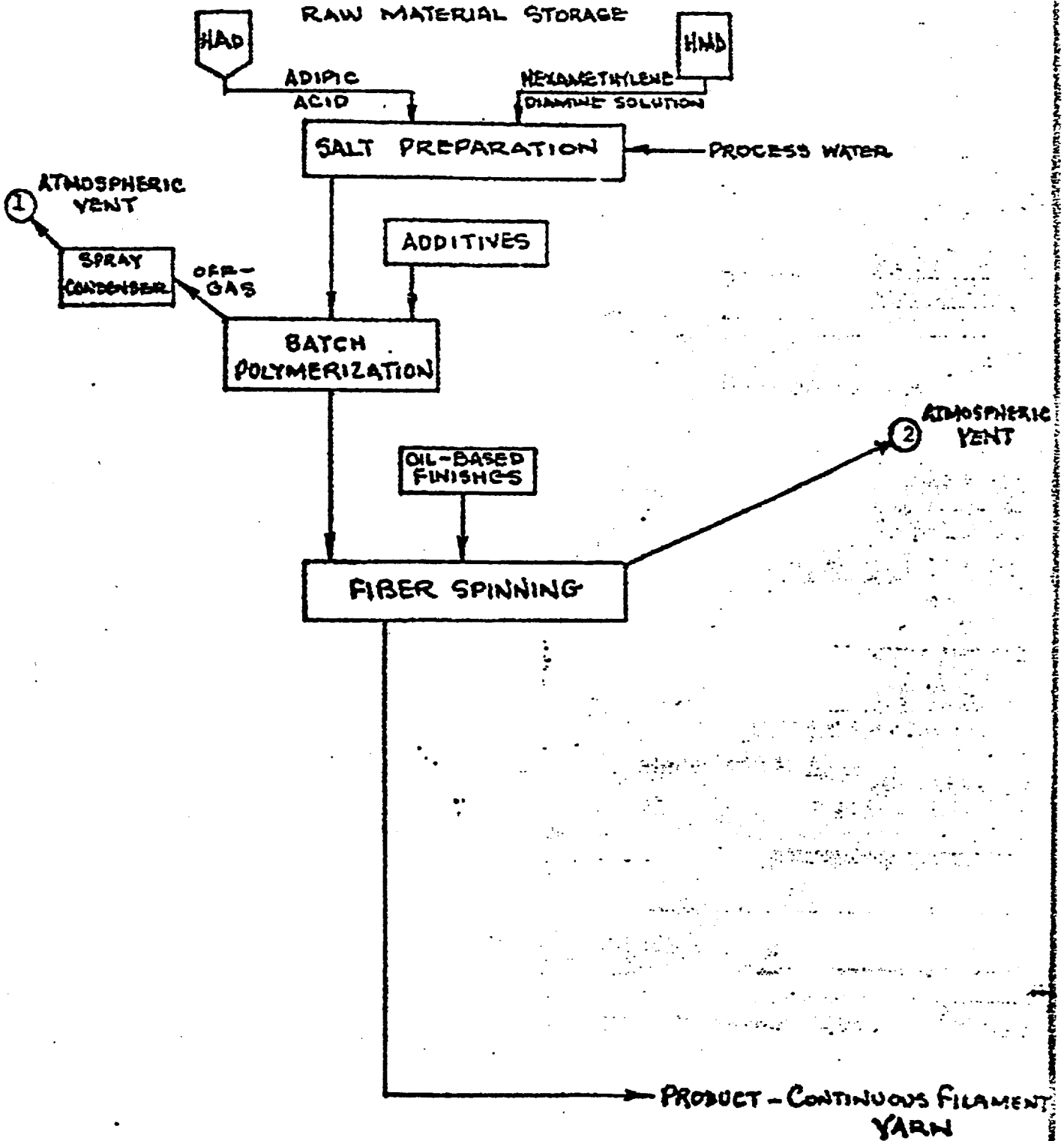
ATTACHMENT 1

Corporation E. I. DU PONT DE NEMOURS

Plant MARTINSVILLE

City MARTINSVILLE State VIRGINIA

NYLON 66 FIBER MANUFACTURING PROCESS



O - SEE ATTACHED ATMOSPHERIC VENT INVENTORY FOR DETAILS.

ATTACHMENT 2

CORPORATION E. I. DU PONT DE NEMOURS & CO., INC.

PLANT MARTINSVILLE

CITY MARTINSVILLE STATE VIRGINIA

NYLON 66 FIBER MANUFACTURING PROCESS ATMOSPHERIC VENT INVENTORY

(1) BATCH POLYMERIZATION OFF-GAS

- Emission Control Device - Spray condensers using cooled condensate as a condensing medium.
- Emissions to Condensers
  - Composition

    Hydrocarbons - Hexamethylene diamine - 2.0 - 2.1 lb./1,000 lb. product.

    - Miscellaneous hydrocarbon traces - 0.2 lbs./1,000 lbs. product.
  - Method of Measurement - Material balance based on salt and polymer analyses.
- Emissions From Condensers
  - Essentially none - A total condensation process.

(2) FIBER SPINNING EXHAUST

- Emissions to Atmosphere
  - Composition

    Hydrocarbons - Mineral/vegetable oils-approximately 0.3 lb./1,000 lb. product.
  - Method of Measurement - Material balance.

CORPORATION E. I. DU PONT DE NEMOURS & CO.

PLANT SEAFORD

CITY SEAFORD STATE DEL

NYLON 66 FIBER MANUFACTURING PROCESS DESCRIPTION

Nylon 66 fiber is manufactured from polymer formed by reacting two petro-chemical derived raw materials, adipic acid $[(CH_2)_4 - (COOH)_2]$ and hexamethylene diamine $[(CH_2)_6 - (NH_2)_2]$. The adipic acid is supplied to the process as a powdered crystalline solid and the diamine as a water solution. There are no vapor losses from diamine solution storage since the storage tank is inert gas blanketed with vapor displacement back to the shipping tank car during raw material unloading.

Adipic acid, diamine, and water are combined to form a salt solution which is fed to both batch and continuous polymerization processes. Both types of polymerization are carried out under elevated pressure and temperature with vented off-gases consisting of evaporated water of solution, water of polymerization, volatized hexamethylene diamine, and traces of volatile, but water-soluble, ingredient impurities. The vented off-gases go to spray condensers where total condensation occurs; the condensate goes to a biological waste treatment system.

Molten polymer from the batch polymerization process is extruded, cooled, flaked, stored/blended, and then fed as needed to remelters which supply fiber spinning machines. In the continuous polymerization process the molten polymer is used directly as a fiber spinning feed.

Oil based finishes are applied to the fiber in the spinning step to provide the lubrication and static suppression needed for subsequent fiber processing operations. Air exhausts from the spinning machines contain volatized and atomized water and mineral/vegetable oils from the finishes lost in processing. These machine exhausts go to catalytic oxidation units which remove about 80% of the hydrocarbons before discharging the residual gases to the atmosphere.

Fiber which is to be sold as continuous filament yarn requires no further processing after it is spun. That which is to be staple and tow products goes from spinning to a drawing and crimping operation. Fiber finish lost as vapor in this process step is exhausted to a catalytic oxidation unit which removes about 80% of the hydrocarbons in the air, water and mineral/vegetable oil mixture before discharging the gases to the atmosphere.

Drawn/crimped fiber which is sold as a staple product is cut before being packaged for marketing. That which will be tow product is processed through a dryer before final packaging. The air/water mixture along with some volatized mineral/vegetable oils is exhausted from the dryer and discharged to the atmosphere without emission controls.

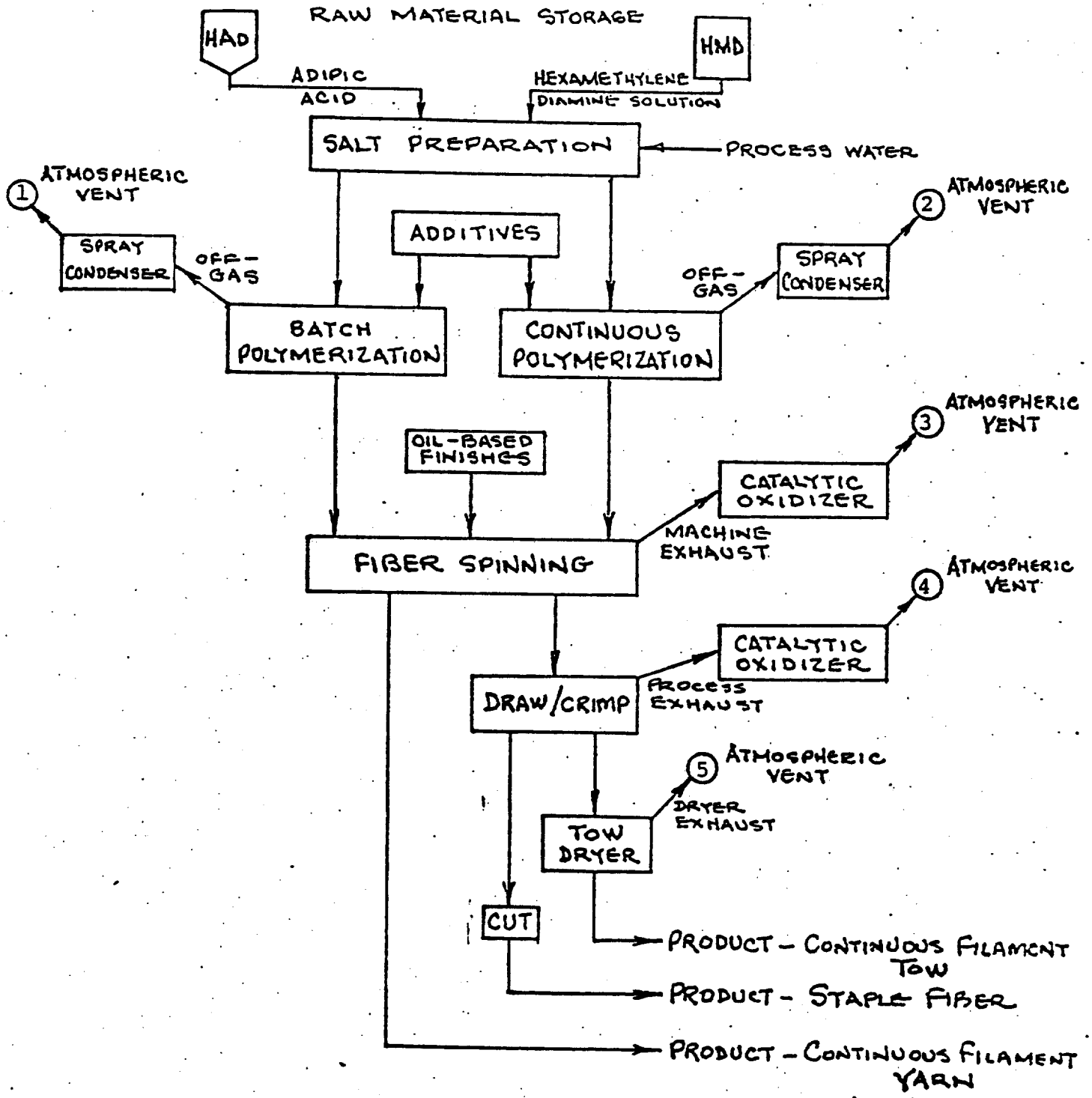
A process diagram showing hydrocarbon atmospheric emission points is given in Attachment 1. Attachment 2 is an atmospheric vent inventory giving emission details.

Confidential Enclosure No. 1, which gives fiber production statistics supporting and supplementing the other emission data, is enclosed under separate cover.

JCR:dtk
9/20/78

Corporation E. I. DU PONT DE NEMOURS & CO., INC.
Plant SEAFORD
City SEAFORD State DEL 19973

NYLON 66 FIBER MANUFACTURING PROCESS



○ - SEE ATTACHED ATMOSPHERIC VENT INVENTORY FOR DETAILS.

ATTACHMENT 2

CORPORATION E. I. DU PONT DE NEMOURS & CO., INC.

PLANT SEAFORD

CITY SEAFORD STATE DEL

NYLON 66 FIBER MANUFACTURING PROCESS
ATMOSPHERIC VENT INVENTORY

① BATCH POLYMERIZATION OFF-GAS

- Emission Control Device - Spray condensers using cooled condensate as a condensing medium.
- Emissions to Condensers
  - Composition

    Hydrocarbons - Hexamethylene diamine - 1.1-1.5/1,000 lb. product.

    - Unmeasured traces hexamethylene imine and cyclopentanone.

    Other - Ammonia, carbon dioxide, and water.
  - Method of Measurement - Material balance based on salt and polymer analyses.
- Emissions From Condensers
  - None - A total condensation process.

② CONTINUOUS POLYMERIZATION OFF-GAS

- Emission Control Device - Spray condensers using cooled condensate as a condensing medium.
- Emission to Condensers
  - Composition

    Hydrocarbons - Hexamethylene diamine - 1.7-2.3/1,000 lb. product.

    - Unmeasured traces of hexamethylene imine and cyclopentanone.

    Other - Ammonia, carbon dioxide and water.
  - Method of Measurement - Material balance based on salt and polymer analyses.
- Emissions From Condensers
  - None - A total condensation process.

③ SPINNING MACHINE EXHAUST

- Emission Control Device - Catalytic oxidizers using platinum catalyst and operating at a 210°C. feed gas temperature. Efficiency of hydrocarbon removal averages about 80%.

- Emissions to Catalytic Oxidizers

  - Composition

    Hydrocarbons - Mineral/vegetable oils - 0.6-1.4/1,000 lb. product.

    Other - Water.

  - Method of Measurement - Calculated from pitot tube flows, absorption train sampling, and gravimetric analysis of emissions from the oxidizers, using 80% removal efficiency.

- Emissions From Catalytic Oxidizers

  - Composition

    Hydrocarbons - Mineral/vegetable oils - 0.12-0.28/1,000 lb. product.

    Other - Carbon dioxide, water.

  - Method of Measurement - Pitot flows, absorption train sampling, and gravimetric analysis of emissions from the oxidizers.

④ DRAW/CRIMP PROCESS EXHAUST

- Emission Control Device - Catalytic oxidizer using platinum catalyst and operating at 210°C. feed gas temperature.

- Emissions to Catalytic Oxidizer

  - Composition

    Hydrocarbons - Mineral/vegetable oils - 0.08-0.13/1,000 lb. product.

    Other - Carbon dioxide, water.

  - Method of Measurement - Calculated from pitot tube flows, absorption train sampling, and gravimetric analysis of emissions from the oxidizer, using an 80% hydrocarbon removal efficiency.

④ DRAW/CRIMP PROCESS EXHAUST (CONTINUED)

- Emissions From Catalytic Oxidizer

  Hydrocarbons - Mineral/vegetable oils - 0.01-0.03/1,000 lb. product.

  Other -

  - Method of Measurement - Pitot tube flows, absorption train sampling, and gravimetric analysis of emissions from the oxidizer.

⑤ TOW DRYER EXHAUST

- Emission Control Device - None.
- Emissions to Atmosphere
  - Composition

    Hydrocarbons - Mineral/vegetable oils - 0.002-0.004/1,000 lb. product.

    Other - Water.

  - Temperature of Exhaust Discharge - 80°C.
  - Method of Measurement - Pitot tube flows, absorption train sampling and gravimetric of emissions.

NOTE: Emission rates all expressed as pounds of emissions relative to 1000 pounds of total plant production.

JCR:dtk
9/20/78

COMPANY CONFIDENTIAL

CORPORATION E. I. DU PONT DE NEMOURS & CO, INC.
PLANT WAYNESBORO
CITY WAYNESBORO STATE VA

NYLON 66 FIBER MANUFACTURING PROCESS DESCRIPTION

Nylon 66 fiber is manufactured from polymer formed by reacting two petro-chemical derived raw materials, adipic acid $\{(CH_2)_4 - (COOH)_2\}$ and hexamethylene diamine $\{(CH_2)_6 - (NH_2)_2\}$. The adipic acid is supplied to the process as a powdered crystalline solid and the diamine as a water solution. There are no vapor losses from diamine solution storage since the storage tank is inert gas blanketed with vapor displacement back to the shipping tank car during raw material unloading.

Adipic acid, diamine, and water are combined to form a salt solution which is fed to continuous polymerization processes. Polymerization is carried out under elevated pressure and temperature with vented off-gases consisting of evaporated water of solution, water of polymerization, volatized hexamethylene diamine and traces of volatile, but water-soluble, ingredient impurities. The off-gases undergo energy conservation and diamine recovery before being vented to the atmosphere.

Oil based finishes are applied to the fiber in the spinning step to provide the lubrication and static suppression needed for subsequent fiber processing operations. Air exhausts from the spinning machines contain volatized and atomized water and mineral/vegetable oils from the finishes lost in processing. These machine exhausts go to catalytic oxidation units which remove about 80% of the hydrocarbons before discharging the residual gases to the atmosphere.

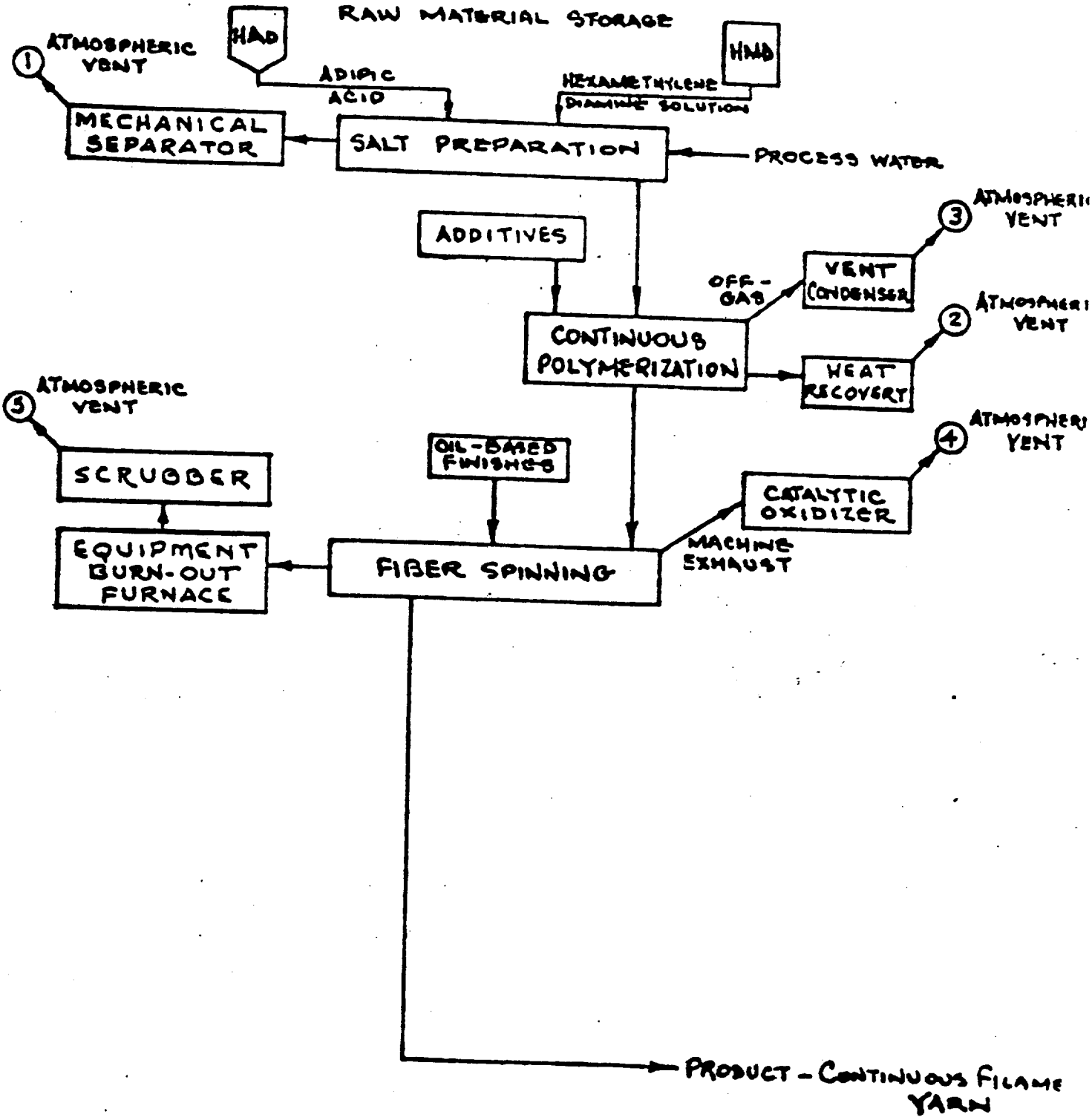
Fiber which is to be sold as continuous filament yarn requires no further processing after it is spun.

A process diagram showing hydrocarbon atmospheric emission points is given in Attachment 1. Attachment 2 is an atmospheric vent inventory giving emission details.

Confidential Enclosure No. 1, which gives fiber production statistics supporting and supplementing the other emission data, is enclosed under separate cover.

Corporation E. I. DU PONT DE NEMOURS & CO.
Plant WAYNESBORO
City WAYNESBORO State VA

NYLON 66 FIBER MANUFACTURING PROCESS



O - SEE ATTACHED ATMOSPHERIC VENT INVENTORY FOR DETAILS.

COMPANY CONFIDENTIAL

ATTACHMENT 2

CORPORATION E. I. DU PONT DE NEMOURS & CO.

PLANT WAYNESBORO

CITY WAYNESBORO STATE VA

NYLON 66 FIBER MANUFACTURING PROCESS
ATMOSPHERIC VENT INVENTORY

(1) SALT PREPARATION VENTS

- Emission Control Devices - Spray scrubber and cyclone separator
- Emission to Control Devices
  - Composition
    Adipic Acid Dust - unmeasured
- Emission from Control Devices
  - Composition
    Adipic Acid Dust - 0.2 lb/1000 lb. product
  - Method of Measurement - Estimate

(2) CONTINUOUS POLYMERIZATION OFF-GAS

- Emission Control Devices - Heat Recovery/Steam Condensation process "scrubs" off-gas.
- Emission to Heat Recovery/Steam Condensation
  - Composition
    Hydrocarbons - Hexamethylene diamine - 0.7 lb/1000 lb. product
    - Soluble ingredient impurities - unmeasured
    Other - water, ammonia, carbon dioxide
  - Method of Measurement - Calculated
- Emission from Heat Recovery/Steam Condensation
  - Composition
    Hydrocarbons - Hexamethylene diamine - 0.1 lb/1000 lb. product
    - Soluble ingredient impurities - unmeasured
    Other - water ammonia, carbon dioxide
  - Method of Measurement - Calculated

③ CONTINUOUS POLYMERIZATION OFF-GAS

- Emission Control Device - vent condensers using cooled condensate as a condensing medium (Finisher).
- Emission to Vent Condensers
  - Composition

    Hydrocarbons - Hexamethylene diamine - 0.7 lb/1000 lb. product.
    - Unmeasured traces of hexamethylene imine and cyclopentanone.

    Other - Ammonia, carbon dioxide and water
  - Method of Measurement - Calculated
- Emission From Vent Condensers
  - Negligible

④ SPINNING MACHINE EXHAUST

- Emission Control Device - Catalytic oxidizers using platinum catalyst and operating at a 210°C. feed gas temperature. Efficiency of hydrocarbon removal averages about 80%.
- Emissions to Catalytic Oxidizers
  - Composition

    Hydrocarbons - Mineral/vegetable oils - 3.5 lb/1000 lb. product

    Other - water
  - Method of Measurement - Calculated
- Emissions From Catalytic Oxidizers
  - Composition

    Hydrocarbons - Mineral/vegetable oils - 0.7 lb/1000 lb. product

    Other - Carbon dioxide, water
  - Method of Measurement - Calculated

⑤ EQUIPMENT BURNOUT FURNACE EXHAUST

- Emission Control Device - spray scrubber. Efficienty of particulate removal averages 80%.
- Emission to Spray Scrubber
  - Composition

    Particulates - combustion products - 0.5 lb/1000 lb. product
  - Method of Measurement - Calculated
- Emissions from Spray Scrubber
  - Composition

    Particulates - combusion products - 0.1 lb/1000 lb. product
  - Method of Measurement - Calculated

Nylon 66 Spinning Machine Emissions

RECEIVED
13 NOV 1978
F. BECHSTEIN

CORPORATION E. I. DU PONT DE NEMOURS & CO.

PLANT MAY

CITY CAMDEN STATE S. C.

NYLON 66 FIBER MANUFACTURING PROCESS DESCRIPTION

Nylon 66 fiber is manufactured from polymer formed by reacting two petrochemical derived raw materials, adipic acid $[(CH_2)_4 - (COOH)_2]$ and hexamethylene diamine $[(CH_2)_6 - (NH_2)_2]$. The adipic acid is supplied to the process as a powdered crystalline solid and the diamine as a water solution. There are no vapor losses from diamine solution storage since the storage tank is inert gas blanketed with vapor displacement back to the shipping tank car during raw material unloading.

Adipic acid, diamine, and water are combined to form a salt solution which is fed to both batch and continuous polymerization processes. Both types of polymerization are carried out under elevated pressure and temperature with vented off-gases consisting of evaporated water of solution, water of polymerization, volatized hexamethylene diamine, and traces of volatile, but water-soluble, ingredient impurities. The vented off-gases go to spray condensers where total condensation occurs; the condensate goes to a biological waste treatment system.

Molten polymer from the batch polymerization process is extruded, cooled, flaked, stored/blended, and then fed as needed to remelters which supply fiber spinning machines. In the continuous polymerization process the molten polymer is used directly as a fiber spinning feed. The fiber is sold as continuous filament yarn and requires no further processing after it is spun.

Oil based finishes are applied to the fiber in the spinning step to provide the lubrication and static suppression needed for subsequent fiber processing operations. Air exhausts from the spinning machines contain volatized and atomized water and mineral/vegetable oils from the finishes lost in processing. These machine exhausts go to catalytic oxidation units which remove about 80% of the hydrocarbons before discharging the residual gases to the atmosphere.

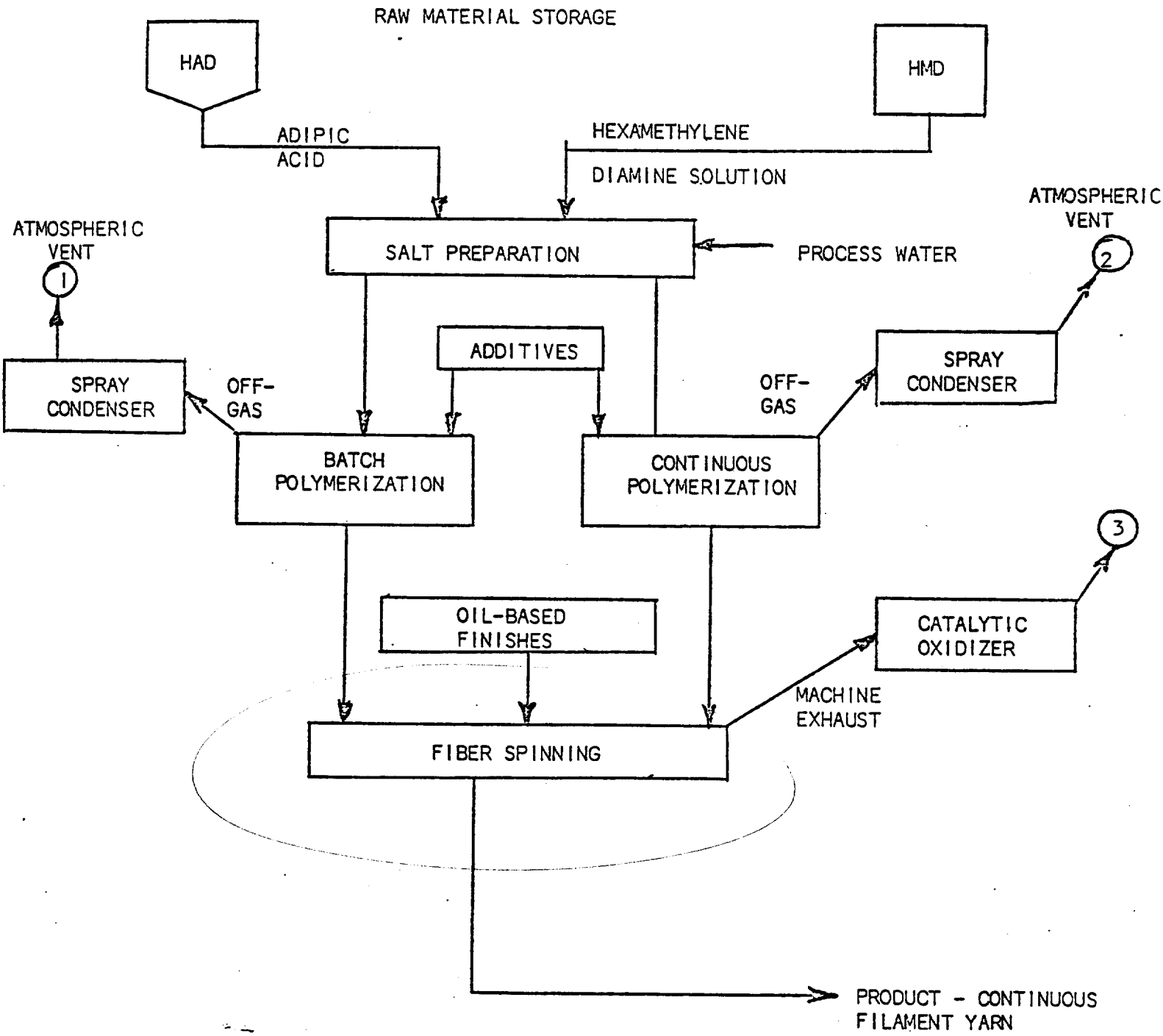
A process diagram showing hydrocarbon atmospheric emission points is given in Attachment 1. Attachment 2 is an atmospheric vent inventory giving emission details.

ATTACHMENT 1

PLANT CITY

DE NEMOURS & CO., INC.
MAY
CAMDEN STATE S.C. 29020

NYLON 66 FIBER MANUFACTURING PROCESS



◯- SEE ATTACHED ATMOSPHERIC VENT INVENTORY FOR DETAILS.

ATTACHMENT 2

CORPORATION E.I. DU PONT DE NEMOURS & CO., INC.

PLANT SEAFORD

CITY CAMDEN STATE S. C.

NYLON 66 FIBER MANUFACTURING PROCESS
ATMOSPHERIC VENT INVENTORY
(POUNDS OF EMISSIONS PER 1000 POUNDS OF PRODUCT)

(1) BATCH POLYMERIZATION OFF-GAS

- Emission Control Device - Spray condensers using cooled condensate as a condensing medium.
- Emissions to Condensers
  - Composition

    Hydrocarbons - Hexamethylene diamine - 1.3-1.6/1,000 lb. product.

    - Unmeasured traces hexamethylene imine and cyclopentanone.

    Other - Ammonia, carbon dioxide, and water.

  - Method of Measurement - Material balance based on salt and polymer analyses, plus condensate analyses.
- Emissions From Condensers
  - None - A total condensation process.

(2) CONTINUOUS POLYMERIZATION OFF-GAS

- Emission Control Device - Spray condensers using cooled condensate as a condensing medium.
- Emission to Condensers
  - Composition

    Hydrocarbons - Hexamethylene diamine - 0.6-1.9/1,000 lb. product.

    - Unmeasured traces of hexamethylene imine and cyclopentanone.

    Other - Ammonia, carbon dioxide and water.

  - Method of Measurement - Material balance based on salt and polymer analyses, plus condensate analyses.
- Emissions From Condensers
  - None - A total condensation process.

(3) SPINNING MACHINE EXHAUST

- Emission Control Device - Catalytic oxidizers using platinum catalyst and operating at a 190°C. feed gas temperature. Efficiency of hydrocarbon removal averages about 80%.

- Emissions to Catalytic Oxidizers

  - Composition

    Hydrocarbons - Mineral/vegetable oils - 0.5-2.0/1000 lb. product.

    Other - Water.

  - Method of Measurement - Calculated from absorption train sampling and gravimetric analysis of emissions from the oxidizers, using 80% removal efficiency.

- Emissions From Catalytic Oxidizers

  - Composition

    Hydrocarbons - Mineral/vegetable oils - 0.1-0.4/1000 lb. product.

    Other - Carbon dioxide, water.

  - Method of Measurement - Absorption train sampling and gravimetric analysis of emissions from the oxidizers.

80% efficient

CORPORATION E. I. DU PONT DE NEMOURS & CO.

PLANT CHATTANOOGA

CITY CHATTANOOGA STATE TENN.

NYLON 66 FIBER MANUFACTURING PROCESS DESCRIPTION

Nylon 66 fiber is manufactured from polymer formed by reacting two petro-chemical derived raw materials, adipic acid [(CH_2) 4 - $(COOH)_2$] and hexamethylene diamine [(CH_2) 6 - $(NH_2)2$]. The adipic acid is supplied to the process as a powdered crystalline solid and the diamine as a water solution. There are no vapor losses from diamine solution storage since the storage tank is inert gas blanketed with vapor displacement back to the shipping tank car during raw material unloading.

Adipic acid, diamine, and water are combined to form a salt solution which is fed to both batch and continuous polymerization processes. Both types of polymerization are carried out under elevated pressure and temperature with vented off-gases consisting of evaporated water of solution, water of polymerization, volatized hexamethylene diamine, and traces of volatile, but water-soluble, ingredient impurities. The vented off-gases go to spray condensers where total condensation occurs or to reflux columns from which the tails are returned to the process for reuse and the off-gases (steam) is used for heating other process vessels. All condensate from these systems goes to a biological waste treatment system.

Molten polymer from the batch polymerization process is extruded, cooled, flaked, stored/blended, and then fed as needed to remelters which supply fiber spinning machines. In the continuous polymerization process the molten polymer is used directly as a fiber spinning feed.

Oil based finishes are applied to the fiber in the spinning step to provide the lubrication and static suppression needed for subsequent fiber processing operations. Air exhausts from the spinning machines contain volatized and atomized water and mineral/vegetable oils from the finishes lost in processing. These machine exhausts go to demisters or catalytic oxidation units which remove about 90% of the hydrocarbons before discharging the residual gases to the atmosphere.

The fiber which is sold as continuous filament yarn requires no further processing after it is spun.

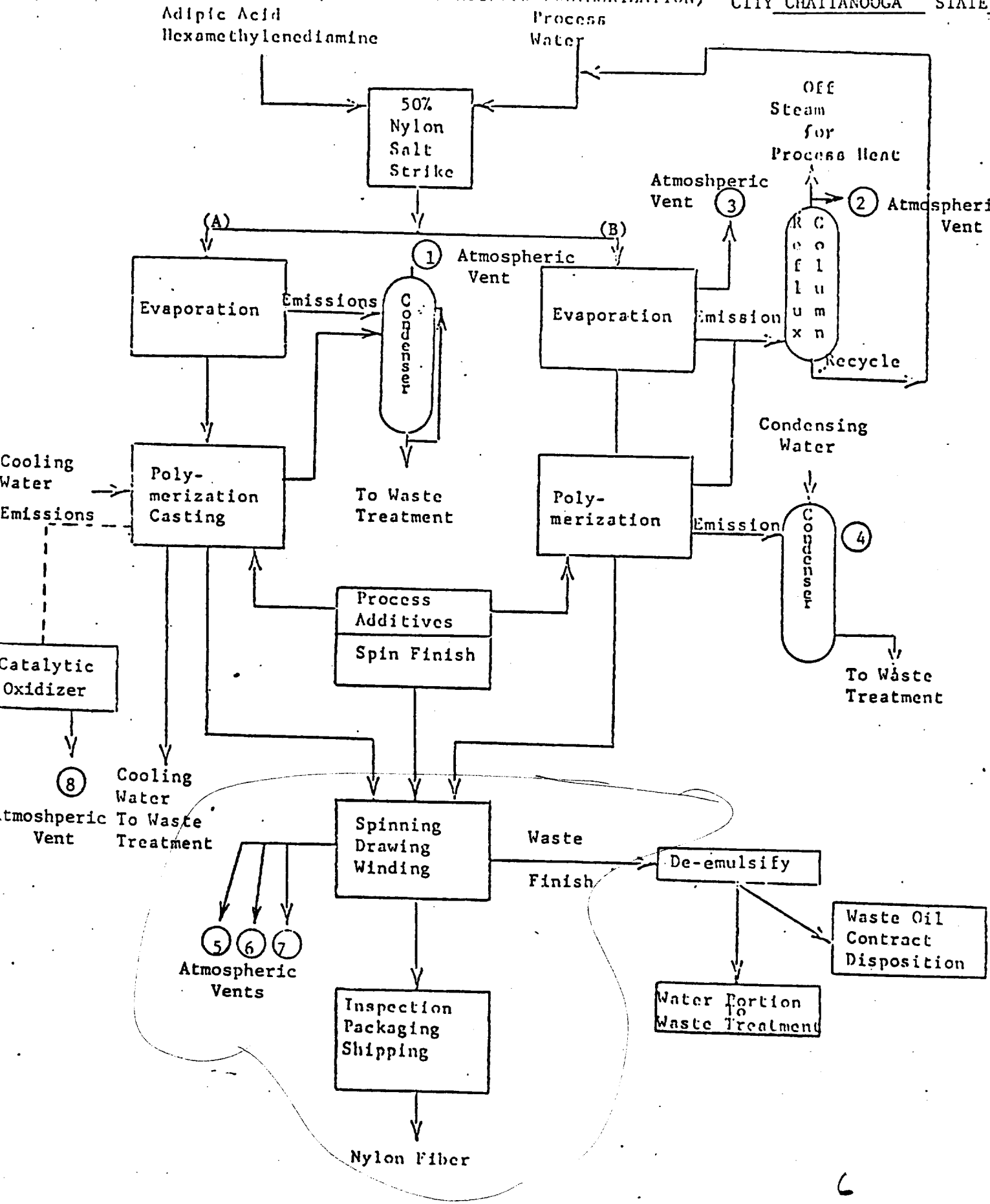
CORPORATION E. I. DU PONT DE NEMOURS & CO.

PLANT CHATTANOOGA

CITY CHATTANOOGA STATE TEN

NYLON PROCESS

(BATCH AND CONTINOUS POLYMERIZATION)



(A) Evaporation & Polymerization are batch operations.

(B) Evaporation & Polymerization

NYLON 66 FIBER MANUFACTURING PROCESS
ATMOSPHERIC VENT INVENTORY

① BATCH EVAPORATION AND POLYMERIZATION OFF-GAS

- Emission Control Device - Spray condensers using cooled condensate as a condensing medium.
- Emissions to Condensers
  - Composition

    Hydrocarbon - Hexamethylene diamine - 2.9 - 3.1 lb./1,000 lb. product.

    - Unmeasured traces hexamethylene imine and cyclopentanone.

    Other - Ammonia, carbon dioxide, and water.

  - Method of Measurement - Analysis of condensed emissions together with flow measurement by pitot tube.
- Emissions From Condensers
  - None - A total condensation process.

② CONTINUOUS EVAPORATION AND POLYMERIZATION OFF-GAS

- Emission Control Device - Reflux column to concentrate off-gas hydrocarbons.
- Emissions to Reflux Column
  - Composition

    Hydrocarbons - Hexamethylene diamine - 2.3 - 3.0 lb./1,000 lb. product.

    - Unmeasured traces hexamethylene imine and cyclopentanone.

    Other - Ammonia, carbon dioxide, and water.

  - Method of Measurement - Analysis of condensed emissions.
- Emissions from Reflux Column
  - Composition

    Hydrocarbons - Hexamethylene diamine 0.2 - 0.3 lb./1,000 lb. product.

    - Unmeasured traces of hexamethylene imine and cyclopentanone.

- Emissions from Reflux Column (Cont'd)

  Other - Ammonia, carbon dioxide and water.

  - Method of Measurement - Condensation of emissions and analysis.

③ CONTINUOUS EVAPORATION OFF-GAS

- Emission Control Device - None.
- Emissions to Atmosphere
  - Composition

    Hydrocarbons - Hexamethylene diamine - 0.1 - 0.2 lb./1,000 lb. product.

    - Unmeasured traces hexamethylene imine and cyclopentanone.

    Other - Ammonia, carbon dioxide, and water.

  - Method of Measurement - Analysis of condensed emissions.

④ CONTINUOUS POLYMERIZATION OFF-GAS

- Emission Control Device - Spray condenser.
- Emissions to Condensers
  - Composition

    Hydrocarbons - Hexamethylene diamine - 0.9 - 1.2 lb./1,000 lb. product.

    - Unmeasured traces of hexamethylene imine and cyclopentanone.

    Other - Ammonia, carbon dioxide and water.

  - Method of Measurement - Analysis of condensed emission.

- Emissions From Condensers
  - None - A total condensation process.

⑤ SPINNING MACHINE EXHAUST

- Emission Control Device - Catalytic oxidizers using platinum catalyst. Efficiency of hydrocarbon removal averages about 90%.

- Emissions to Catalytic Oxidizers

  - Composition

    Hydrocarbons - Mineral/vegetable oils - 2.0 - 3.0 lb./1,000 lb. product.

    Other - Water.

  - Method of Measurement - Estimated based on oil mass balance calculations.

- Emissions From Catalytic Oxidizers

  - Composition

    Hydrocarbons - Mineral/vegetable oils - 0.2 - 0.3 lb./1,000 lb. product.

    Other - Carbon dioxide, water.

  - Method of Measurement - Based on 90% catalytic oxidizer efficiencies measured on other equipment.

⑥ SPINNING MACHINE EXHAUST

- Emission Control Device - Demister

- Emissions to Demister

  - Composition

    Hydrocarbons - Mineral/vegetable oils - 1.3 - 1.8 lb./1,000 lb. product.

    Other - Carbon dioxide, water.

  - Method of Measurement - Calculated from pitot tube flows, absorption train sampling, and analysis of emissions from the exhaust duct.

- Emissions From Demister

  - Composition

    Hydrocarbons - Mineral/vegetable oils - 0.1 - 0.2 lb./1,000 lb. product.

    Other - Water.

- Emissions From Demister (Cont'd)

  - Method of Measurement - Calculated from pitot tube flows, absorption train sampling, and analysis of emissions from the exhaust ducts.

⑦ ROOM AIR EXHAUST

- Emission Control Device - None
- Emissions to Atmosphere

  - Composition

    Hydrocarbon - Mineral/vegetable oils - 0.05-0.10 lb./1,000 lb. product.

    Other - Carbon dioxide, water.

  - Method of Measurement - Pitot flows, absorption train sampling, and analysis of emissions from the exhaust ducts.

⑧ BATCH POLYMERIZATION OFF-GAS*

- Emission Control Device - Catalytic oxidizer using platinum catalyst and operating at 650°F feed gas temperature.
- Emissions to Catalytic Oxidizer

  - Composition

    Hydrocarbons - Hexamethylene diamine - 2.5-3.0 lb./1,000 lb. product.

    - Unmeasured traces hexamethylene imine and cyclopentanone.

    Other - Ammonia, carbon dioxide, and water.

  - Method of Measurement - Pitot flows; condensation and analysis of emissions.

- Emissions From Catalytic Oxidizers

  - Composition

    Hydrocarbons - Hexamethylene diamine - 0.08-0.09 lb./1,000 lb. product.

    Other - Ammonia, carbon dioxide and water.

  - Method of Measurement - Calculated from pitot tube flows, absorption train sampling, and analysis of emissions from the oxidizer.

*Used as a partial alternative to ① when Wastewater Treatment System becomes overloaded.

CORPORATION E. I. DU PONT DE NEMOURS & CO.

PLANT SPRUANCE

CITY RICHMOND STATE VA.

NYLON 66 FIBER MANUFACTURING PROCESS DESCRIPTION

Nylon 66 fiber is manufactured from polymer formed by reacting two petro-chemical derived raw materials, adipic acid $[(CH_2)_4 - (COOH)_2]$ and hexamethylene diamine $[(CH_2)_6 - (NH_2)_2]$. The adipic acid is supplied to the process as a powdered crystalline solid and the diamine as a water solution. There are no vapor losses from diamine solution storage since the storage tank is inert gas blanketed with vapor displacement back to the shipping tank car during raw material unloading.

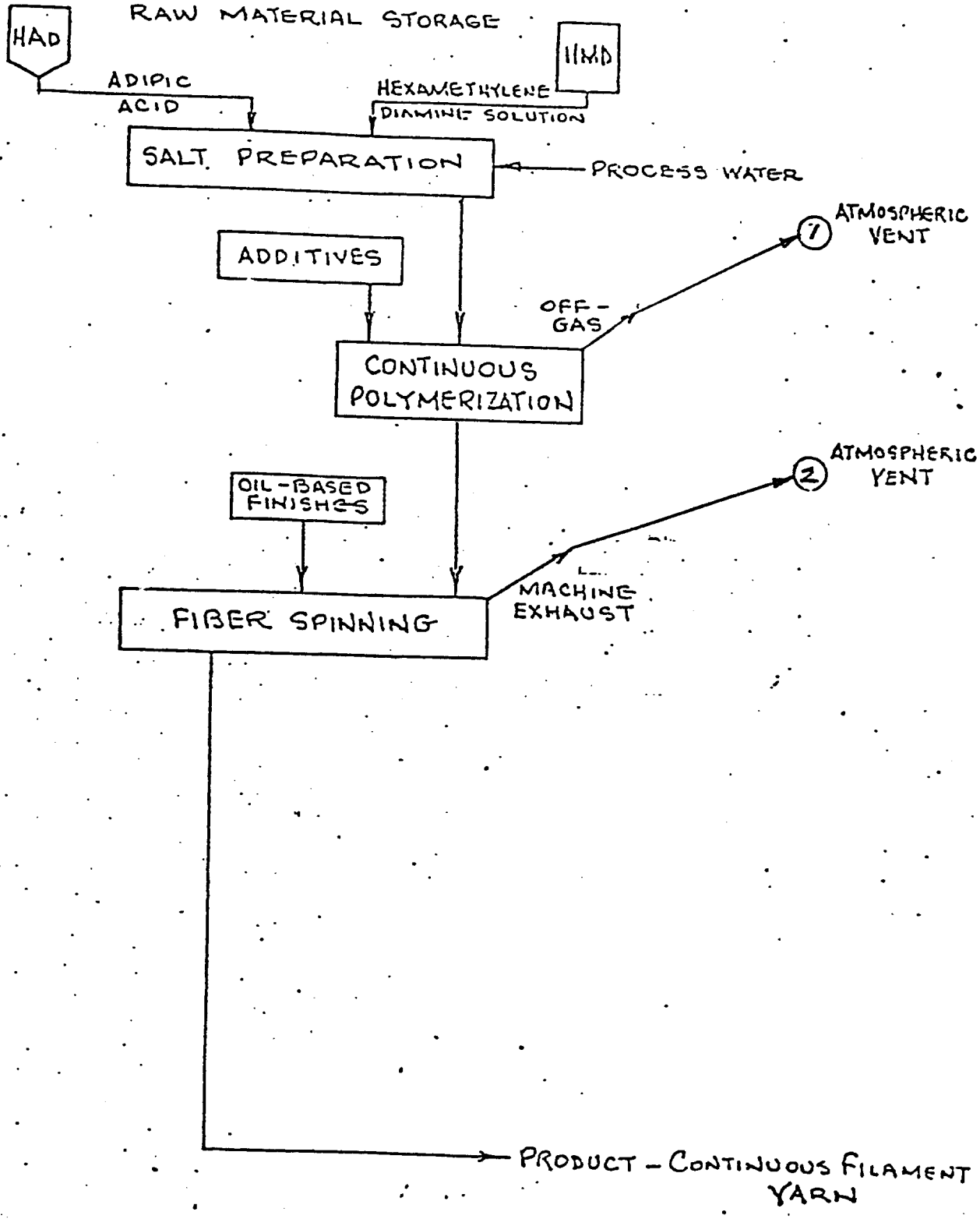
Adipic acid, diamine, and water are combined to form a salt solution which is fed to the continuous polymerization process. Polymerization is carried out under elevated pressure and temperature with vented off-gases consisting of evaporated water of solution, water of polymerization, volatized hemamethylene diamine, and traces of volatile, but water-soluble, ingredient impurities. The vented off-gases go to the atmosphere.

Oil based finishes are applied to the fiber in the spinning step to provide the lubrication and static suppression needed for subsequent riber processing operations. Air exhausts from the spinning machines contain volatized and atomized water and mineral/vegetable oils from the finishes lost in processing. These machine exhausts go to the atmosphere.

for Nylon 66 text

Plant SPRUANCE
City RICHMOND State VA.

NYLON 66 FIBER MANUFACTURING PROCESS



○ - SEE ATTACHED ATMOSPHERIC VENT INVENTORY FOR DETAILS.

ATTACHMENT 2

CORPORATION E. I. DU PONT DE NEMOURS & CO.

PLANT SPRUANCE

CITY RICHMOND STATE VA.

NYLON 66 FIBER MANUFACTURING PROCESS
ATMOSPHERIC VENT INVENTORY

1. CONTINUOUS POLYMERIZATION OFF-GAS

- Emission Control Device - The evaporator diamine scrubber columns recover approximately 85% of the evaporator emissions.

- Emission to Atmosphere

  - Composition

    Hydrocarbons - Includes hexamethylene diamine, hexamethylene imine, cyclopentanone, and solids (salt and/or polymer) - 2.3 lbs./1000 lbs. product.

    Other - Ammonia and water.

  - Method of Measurement - Condense off-gas steam and analyze for total organic carbon and NH_3.

2. SPINNING MACHINE EXHAUST

- Emission Control Device - Catalytic oxidizers using platinum catalyst and operating at a 210°C hot chest temperature. Efficiency of hydrocarbon removal averages about 80%.

- Emissions to Atmosphere

  - Composition

    Hydrocarbons - Mineral/vegetable oils, monomer 0.5 lbs./1000 lbs. product.

    Other - Water.

  - Method of Measurement - Calculated from pitot tube flows and absorption train sampling.

NOTE: Emission rates all expressed as pounds of emissions relative to 1000 pounds of total plant production.