OPERATING MANUAL

OLD UNIT PVC REACTORS

ABERDEEN, MISSISSIPPI

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OPERATING MANUAL

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I. INTRODUCTION

A. Operator Responsibilities

The purpose of this plant is to safely and economically convert vinyl chloride·monomer (VCM) into a useable form of poly vinyl chloride (PVC). This is accomplished by a batch process in which VCM, water, initiator and colloid solution are charged into the reactor and under carefully controlled conditions, PVC with the desired physical properties is produced. This chemical reaction, which changes VCM to PVC, is called polymerization.

The operator helps fulfill the plant's purpose by making sure that quality production is obtained from his equipment without endangering his fellow workers or his equipment. The operator is able to attain his goals in safety, job performance and efficient operation through a training period and on the job experience.

The operator fulfills his responsibilities by:

1. Understanding how his equipment functions.
2. Understanding what role each piece of equipment plays in the process.
3. Keeping a close and regular check on equipment.
4. Knowing how to spot malfunctions and correct them.
5. Keeping his area of responsibility safe and clean.
6. Keeping complete and accurate records.

I. INTRODUCTION (CONTINUED)

A. Operator Responsibilities (Continued)

The operating Manual will cover the normal responsibilities and duties of the Lead Operator and the Reactor "A" Operator. Each phase in the production method will be covered. In addition to normal operating methods, it will also discuss operations under abnormal and emergency conditions. The operator must be prepared to meet these situations with temporary measures until the abnormal condition is corrected or the emergency crisis ceases to exist.

Safety takes second place to no plant activity. The safety of the plant personnel and equipment is to be carefully considered before any job is started. The Conoco safety slogan, "our work is never so urgent or important that we cannot take time to do it safely", is an idea that can help make the work area safer for everyone when it is put into practice.

Good housekeeping is also an important responsibility of the operators. It requires careful attention for safety reasons and to maintain good working conditions. Cleaning up after job completion is the responsibility of the person doing the job. A job should not be considered complete until all materials are picked up and properly stored.

I. INTRODUCTION (CONTINUED)

B. Process Information

Several types of resins are produced. Resin type is determined by a set of physical properties such as particle size and viscosity. Each type of resin produced requires that a certain set of operating conditions be closely followed so that the desired resin properties are obtained. Minor changes in formulas or operating conditions can cause major differences in the physical properties of the resin. Some factors in determining resin properties are reaction temperature, which helps determine viscosity, colloid, which influences particle size, and the amount of recovered VCM charged, which also effects particle size.

The phases of reactor operation and a brief description of each follows:

1. Evacuation

This step removes all air possible by steam ejectors. Too much air left in a reactor will alter particle size. Evacuation should require about five minutes.

2. Charge

Water, Colloid and VCM are charged to the reactor simultaneously through a timed sequence system. The temperature of the reactor contents at the end of charging is determined by the charge water temperature. The reactor will be below run temperature at the end of the charge and jacket steam will be used to raise

I. INTRODUCTION (Cont.)

B. Process Information (Cont.)

2. Charge (Cont.)

the temperature to the desired level. Charge should take about nine minutes for D-300, D-400, D-500, and D-600. D-700 will require about fifteen minutes.

3. Initiator

The initiator is manually loaded into the initiator injection pot and charged into the reactor after reactor charge is complete.

4. Polymerization

This is the time from the initiator addition until most of the VCM has been converted to resin. The reaction generates heat continuously as liquid VCM becomes PVC resin. Heat that is generated is removed by cooling water on the reactor jacket and condenser. Reaction times varies, but generally requires five to six hours for D-300, D-400, D-500, and D-600. D-700 will require 4 1/2 to 5 hours.

5. Recovery and Steam Stripping

Recovery and steam stripping removes most of the un-reacted VCM from the eractor via a compressor-vacuum pump system. Steam is added to the bottom of the reactor and rises through the PVC and water slurry to help remove unreacted VCM. Recovery and steam stripping takes about 60 minutes for D-300, D-400, D-500, and D-600 and 90 minutes for D-700.

6. Dumping

The PVC resin, after reaction is complete, is in a slurry form. The slurry is dumped to a strainer and dump tank and is pumped to blend tanks in the Dryer Room for drying. Dump requires about 25 minutes for D-300, D-400, D-500, and D-600 and 35 minutes for D-700.

II. GENERAL PROCESS DESCRIPTION

A. Evacuation

Before charging, the inerts present in the polymerization reactor are removed by evacuation. The interlock selector switch is placed on "evacuation" position. *The main condenser valve is opened; the reactor evacuation valve is opened, and the evacuation header valve and the steam supply valves to the ejector system to be used are opened. The emergency cooling water supply valve to the reactor is then opened. When the reactor pressure reaches 28.5 inches of mercury vacuum, *as indicated by the pressure indicator in the control room and at the reactor, evacuation is complete. This portion of the cycle requires about 10 minutes.

B. Charge

1. Precharge Preparations

After evacuation, the reactor is ready to be charged. In preparation for charge, adequate quantities of VCM, hot water, colloid solution, and initiator are made ready for the charge sequence.

Prior to charge, fresh VCM is transferred from the VCM storage sphere to the fresh VCM storage tank. This transfer of VCM begins automatically when the VCM liquid level falls below a certain level. When the high liquid level is regained, the transfer process shuts down automatically. Two 200 gpm VCM transfer pumps are used to transfer the VCM from the VCM storage sphere.

II. GENERAL PROCESS DESCRIPTION (Cont.)

B. Charge (Cont.)

1. Precharge Preparation (Cont.)

Process water is automatically supplied to the hot water tank when the water level drops below a certain point. The water is filtered by the process water filter, and is heated in the hot water preheater, enroute to the hot water tank. The colloid solution, previously made-up, is pumped from the make-up tank to the charge tank before every charge. When the make-up tank becomes empty, a new batch of colloid will be made up. After a new batch is made up, a sample is taken to the laboratory for analysis.

Immediately before the reactor is to be charged, the initiator injection system is made ready for charge in the following manner. First the initiator injection pot will be full after the initiator and/or OMS have been added. The initiator and/or OMS are then added to the pot. The pot is then blocked in and pressurized with high pressure service water to at least 180 psig. The initiator injection system is now ready for the reactor charge.

2. Reactor Charge

After evacuation is completed, the interlock selector switch is moved to the "charge" position. If the following precharge conditions are met, the charge sequence is ready to begin:

a. Levels in the fresh VCM storage tank, the hot water tank, and the colliod charge tank are adequate for a complete reactor charge.

II. GENERAL PROCESS DESCRIPTION (Cont.)

B. Charge (Cont.)

2. Reactor Charge (Cont.)

b. The charge meters are reset to the charge quantities.
Steam is usually applied to the reactor jacket at the start of charge by manually opening the steam valve from the Control Room. This aids in heating the reaction mass to the desired temperature during and immediately following charge. The automatic charge sequence begins with the hot water charge. The hot water is pumped from the hot water tank, to the reactor by the hot water charge pump. After a predetermined quantity of hot water has been charged, the colloid charge pumps and the second hot water charge pump start. The next step in the charge sequence begins with the fresh and recovered VCM charges. The fresh VCM is pumped to the reactor from the fresh VCM storage tank, by one of the two VCM charge pumps. The recovered VCM is pumped from one of two recovered VCM storage tanks by the recovered VCM charge pump into the suction of the VCM charge pump. The recovered VCM is filtered in the recovered VCM filter and the total VCM charge is filtered enroute to the reactor by the VCM charge filter.
Shortly after the beginning of the VCM charge, one of the hot water charge pumps shuts down until the VCM charge is completed and then restarts. This insures that there will be an adequate amount of water charge remaining to flush out the charge line. Both hot water charge pumps continue to run until charge is completed.

II. GENERAL PROCESS DESCRIPTION (CONTINUED)

B. Charge (Continued)

*When the VCM, water and colloid charge is complete, the initiator is charged by the Reactor "A" Operator through the initiator charge pot at each reactor.

C. Polymerization

After charge is completed, the reactor interlock selector switch is placed in the "polymerization" position, and the reactor temperature controller is placed on automatic. When the reaction mass reaches the desired temperature the steam is turned off. The reaction mass temperature is automatically controlled by varying the amount of cooling water that is passed through the top-mounted knockback condenser and the reactor jacket.

*The reaction mass is continually mixed and kept in suspension by the bottom-mounted single speed agitator. The agitator mechanical seals are lubricated and cooled by seal oil from a seal oil pressure unit.

During polymerization, mechanical seal purge water is injected into the reactor through the reactor cleaning nozzle and inboard of the agitator mechanical seal. The water is added to keep the reactor cleaning nozzle and agitator mechanical seals clean. The purge water flow for each service is indicated with a rotameter and manually adjusted.

II. GENERAL PROCESS DESCRIPTION (CONTINUED)

C. Polymerization (Continued)

The inerts present in the reactor during polymerization accumulate in the reactor condenser head space. These inerts are vented to the recovery system to prevent inert blanketing.

Approximately one and one-half hour after the beginning of each polymerization cycle, a sample of resin is taken if problems occur in the reaction process. The sample is checked for unusual resin conglomerates which indicate a potentially bad batch. If these resin conglomerates occur, several more samples are taken. Depending on the severity of the problem, the batch may be killed early or the resin may be isolated after recovery.

When the desired degree of polymerization is reached and the reactor pressure has dropped to the desired pressure, the reaction is stopped by manually adding a mixture of AMS, BHT and OMS (the short stop solution) to the reactor. High pressure service water is used to pressure the short stop solution from the AMS short stop charge pot into the reactor through the same piping as the initiator charge* This system is also used to "kill" runaway reactions.

An emergecny AMS kill pot, located at grade, is provided to pressure AMS into the reactor to kill the reaction in the event of a power failure or upon loss of agitation. The AMS will be injected into the reactor through nozzles in the reactor head, using pushbottons on the control panel or by manually operated valves in the field. The pots for D-300,

II. GENERAL PROCESS DESCRIPTION (Cont.)

C. Polymerization (Cont.)

D-400, D-500, and D-600 will contain 15-20 gallons of AMS. The pot for D-700 will contain 40 gallons of AMS. The material will be pressurized into the reactors using nitrogen, supplied by a nitrogen bottle located beside the pot.

A nitric oxide (NO) short stop addition system is provided to inject NO into the reactors in the event of power failure, major VCM releases, fires, or other emergencies. The system is activated locally. No is supplied from emergency NO short stop bottles and is injected into the reactor through the same piping as the agitator mechanical seal purge water.

D. Recovery and Steam Stripping

1. Recovery

When the reaction is completed, the interlock selector switch is moved to the "recovery and steam stripping" position. The following sequence then occurs. The recovery compressor seal water systems, the water recirculation systems for the recovery knockout drums, and two of the three recovery compresssors are manually started from the board. Cooling water to the recovered VCM condenser and the water recirculation cooler starts automatically with the compressors, and the hydroquinone injection system starts with the compressor seal water systems.

II. GENERAL PROCESS DESCRIPTION (Cont.)

D. Recovery and Steam Stripping (Cont.)

The vapor from the reactor flows through a pressure control valve to two resin knockout drums in series which remove carryover resin. The pressure control valve prevents excessive carryover of resin from the reactor by limiting the pressure to the recovery system to about 35 psig. Each of the knockout drums have an internal water spray system and a recirculation pump. Both knockout drums have an on-off level control system which, on high liquid level, diverts the discharge of the water recirculation pumps to the blowdown tank. A water recirculation cooler, (the function of which is explained in the steam stripping portion of the recovery system process description), is provided and can be used in the water recirculation loop of either scrubbing stage.

The VCM vapors from the knockout drums are compressed by the recovery compressors.

The recovery compressors are constant volume liquid ring compressors with a water seal. The discharge streams from the compressors flow to two parallel seal water recirculation systems which operate as follows. Seal water is separated from the VCM vapors in the seal water separators, filtered by the seal water filters, cooled by the seal water coolers, and pumped back to the compressors by the seal water pumps. The flow of seal water to each compressor is controlled at 50 gpm. The seal water temperature is controlled just above the VCM condensation temperature (95-105^{o}F). Automatic draining of the seal water

II. GENERAL PROCESS DESCRIPTION (Cont.)

D. Recovery and Steam Stripping (Cont.)

1. Recovery (Cont.)

separators to the blowdown tank is provided to maintain the correct water level.

The VCM vapors from the seal water system are condensed in two recovered VCM condensers. The condensed VCM is collected in the recovered VCM collect tank which is on automatic on-off level control. VCM is transferred to the recovered VCM storage tanks by the recovered VCM transfer pump when there is high liquid level in the VCM collect tank.

*When the reactor pressure drops to 10 psig, the two recovery vacuum pumps automatically start. The VCM flow from the recovery knockout drums and the seal water flow are both diverted to the vacuum pumps which discharge into the suction of the compressors.

2. Steam Stripping

In order to reduce residual VCM in the slurry, the slurry in the reactor is heated and stripped with steam. At the start of a normal recovery, steam addition to the reactor is manually started from the control room and the slurry mass is heated. When the temperature of the reactor has risen to the desired temperature, the steam stripping operation is completed.

As recovery proceeds, less and less VCM is recovered from the reactor. To supply sufficient VCM vapor to the recovery vacuum pumps and compressors, a VCM backpressure system is used. This is done to prevent

II. GENERAL PROCESS DESCRIPTION (Cont.)

D. Recovery and Steam Stripping (Cont.)

2. Steam Stripping (Cont.)

cavitation and overheating of the vacuum pumps and compressors. Before entering the recovery knockout drums, the steam and VCM from the reactor are combined with a bleed stream of VCM from the recovered VCM storage tanks. The amount of VCM bled into the recovery system is adjusted by the backpressure control valve such that a set supply pressure to the vacuum pumps is maintained.

The majority of the steam is condensed in the first knockout drum described in the normal recovery process description. The first stage of the scrubbing system consists of a recovery knockout drum with an internal water spray system, a water recirculation pump and the water recirculation cooler. The water cooler reduces the water temperature sufficiently to allow the internal spray system in the knockout drum to cool the VCM and condense much of the steam in the vapor stream. After leaving the first stage of the water scrubbing system, the VCM vapor flows to the second stage of the scrubbing system and then to the rest of the recovery system in the same manner as during normal recovery.

3. Hydroquinone Injection

The VCM removed from the reactor during recovery still contains a small amount of initiator. As a result, the VCM will continue to polymerize, resulting in plugged lines, charge lines, and recovered VCM storage tanks. Polyermization is significantly reduced by

II. GENERAL PROCESS DESCRIPTION (CONTINUED)

D. Recovery and Steam Stripping (Continued)

3. Hydroquinone Injection (Continued)

the addition of an inhibitor such as hydroquinone to the VCM stream as it is being recovered.

A 4.6 percent solution of hydroquinone in water is prepared in the hydroquinone storage tank.

The hydroquinone solution is pumped by the hydroquinone injection pump into the suction of the recovery seal water pumps. The injection pump starts and stops automatically with the seal water pumps. The metering pump has a variable stroke which can be adjusted manually to maintain the preset hydroquinone injection rate.

4. Recovery of Batch Water Stripping Tank

The batch water stripping tanks is to collect the various steam and water streams containing VCM from the four-reactor module. The emission recovery system is used to recover VCM vapor. When the temperature of the tank rises to the desired temperature, recovery of the tank is stopped.

E. Reactor Dump and Rinse

After the reactor is recovered and steam stripped, the reactor interlock selector switch is moved to the "dump" position. The appropriate dump valves are opened from the control room and the

II. GENERAL PROCESS DESCRIPTION (CONTINUED)

E. Reactor Dump and Rinse (Continued)

slurry flows by gravity to the dump system. The slurry passes through an enclosed vibrating slurry strainer where the PVC culls are collected until dump is completed. The slurry then flows to the slurry dump tank. The slurry transfer pumps transfer the slurry to the blend tanks. The dump tank level is automatically controlled. Near the end of dump, the reactor condenser is flushed with water by turning on the condenser rinse system from the board. Hot water is pumped from the hot water tank by the hot water charge pumps through the cleaning nozzle in the reactor condenser. The rinse water mixes with any remaining slurry and is pumped with the slurry to the blend tanks flushing out the slurry transfer lines.

F. Chem Wash and Rinse

If it has been determined that the reactor needs cleaning, the reactor interlock selector switch is moved to the "clean and rinse" position after the dump and rinse is completed.

The chem wash solution is a caustic solution. The cleaning solution pump pumps the solution at 500 GPM from the cleaning solution tank through the cleaning solution heater to the reactor condenser spray nozzle. Steam to cleaning solution heater is automatically adjusted to provide an exit solution temperature of 190°F. When the chem wash solution tank is empty, recirculation is started with the chem wash solution being pumped from the reactor and back to the reactor through the reactor cleaning nozzle.

II. GENERAL PROCESS DESCRIPTION (CONTINUED)

F. Chem Wash and Rinse (Continued)

When chem wash has ended, the solution is pumped back to the cleaning solution tank by the cleaning solution pump. The process for D-300, D-400, D-500, and D-600 requires ten minutes to fill the reactor through the condenser, five minutes to wash the reactor, and ten minutes to empty the reactor, for a total of twenty-five minutes. D-700 requires a total time of forty-one minutes -- twenty-one minutes to wash through the condenser, ten minutes to wash the reactor, and ten minutes to empty the reactor.

After the chem wash is completed, the reactor is rinsed with hot water from the hot water tank. The hot water is pumped by the hot water charge pumps to the reactor. The water first enters through the condenser cleaning nozzle and then the reactor cleaning nozzle. The chem wash and rinse system in manually controlled from the control room.

G. Water Swirl

If the resin formula calls for a water swirl, the reactor interlock selector switch is placed in the "swirl" position after the chem wash rinse is completed. Cold or hot water enters the suction of the hot water charge pumps, and is pumped through the reactor charge line into the reactor. When the water charge reaches a preset amount, the water charge system is automatically shut down.

II. GENERAL PROCESS DESCRIPTION (CONTINUED)

G. Water Swirl (Continued)

The reactor agitator is then used to swirl the water for approximately 25 minutes. The lead operator then drains the water to the sewer. This completes one reaction cycle; the reactor is now ready for evacuation.

H. Batch Water Stripping System

Various waste water streams from the process must be collected and treated before discharge to the plant sewer system. The batch water stripping system serves as a central collection point for all the contaminated streams, which include water drains from the V-11 receivers, water from the emission recovery system, water from the new module, and water from miscellaneous flushes and seal waters. A separate operating guide is included in Section IV of this manual.

The various streams are routed to one of two parallel stripping tanks. Each new tank is used as both a storage tank and a stripper. While one tank serves as a collection vessel, the other one is being stripped with steam. The water collected in each tank is stripped to 170°F and recovered to a vacuum using the emission recovery system. Once the stripping operation is finished, the operator opens the outlet valve on the tank and drains the tank to the sewer. When the liquid level falls below 12% in the tank, the outlet valve is automatically closed, completing the cycle.

III. OPERATING PROCEDURES

A. Reactor Evacuation

Evacuation of the reactor is required prior to charging in order to remove as much of the air as possible. Air is introduced into the reactor during previous phases of the reactor batch cycle since dump, rinse, and chem wash require that the reactor be vented to the atmosphere. Air in the reactor during reaction causes poor temperature control during the polymerization and may alter the particle size of the resin.

Evacuation is accomplished using one of the two available two-stage steam jet ejector systems. Evacuation is controlled by the lead operator from the board. The "A" operator must confirm that all process equipment is operating correctly during evacuation.

Procedure

1. If the reactor has been opened, follow procedure given in the "Reactor Cleaning and Entry" section on how to close the reactor manhead.
2. The lead operator puts the interlock mode selector on "evacuation."
3. The lead operator checks to see that all valves are closed.
4. The lead operator opens the condenser recovery valve and the evacuation reactor valve. Then the lead operator opens the steam supply valves and the evacuation valve to the steam ejector systems as follows:

III. OPERATING PROCEDURES (CONTINUED)

A. Reactor Evacuation (Continued)

a. For D-300, D-400, D-500 and D-600, he will open valves CV-151 and CV-152. This starts the ejector system located in the V-11 building.

b. For D-700, he will open valves CV-133 and CV-131. This starts the ejector system located on the D-700 reactor structure.

He then opens the emergency cooling water valve, which supplies cooling water to the reactor condenser.

Note: In the following steps, 5-10, the operators prepare the initiator for charge while evacuation is in progress.

5. The "A" operator will go to the initiator freezer and bring the specified amount of initiator to the initiator charge pot. Extreme caution must be exercised by the "A" operator to be sure that no VCM is allowed to get back into the initiator injection pot. When a small amount of VCM is mixed with a large amount of initiator, an extremely fast reaction takes place giving off heat and pressure. To guard against this situation, the operator must know that he has an adequate water supply and pressure. The reactor initiator injection valve must never be opened unless the bomb is fully pressurized with the inlet water valve open.

   Note: The following precautions must be taken when handling initiator.

III. OPERATING PROCEDURES (CONTINUED)

A. Reactor Evacuation (Continued)

a. Plastic gloves must be worn while handling initiator.

b. If any initiator is spilled on skin or clothing, immediately flush with water.

c. Should any initiator remain in the containers, return it to storage.

d. Take all empty containers to trash and split side of all containers.

6. The "A" operator must check the initiator charge pot to be sure that it is empty. Close the drain valve. Open the initiator addition valve.

7. The "A" operator will now add the initiator to the injection pot.

8. The lead operator will stop evacuation when a vacuum 28.5 inches Hg is attained. The reactor pressure is double checked by the "A" operator at the reactor with a mercury manometer. The lead operator stops evacuation by closing the condenser recovery valve, evacuation header valve, and the steam supply valve to the ejector. This will shut off the evacuation steam jets. He then closes the emergency cooling water valves.

9. Evacuation is now complete.

B. Reactor Precharge

The reactor precharge procedure includes a series of precharge checks and precautions that must be carried out by the lead and "A" operators. If the necessary precharge conditions are not met, the Modicon (a small computer which controls the automatic charge sequence) will not

III. OPERATING PROCEDURES (CONTINUED)

B. Reactor Precharge (Continued)

allow the automatic charge sequence to begin.

It is the responsibility of the lead operator to see that all precharge checks and precautions are carried out. He should also read the log book at the start of the shift, covering the period since he was last on the job. This will alert him to any changes in formula, mechanical, or operational procedures that may have been passed on verbally.

1. Lead Operator Duties

a. Check level in fresh VCM receiver to see that it is adequate for charge.

b. Drain water in the recovered VCM receiver to the blowdown tank. Valves from the recovered receiver are manually opened from the board until pressure rise in the blowdown tank indicates all the water is out and VCM is being transferred. Valves are then manually shut from the board.

c. Fill out the reactor charge sheet.

d. Check the hot water tank level and temperature.

e. Check to see that all valves on the reactor are closed.

III. OPERATING PROCEDURES (CONTINUED)

B. Reactor Precharge (Continued)

1. Lead Operator Duties (Continued)

f. Have the "A" operator make a precharge check and reading on the following:

(1) Dura-Seal* oil level and pressure.

(2) Mechanical seal purge water pressure and rate to the reactor agitator seal.

(3) Colloid charge tank level and temperature.

g. Record the readings on the charge sheet as they are transmitted by the "A" operator.

2. "A" Operator Duties

a. Check Dura-Seal* level and pressure. There are five Dura-Seal* units. Each individual unit supplies seal oil pressure to individual reactors. If the units fail, an emergency supply of seal oil is provided by the emergency seal oil drum that is nitrogen pressurized. Valves must be opened manually at the unit if the emergency seal oil system is used.

Note: When the primary and spare Dura-Seal* oil units are down and the emergency system is in operation, reactors are not to be charged until at least one of the Dura-Seal* oil units is operating. The emergency system is designed to be a backup system that should be used short term only.

*Registered Trademark

III. OPERATING PROCEDURES (CONTINUED)

B. Reactor Precharge (Continued)

2. "A" Operator Duties (Continued)

When one of the Dura-Seal* oil units is not in operating condition, inform the lead operator so that repairs can be made.

The seal oil level should be checked in both units. The discharge pressure should be checked and be in the range of 205-250 psig. Report the seal oil pressure to the lead operator.

b. Check the mechanical seal purge water pressure and rate of flow to the agitator mechanical seal. Pressure should be 180-220 psig. Adjust the water flow rate to that given in the formula.

Report the seal water pressure and flow rate to the lead operator.

c. Check the colloid charge tank level to be certain enough is in the tank to complete a charge. Notify the lead operator of the present level.

d. Inform the lead operator when checks are completed and the reactor is ready for charge.

*Registered Trademark

III. OPERATING PROCEDURES (CONTINUED)

C. Reactor Charge

This section includes vacuum break and reactor charge. The reactor charge is one of the most critical operations in terms of product quality. Care must be taken to assure that all the raw materials are added in the proper order and in the proper amount.

Procedure

1. When evacuation and precharge checks are complete, the lead operator can move the interlock mode selector to "charge".
2. The lead operator should take the following steps and see that the following conditions are met before charge:
   a. VCM transfer should be in auto.
   b. Recovered VCM charge should be in auto.
   c. Fresh VCM charge should be in auto with either the primary or spare pump selected for charge.
   d. Hot water charge should be in auto.
   e. Colloid charge should be in auto with either the primary or spare pump selected for charge.
   f. Select recipe to be charged by dialing recipe number on the recipe selector on the board.
   g. Push meter reset button, which resets all charge meters.

III. OPERATING PROCEDURES (CONTINUED)

C. Reactor Charge (Continued)

2. h. The charge light will now come on if all the following conditions are met:

(1) The fresh VCM storage tank, hot water tank, and colloid charge tank all have a level adequate for one complete charge.

(2) One reactor is in charge mode.

(3) The reactor being charged has at least 25 inches Hg vacuum.

3. When a charge light is obtained on the panel, the lead operator will inform the "A" operator to stand by for breaking vacuum. The lead operator will break vacuum by:

a. Manually opening the reactor VCM charge valve from the board.

b. Manually opening the reactor charge valve from the board.

c. Turbine meters will start counting as VCM flows into the reactor.

d. As soon as a positive pressure is indicated in the reactor, close the VCM charge valve.

III. OPERATING PROCEDURES (Continued)

C. Reactor Charge (Continued

4. The "A" operator will then watch the pressure gauge at the top of the reactor. When the pressure rises above zero, start checking the following:

   a. Inspect manhead visually and by moving hands around Lenape* lid feeling for escaping vapor.

   b. Check safety disc gauges for pressure. Any pressure indicates a leaking or ruptured disc.

   c. Turn flush water (injection water) on sprayhead. The purpose is to keep heads free of resin. Set rate according to recipe.

   d. If all checks okay, notify lead operator. If not, notify lead to hold on charge until problem can be corrected.

5. The lead operator can now push the charge button. In rapid sequence, the following occurs:

   a. Reactor water charge valve opens.

   b. "A" hot water pump starts, valves open, and water starts into the reactor.

   c. The valves from the fresh VCM receiver to the VCM charge pump and discharge valve open.

*Registered Trademark

III. OPERATING PROCEDURES (CONTINUED)

C. Reactor Charge (Continued)

5. d. At set point No. 1 on water meters:

(1) "B" hot water pump starts and discharge valve opens.

(2) The colloid charge pump discharge valve will open and pump will start. The preset amount of colloid will be pumped into the reactor. When the colloid meter set point is reached, the colloid charge pump will cut off and the discharge valve and reactor colloid charge valve will close.

Note: The lead operator will turn on reactor jacket steam during colloid and water charge to assist reactor heatup.

e. At set point No. 2 on water meter, the reactor VCM charge valve opens and the VCM and recovered VCM charge pump start.

f. At set point No. 3 on the water meter, "B" hot water pump stops and discharge valve closes. This allows time for all VCM to be charged to the reactor before the water charge is completed.

III. OPERATING PROCEDURES (CONTINUED)

C. Reactor Charge (continued)

5. g. When VCM meters reach the set point (two meters running in tandem, first to reach the set point cuts pump off and closes valve), the VCM pump, and reactor VCM valve close. This action also starts "B" hot H_2O pump and opens discharge valve.

h. At set point No. 4 on the water meters, "A" and "B" hot water pumps stop and discharge valves close. Also, the reactor water charge valve and main dump valve close.

6. When the automatic charge sequence has been completed, it is safe to charge the initiator.

7. The reactor "A" operator charges the initiator by flushing the initiator charge pot into the reactor with high pressure service water.

8. The lead operator will now record the final reactor temperature. Adjust reactor temperature set point to setting called for in the formula and put temperature controller in "auto" position.

D. Polymerization

Polymerization is the phase of the reactor cycle in which liquid VCM is converted into solid PVC. This portion of the reactor cycle is mainly accomplished by accurate instrumentation. The primary area of responsibility for the

III. OPERATING PROCEDURES (CONTINUED)

D. Polymerization (Continued)

lead operator is coordination of the activities of the "A" operator. The "A" operator is required to sample the reactor and kill the reaction when polymerization has progressed to the point that product quality is satisfactory.

1. Lead Operator Duties

a. Change the interlock mode selector to "polymerization". Monitor the temperature and pressure closely until the reactor reaches the desired set point and lines out.

b. Cut off steam valve to jacket at two to four degrees below set point, depending on the rate of temperature rise.

c. After 1½ hours at run temperature, have "A" operator obtain slurry sample with reactor sample bomb if problems occur in the reaction process.

d. Examine the resin. At this stage of the reaction, the resin should be formed into individual, separate particles. Resin forms you would suspect as irregular are:

(1) Stringers-- Several particles of resin stringing together.

(2) Conglomerates-- Clusters of resin stuck together in little balls.

III. OPERATING PROCEDURES (CONTINUED)

D. Polymerization (Continued)

d. (Continued)

If either of the above conditions are observed, have the "A" operator take samples every fifteen minutes until a definite trend can be established. If this irregularity clears up, continue the run; but if the condition worsens, notify the shift supervisor who will make the decision as to what corrective action should be taken.

e. It may become necessary to remove the inerts. Inerts in the condenser will cause the rector pressure to rise as they blanket the condenser and do not allow VCM vapor to be condensed. Under these conditions, less heat can be removed even though the condenser water flow will be full open. Vent the inerts through the main condenser valve to the recovery system. Open the valve from the board. As soon as the "Valve Open" light comes on, push the "Valve Close" button. One time should be enough; but if the reactor pressure does not stay at the set point, it may be necessary to vent twice.

III. <u>OPERATING PROCEDURES (CONTINUED)</u>

D. <u>Polymerization (Continued)</u>

f. Irregularities during polymerization;

(1) <u>Slow Heatup</u>--May be caused by weak or no initiator. Slow heatup can also be caused by no steam on reactor jacket or the cooling water valves may be open. Contact the shift supervisor if this condition persists.

(2) <u>Excessively Long Run</u>--Caused by low initial initiator charge or a buildup of inhibitor or chem wash solution (caustic) in batch. If there is only slow reaction and the resin checks okay, the shift supervisor will give word on what to do.

If caustic is in the reactor, the batch will turn slightly yellow and coarsen. If this is found to be true, kill immediately with the amount of short stop solution specified in the formula.

(3) <u>Simultaneous Temperature and Pressure Rise</u>--Check cooling water temperature and valves. The reactor is producing more heat than the cooling water can remove. Also could be an overcharge of initiator. Notify shift supervisor for instructions.

III. OPERATING PROCEDURES (CONTINUED)

D. Polymerization (Continued)

1. Lead Operator Duties (Continued)

(4) Simultaneous Temperature and Pressure Drop-- The cooling water valves are probably wide open. This happens more often in freezing weather when relays freeze up. Throttle manual valves until malfunction is found and corrected.

(5) Agitator Kicks Out or Power Failure-- Most power failures are of short duration (seconds to two minutes), and the reactor pressure does not have time to build to a dangerous level. If outage is prolonged, the pressure will build. If this situation occurs, follow the procedure in Section III.C.3, which outlines action to be taken during emergency shutdown (such as during a power failure).

2. "A" Operator Duties

a. When charge is complete, recheck water injection rates through the cleaning nozzle and seal flush.

b. On instruction from the lead operator, resin samples will be taken from the reactor. This normally occurs 1 1/2 hours after initiator injection. If the first sample shows formation of undesirable resin particles, additional samples may be called for every fifteen minutes until a decision is made

III. OPERATING PROCEDURES (CONTINUED)

D. Polymerization (Continued)

2. "A" Operator Duties

about what should be done with the batch.

c. When the lead operator instructs the "A" operator to do so, the batch is killed by adding short stop solution to the reactor. High pressure service water is used to pressure the short stop solution from the initiator/AMS charge pot into the reactor through the same piping as the initiator is added to the reactor.

3. Emergency Shutdown

The following parameters are to be maximum limits on a runaway rection. The reaction should be killed with AMS is either one of the parameter is exceeded.

Resin	Maximum Temperature	Maximum Pressure
5385, 5425, 5465	142°F	145 PSIG
5305	155°F	155 PSIG

A runaway reaction immediately after charge and heat-up indicates that the reactor condenser may be plugged, and that the reaction must be killed.

If AMS will not kill the reaction, use the nitric oxide (N.O.) short stop system. CAUTION: N.O. is a highly poisonous orange-colored gas. A Scott Air Pack or a "Rocket Fuel" cannister mask must be worn while killing a reactor with N.O. short stop system.

III. OPERATING PROCEDURES (CONTINUED)

3. Polymerization (Continued)

3. Emergency Shutdown (Continued)

The runaway reaction must be killed immediately if either one of the pressure or temperature limits listed above are exceeded. If the reaction is allowed to exceed these limits, it may not be controllable and result in a relief valve or rupture disc discharge to the atmosphere.

The following steps are to be taken during emergency shutdown:

(a) (1) Use the emergency AMS kill system to kill each reactor. Each reactor has a pot located at grade, containing AMS. The AMS is injected into the head space of the reactor with nitrogen by opening the appropriate control valves from the control room. The handswitch for the control valves for each reactor is located next to the reactor agitator start-stop handswitch on each reactor's control station.

(2) Use the nitric oxide (NO) system short stop if the AMS does not kill the reaction. There are six cylingers of NO that can be released for D-300, D-400, D-500, and D-600. D-700 has 12 cylinders of NO that can be released. The NO system can be activated at the reactors by manually opening the correct valves.

III. OPERATING PROCEDURES (CONTINUED)

D. Polymerization (Continued)

3. Emergency Shutdown (Continued)

(b) Use nitrogen to pressurize the Dura-Seal* unit emergency seal water drums with their respective systems must be opened manually.

(c) There will be sufficient air in the air system surge tank to operate valves for approximately fifteem minutes. It will be necessary to use the nitrogen backup system to operate valves after fifteen minutes. The surge tank should be valved off before the backup nitrogen system is activated.

(d) Monitor each reactor for pressure rise. If the pressure continued to rise, the following steps are to be taken:

(1) Equalize the reactor with any other empty or killed reactor of the same type product.

(2) If the pressure still continues to rise, vent through the main condenser valve to the recovery system and the recovered VCM receiver.

(3) If this will not relieve the pressure buildup, then equalize the reactor with a reactor of different type resin.

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III. OPERATING PROCEDURES (CONTINUED)

D. Polymerization (Continued)

3. Emergency Shutdown (Continued)

(d) (4) If steps 1, 2, and 3 do not relieve the reactor pressure, the reactor relief valves will lift. Manually vent the reactor to the atmosphere only after the relief valve has lifted. Do this only to prevent the reactor double disc from rupturing.

Note: Step (4) is to be the last resort. Under the new EPA law, any venting must be reported and could result in a fine.

E. Recovery and Steam Stripping

The reactor is ready for recovery when certain conditions are reached in the reaction process. The conditions under which recovery will start are:

Pressure Drop--There is not enough unreacted VCM left in the reactor maintain run pressure. A pressure drop is accompanied by a drop in the cooling water flow to the reactor jacket and condenser.

Runaway--Reaction has increased to the point that it has outrun the capabilities of the cooling water to control. Temperature and pressure will both rise when this occurs. Follow instructions on each product formula as to the exact conditions at which the reaction is killed.

III. OPERATING PROCEDURES (CONTINUED)

E. Recovery and Steam Stripping

Temperature Rise--Pressure Drop--This is the ideal recovery situation and indicated proper initiator loading. The reaction will peak and slightly outrun the capabilities of the cooling water. This situation gives the best recovery conditions since there is less VCM to be recovered and more converted to resin.

Quick Kill--A reactor is sometimes killed on specific products to meet certain customer specifications--lower dry time (higher plasticizer absorbtion). The reactor is killed with a specified amount of the short stop solution at a specified set of conditions. The short stop solution mixture stops the reaction chain.

On a quick-kill batch, it is very important to guard against resin carryover to the recovery system. An injection of defoamer will help to control foaming. A fast recovery is also important and will affect the dry time.

1. "A" Operator Duties

When notified by the lead operator that the recovery conditions specified in the formula are met, the "A" operator will take the following steps:

a. Check the hydroquinone injection system to make sure that the proper valves are open and hydroquinone level is adequate.

III. OPERATING PROCEDURES (CONTINUED)

E. Recovery and Steam Stripping (Continued)

1. "A" Operator Duties (Continued)

b. Check the blowdown tank level and pressure. Level and pressure must be low to allow the automatic drain on the water circulation pump to operate.

c. Check the water levels in the seal water separators and knockout drums. These levels are controlled automatically but should be checked before startup. Knockout drum level should be at or below the mid-point of the inlet to the vessel. The seal water separator level should be at or below the mid-point of the inlet to the vessel.

d. Check the backflow pressure controller. It should be set at ten inches Hg vacuum.

e. Check to see that the flush to the knockout drum and seal water separator level are on.

f. Notify the lead operator that the recovery system is ready to start up.

g. Steam header pressure should be greater than 100 psig.

h. Reactor steam line should be checked and reactor steam valves should be checked to make sure that they are opening correctly.

i. Fill out once per shift the recovery system checklist.

III. OPERATING PROCEDURES (CONTINUED)

E. Recovery and Steam Stripping (Continued)

2. Lead Operator Duties (Continued)

f. (4) When the reactor is at 215°F, open the emergency cooling water to the condenser.

(5) Hold the reactor at this stage for 25 minutes.

(6) The reactor must be recovered to a vacuum. Extend the hold time if necessary.

(7) Record the inches of mercury vacuum reached on the batch sheet.

(8) If a vacuum pump kicks out and will not restart, shut off the corresponding compressor to prevent VCM from backing up into the other vacuum pump.

(9) Do not recover the blowdown tank at the same time as recovering a reactor.

g. Watch the temperature of the reactor condenser.

h. When stripping conditions specified in step "f" are met, steam stripping is complete.

i. When steam stripping and recovery is complete, the recovery system is shut down as follows:

(1) Push stop buttons for the recovery compressors 72-711, 72-712, or 72-792. This also stops the vacuum pumps.

(2) Push stop buttons for seal water pumps 72-033 and 72-032. This also stops hydroquinone injection pump.

III. OPERATING PROCEDURES (CONTINUED)

E. Recovery and Steam Stripping (Continued)

2. Lead Operator Duties

a. When the "A" operator has checked the recovery system, the lead operator can change reactor interlock mode to "recovery".

b. Start the water recirculation pumps, 72-031 and 72-431.

c. Start the seal water pumps, 72-033 and 72-032. This automatically starts the hydroquinone injection pump.

d. Start two recovery compressors, 72-711, 72-712 or 72-792. This also opens the valves associated with compressor startup.

e. The vacuum pumps wil automatically come on when the suction pressure of the compressor is 10 psig. The necessary valve changes are also automatically made.

f. This unit will produce 5385 product only. The stripping procedure is:

(1) Put reactor temperature controller on 200°F.

(2) Set new steam flow controller at 20,000 lbs./hr.

(3) When the reactor is at 200°F and vacuum pumps are on, move the temperature controller to 230°F. Do not move the temperature controller until both conditions are met.

III. OPERATING PROCEDURES (CONTINUED)

E. Recovery and Steam Stripping (Continued)

2. Lead Operator Duties (Continued)

i. (3) Push stop buttons for the water recirculation pumps, 72-031 and 72-431.

3. Recovery System Troubleshooting

a. High Compressor Outlet Temperature

Probable cause is poor or no water recirculation in the recovery knockout drum, 45-027. Check K.O. pump discharge pressure. Check VCM backflow controller setting. Controller setting should be at 25 inches Hg.

b. High Compressor Discharge Pressure

High pressure can be caused by:

(1) Plugged Condenser--Have lead operator report problem to the shift supervisor.

(2) Plug in the Line from the Condenser to the VCM Collect Tank--Line will have to be pulled and cleaned.

(3) High Level in the VCM Collect Tank

(a) Switch transfer pump to manual.

(b) Check level of the recovered VCM receiver--east or west.

(4) No Cooling Water to Condenser--Check inlet and outlet water valves.

(5) High Seal Water Temperature--This temperature should be $110^{\circ} \pm 10^{\circ}$. Check seal water pump for flow and pressure and check filter pack.

III. OPERATING PROCEDURES (CONTINUED)

E. Recovery and Steam Stripping (Continued)

3. Recovery System Troubleshooting (Continued)

c. If the compressor is not compressing the VCM vapor and does not have a 50 to 70 psi discharge pressure:

(1) Check seal water flow.

(2) Check seal water separator water level and adjust as necessary.

(3) Check seal water temperature--below 80°F water will condense the VCM vapor and cause displacement of the water seal around the compressor cone.

d. Recirculation water pump 72-031 goes out (mechanical-electrical).

(1) Under normal operation, recirculation water pump 72-031 circulates water through the water recirculation cooler and into recovery knockout drum 45-027. Crossover piping is provided so that, if recirculation water pump 72-031 fails, recirculation water pump 72-431 will be valved to circulate throught the recirculation water cooler and into recovery knockout drum 45-027.

III. OPERATING PROCEDURES (CONTINUED)

E. Recovery and Steam Stripping (Continued)

3. Recovery System Troubleshooting (Continued)

Note: Normal operating temperatures for the recovery system during stripping are:

(a) Reactor Condenser- 215-225°F (Peak (Temperature)

(b) 45-027 Knockout Drum Outlet-122-128°F

(c) 45-017 Knockout Drum Outlet -90-115°F

(d) Compressor Outlet- 130-140°F

The lead operator must monitor these temperatures on the multipoint recorder and have the "A" operator check out and correct deviations.

e. Reactor Foaming (carryover)--When foaming is detected, the "A" operator will:

(1) Inject defoamer into the reactor to reduce slurry surface tension and lower the reactor slurry level. It may become necessary for the lead operator to shut down one compressor to slow the recovery. If excessive foaming occurs, shut down recovery and thoroughly flush the entire system with water until clear.

III. OPERATING PROCEDURES (CONTINUED)

F. Reactor Dump and Rinse

When the recovery of the reactor has been completed, the slurry is ready to be dumped to the slurry blend tank(s) that has been designated by the shift supervisor.

1. "A" Operator Duties

a. Check the selected blend tank or tanks to make sure it will hold the batch.

b. Check to see that the blend tank sewer valve is closed and Air Sparger* aeration air is on.

c. Check the slurry transfer pump valving to make sure the flow will be going to the correct line.

d. Place the coarse overflow collector into position. Inform the lead operator that the dump can begin.

e. Monitor the dump tank level until the flow to the pump and discharge from the reactor have leveled out to a steady rate.

f. Add calcium stearate to the dump tank as directed by the shift supervisor.

g. If instructed by the lead operator, open the reactor manhead to inspect the reactor internals. Follow opening procedure in "Reactor Cleaning and Entry" section.

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III. OPERATING PROCEDURES (CONTINUED)

F. Reactor Dump and Rinse (Continued)

2. Lead Operator Duties

a. Select the blend tank to be used by opening the appropriate control valves in the slurry transfer lines. The valves will be operated by pushbuttons located on the recovery control panel under the "Slurry Dump" section as follows:

CV-1517	To	T-501
CV-1518	To	T-407
CV-1520	To	T-747
CV-1502	To	T-502
CV-1519	To	Small blend tank manifold

b. Check the sewer valve on the reactor to be sure it is closed.

c. Turn on Sweco* screener

d. Check the Sweco* exhauster to be sure it is running. It should be running continuously.

e. Turn the interlock mode selector switch to the "dump" position.

f. After the "A" operator informs lead operator that dump can begin, place the slurry transfer pumps, 72-496 and/or 72-497, in the "run" position. The level in slurry dump tank 89-007 is automatically controlled.

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III. OPERATING PROCEDURES (CONTINUED)

F. Reactor Dump and Rinse (Continued)

2. Lead Operator Duties (Continued)

g. Five minutes after the start of dump, open the reactor vent to the atmosphere.

h. When there is no slurry flow through the sight glass, the reactor is rinsed according to formula instructions.

i. When dump and rinse are complete, place the slurry transfer pumps in the stop position. This shuts down the pumps, 72-496 and/or 72-497.

G. Chem Wash and Rinse

Chem wash and rinse is not done as a matter of routine on all reactors; however, if it is has been determined that chem wash is needed the shift supervisor will inform the lead operator to do so.

After the reactor has been rinsed during the dump cycle, it is ready to be chem washed. The chem wash cycle is necessary to remove polymer buildup from the reactor condenser, walls, baffles, and agitator. If polymer buildup is allowed to remain in the reactor, it continues to grow with each successive charge. Buildups will contribute to high gel, low quality resin, and will make reactor dumping very difficult if they get large enough to break off and plug dump valves and lines.

*Registered Trademark

III. OPERATING PROCEDURES (CONTINUED)

G. Chem Wash and Rinse (Continued)

Operators must exercise caution during chem wash due to the caustic in the solution. If any solution should get on an operator, flush immediately with water. Caustic feels slick to the touch and will start burning the skin just a few seconds after contact. If the solution spray over the body, immediately get under a safety shower and remove your clothing. If any should get in the eyes, flush eyes for at least fifteen minutes but until all the burning stops and report to your supervisor.

Procedure

1. The lead operator will check and make sure the reactor sewer valve is closed.
2. The lead operator will then place the interlock mode selector switch to "clean and rinse."
3. The lead operator then checks to see that cleaning solution tank is at least 85% full.
4. The lead operator then opens the valves from the cleaning soltion pumps, 72-961 or 72-962, to the reactor condenser cleaning nozzle. The atmospheric vent on the reactor should be closed. All other reactor valves are closed.
5. The lead operator then opens the suction valve, CV-122 for the cleaning solution pumps, 72-961 or 72-962.

III. OPERATING PROCEDURES (CONTINUED)

G. Chem Wash and Rinse (Continued)

Procedure (Continued)

6. The Reactor"A" operator willcheck to see that the cleaning solution heater temperature controller is set at 190^{o}F.

7. The lead operator will then turn on one cleaning solution pump 72-961 or 72-962.

8. When the chem wash has been flushed through the reactor condenser, the lead opeator will:

   a. Shut off cleaning solution pump. Close pump suction valve CV-122 from the cleaning solution tank.

   b. Open chem wash return valve on reaactor.

   c. Open cleaning solution pump suction valve CV-125 from the reactor.

   d. Close valves to the condenser cleaning nozzle.

   e. Open valves to the reactor cleaning nozzle.

   f. Restart the cleaning solution pump. The chem wash solution should now be circulating from the bottom of the reactor back to the reactor cleaning nozzle.

   g. The reactor agitator remains on.

III. OPERATING PROCEDURES (CONTINUED)

G. Chem Wash and Rinse (Continued)

Procedure (Continued)

9. The lead operator will recirculate the chem wash solution through the reactor for five minutes and will them pump the chem wash solution back to the cleaning solution tank by:
   a. Opening CV-124
   b. Closing CV-123. This sends the cleaning solution pump discharge to the cleaning solution tank.
10. The "A" operator should monitor the cleaning solution pump and notify the lead operator when it loses suction (check pressure gauge on pump discharge).
11. The lead operator will not shut off the cleaning solution pump.
12. The lead operator will then check the cleaning solution tank level indicator to see if all the chem wash solution has returned. If any solution is lost or accidently dumped to the sewer, notify the utilities supervisor. The spilled solution must be neutralized to avoid upsetting the chemical balance in the lagoons.
13. The lead operator will now close the reactor cleaning valves and open the condenser cleaning valve and the reactor sewer valve.
14. The lead operator will cut on both hot water charge pumps and flush through the condenser to the sewer for ten minutes.

III. OPERATING PROCEDURES (CONTINUED)

G. Chem Wash and Rinse (Continued)

Procedure (Continued)

15. The lead operator will then close the condenser cleaning valve, open the reactor cleaning valve, and flush the reactor to the sewer for ten minutes.
16. The lead operator will now close the reactor sewer valve.
17. Because of water dilution and resin accumulation, chem wash must be disposed of and fresh caustic pumped to the cleaning solution tank once per week. Follow the procedure outlined under "Used Chem Wash Solution Disposal."

H. Full and Partial Swirl

To assist in the production of quality resin, particularly low gel, it has been found that, by filling the reactor with water and agitating, the gel count is markedly lower.

Swirl is performed when specified in the formula.

1. Full Swirl

In this swirl, the reactor is almost completely filled with water.

Lead Operator Duties

a. Turn the interlock mode selector switch to the "swirl" position.
b. Opens the reactor main charge valve and water charge valve.
c. Starts both hot water charge pumps.

III. OPERATING PROCEDURE (CONTINUED)

H. Full and Partial Swirl

Lead Operator Duties

d. (1) Adds 1400 counts of water to D-300, D-400, D-500 and D-600 reactors. (14000 gallons)

(2) Adds 2000 counts of water to D-700 reactor (20000 gallons)

e. Cuts off pumps and closes valves.

f. Agitates for ten minutes

g. Opens sewer valve and dumps

2. Partial Swirl

This swirl procedure is the same as the full swirl except for the amount of water used. Charge 700 counts, (7000 gallons) for D-300, D-400, D-500 and D-600. Charge 1000 counts (10,000 gallons) for D-700. Then follow the same procedure as the full swirl.

I. Colloid Solution Makeup

The properties of polyvinyl chlordie (PVC) are strongly dependent upon the type and quality of the colloid solution used. The colloid solution must be very accurate and consistent every time it is prepared. The colloid solution is a three (3) percent solution of Dow F-50 Methocel* powder in water.

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III. OPERATING PROCEDURES (CONTINUED)

I. Colloid Solution Makeup

1. Lead Operator Duties

As soon as the lead operator is notified by the "A" operator that the colloid storage tank level is below the stright wall, he will schedule the "A" operator to make up colloid solution as follows:

a. When the "A" operator indicates that the makeup tank is empty, schedule the "A" operator to make up a new batch of colloid solution as soon as possible.

b. During the first part of the colloid makeup procedure when notified by the lead operator, the "A" operator will open the hot water charge valve to the makeup tank and the lead operator will start one hot water charge pump and the discharge valve associated with the charge pump to transfer hot water to the colloid makeup tank. When the water reaches the desired amount, the "A" operator will notify the lead operator to stop the hot water addition.

2. "A" Operator Duties

The "A" operator aids in colloid solution transfer by notifying the lead operator when the colloid charge tank needs to be refilled.

III. OPERATING PROCEDURES (CONTINUED)

I. Colloid Solution Makeup (Continued)

2. "A" Operator Duties

The "A" operator aids in colloid solution transfer by notifying the lead operator when the colloid charge tank needs to be refilled.

When notified by the lead operator, the "A" operator makes up a new batch of colloid solution by the following procedure:

a. Bring six bags of Dow F-50 Methocel* powder (50 pounds per bag) to the top of the colloid makeup tank.

b. Rinse the colloid makeup tank with water to the sewer until it is clean.

c. Open the hot water charge valve into the colloid makeup tank. Notify the lead operator to start the hot water charge pump to put in the tank. When the makeup tank is about ½ full, notify lead operator to shut off pumps (this is approximately 72 counts).

d. Start the colloid tank heater and the tank agitator. Heat the water in the tank to 180°F.

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III. OPERATING PROCEDURES (CONTINUED)

I. Colloid Solution Makeup (Continued)

2. "A" Operator Duties (Continued)

e. When the heater is off, add the methocel powder very slowly with the agitator still on. Each bag should take about one minute to add. If the powder is added too quickly, it will form lumps and not dissolve properly. Carry the empty bags to a trash container.

f. Allow about thirty minutes to let the agitator thoroughly mix the powder into the hot water. Check the mixture for lumps and continue to mix if lumps are present.

g. When the mixture contains no lumps, add cold water to the tank until the outage is 3 inches from the top of the tank.

h. Start the colloid tank cooler. Close the cooling jacket valve when the colloid solution reaches $85^{\circ}F$.

i. Check the temperature after four hours of cooling. If the temperature is $85^{\circ}F$, close the cooling jacket valves and turn off the agitator. If the tank is still cooling, leave the agitator on until the tank has reached $85^{\circ}F$. It is very important to cool the colloid solution completely each time to produce a good quality colloid solution.

III. OPERATING PROCEDURES (CONTINUED)

J. Hydroquinone Solution Makeup

Hydroquinone is injected into the recovery system to short stop the chain reaction and polymerization of vinyl chloride. If the hot VCM gases are allowed to flow through the recovery lines without any inhibitor, they continue the reaction that was started in the reactor and rapidly fill and plug the recovery lines. Plugged lines in the recovery system are very time consuming to pull and clean and cause considerable amounts of downtime.

Adequate and accurate injection of hydroquinone eliminates this problem. Hydroquinone (commercial name Tecquinol*) comes in a powder form and must be put into a solution with water for our use.

When the hydroquinone solution level is low, a new batch is to be made. Each batch should last approximately one month.

1. Lead Operator Duties

   As soon as it is determined that the hydroquinone storage tank is low, the lead operator should schedule hydroquinone makeup between reactor recoveries.

2. "A" Operator Duties

   When notified by the lead operator to make up a new batch of hydroquinone solution, the "A" operator does the following:

   a. Weight up twenty pounds of hydroquinone powder.

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III. OPERATING PROCEDURES (CONTINUED)

J. Hydroquinone Solution Makeup (Continued)

2. "A" Operator Duties (Continued)

b. Turn off hydroquinone metering pump suction valve and, with the nitrogen turned on and the vent closed, drain the remaining heel to the sewer and rinse with water to the sewer.

c. Add water to the mixing drum until it is within 2-3 inches from the top.

d. Turn the agitator on and add the hydroquinone powder. Mix thoroughly.

e. Transfer the hydroquinone mixture to the charge tank using the drum pump.

f. Close the vent and open the nitrogen to the charge tank. Maintain 1-2 PSIG on the charge tank.

g. Make sure the valves are lined up to the hydroquinone metering pump.

3. Safety Precautions

Rubber gloves and full face shield must be worn while handling and transferring hydroquinone dust and liquid. Hydroquinone dust can irritate and seriously damage the eyes.

First Aid -- In case of contact, immediately flush eyes with water for fifteen (15) minutes. Notify the plant nurse. Flush skin with water and wash clothing before reuse.

III. OPERATING PROCEDURES (CONTINUED)

K. Used Chem Wash Solution Disposal

Procedure

1. The shift supervisor must have given instructions to dump the used chem wash solution and make up a fresh batch.
2. The lead operator will instruct the "A" operator to open the tank drain valve, CV-137. The "A" operator will open the valve using a locally mounted handswitch mounted on the south side of the tank.
3. As soon as the tank is empty of solution, the "A" operator will open the three-inch process water valve to the cleaning solution tank to flush out the tank to sewer. Then the operator will close the process water valve and the tank's drain valve.
4. Make up a new batch of cleaning solution.

Note: Notify the utility operator that the cleaning solution has been dumped to the sewer.

III. OPERATING PROCEDURES (CONTINUED)

L. Initiator Handling and Storage

In the conversion of vinyl chloride monomer to polyvinyl chloride resin, an initiator is needed to start and help sustain the reaction process. The Aberdeen plant uses peroxide-type initiators. The physical properties of the type resin needed to determines the type of initiator to be used. All of these products must be kept in cold storage because of rapid decomposition at room temperatures. THe initiator is a skin and eye irritant and must be handled accordingly.

Safety precautions for all types of initiators are basically the same, with some differences in hadling temperatures and explosive limits.

1. Safety Precautions in Handling Initiator

   a. Always wear impervious gloves.

   b. Avoid contact with skin or clothing (will bleach out clothes).

   c. Do not leave initiator unattended when not under refrigeration.

   d. If initiator is spilled, soak up with absorbent material.

   e. Dispose of empty containers immediately. Leave cap off and split the side of this container.

   f. Bring only what is necessary to the production area. Do not allow the amount in the reactor area freezers to exceed one day's comsumption.

III. OPERATING PROCEDURES (CONTINUED)

L. Initiator Handling and Storage (Continued)

1. Safety Precautions in Handling Initiator (Continued)

g. If a partial or full jug of initiator is found sitting out, it may be water, but always handle and dispose just as if it were initiator.

h. If spill on skin area, wash with large amounts of water. If splashed in the eyes, flush with water fifteen (15 minutes) and notify your supervisor. Do not use oils or salve on eyes.

i. Should any initiator catch on fire, use a dry chemical or foam fire extinguisher. Water will only spread the fire, However, if the fire is spreading and likely to ignite other initiator, get out of the area since an explosion is very likely.

2. Physical Characteristics

The following physical characteristics are given for Lupersol 223M-75 and Lup-11 because they are currently in use; however, a different initiator may be used in the future.

	223M-75	Lup-11
Form	Liquid	Liquid
Freezing Point, ^{o}F	-110	-2
Top Safe Storage, ^{o}F	20	0-40
Decomposition Temp. ^{o}F	50	160
Container	One gallon Poly Jug	One gallon Poly Jug
Label	Red*	Yellow**

* Red Label -- Liquids with flash point below 80^{o}F.
** Yellow Label-- All liquids and solids with flash point above 80^{o}F.

III. OPERATING PROCEDURES (CONTINUED)

L. Initiator Handling and Storage (Continued)

3. Initiator Storage Freezers

The walk-in freezers and one chest freezer have been installed for initiator storage at temperatures down to $-30^{o}F$. Each freezer has two independent refrigeration compressors with one to be held in reserve. This is to insure continuous operation at the temperature set point. High temperature in any freezer will activate the air horn and beacon flasher alarms. An automatic defrost system controlled by time clocks will provide frost-free operation.

a. Operating Conditions

(1) Temperature

The temperatures are adjustable. They can be set from $-30^{o}F$ to $+30^{o}F$.

(2) Alarms

The chest and the walk-in freezers on high temperature setting will activate the red beacon light and air horn. This is the same for all freezers in the plant. The alarm's present setpoint is $17^{o}F$ ($\pm$ 2^{o}).

III. OPERATING PROCEDURES (CONTINUED)

L. Initiator Handling and Storage (Continued)

a. Operating Conditions

(3) Compressors

The compressors for the freezers are located in two interconnected sheds 50 feet north of the freezers. The compressors for the chest freezer and the west and middle walk-in freezers are located in the west shed. The compressors for the east walk-in freezer is in the east shed.

The compressors in the west shed are numbered 1 thru 6.

(a) No. 1 and No. 2 compressors serve the middle walk-in freezer.

(b) No. 3 and No. 4 compressors serve the west walk-in freezer.

(c) No. 5 and No. 6 compressors serve the chest freezer on the west end.

The compressors in the east shed are numbered 7 and 8. They serve the east walk-in freezer.

(4) Compressor Shutdown Conditions (Automatic)

(a) Freezer Temperature

(b) Compressor low oil level

(c) High or low compressor pressure

III. OPERATING MANUAL (CONTINUED)

L. Initiator Handling and Storage (Continued)

a. Operating Conditions

(5) Circuit Breakers

(a) West compressor shed--located on north wall

(1) Compressor panel-- the compressor circuit breakers are numbered in sequence 1 thru 6.

(2) Fan panel-- the fans are numbered 2, 3, 5, and 6.

(3) Auxiliary Panel--contains lights, defrost controls, alarms, fans and defrost time clocks.

(b) East Compressor Shed- located on north wall

(1) Compressor panel--the compressor circuit breakers are numbered 1 and 2. The fans are numbered 7 and 8.

(2) Auxiliary Panel--contains lights, defrost controls, alarms, and defrost time clocks.

(6) Defrost Cycles - Adjustable

In the walk-in freezers, each compressor switches to hot gas bypass every six hours to provide a defrost cycle. This is controlled by a time clock.

(7) Freezer Capacity

(a) East walk-in freezer - 600 gallons

(b) Middle and West walk-in freezers - 550 gallons

(c) Chest freezer - 100 gallons

III. OPERATING MANUAL

L. Initiator Handling and Storage (Continued)

4. Design and Operational Functions

Each freezer is provided with two refrigeration units each which are capable of maintaining the desired freezer temperature. Both units can be run simultaneously to allow a check on compressor operation.

The temperature element in each freezer is connected to a mercury switch which starts and stops the compressor. These are adjustable and can be set for different temperatures.

Each compressor has a timer which activates a solenoid valve in the hot gas line to send hot gas directly to the evaporator to allow for the defrost cycle. The fan normally runs with the compressor but is off during the defrost cycle. The east middle and west walk-in freezers defrost every six hours, and the chest freezer defrosts every eight hours. The water-cooled condensers on each compressor in the west compressor shed have water bypass to allow continuous flow and prevent freezeup during cold weather. The condensers also have inlet and outlet valves to allow for acid cleaning. Condenser cooling water is normally supplied by and returned to the cooling tower. During shutdowns and power outages, a bypass valve from the well/city water can be opened to supply

III. OPERATING MANUAL (CONTINUED)

L. Initiator Handling and Storage (Continued)

4. Design and Operational Functions (Continued)

water pressure. If the condensers are put on the well water, open the block valve in the manhole at the west end of the cooling tower to divert the water to the sewer.

The condensers on the east walk-in freezer are air cooled and are not tied in to the cooling water system.

5. Daily Operational Checks

a. Each compressor oil level by maintenance

b. Temperature recorders by "A" operator.

c. Frost buildup on freezer coils by "A" operator.

NOTE: Manual defrost instructions are on the inside front of each time clock.

NOTE: Due to the explosive nature of this initiator, formal approval must be obtained from the operations superintendent and the mechanical superintendent before any changes are made to this operation.

III. OPERATING PROCEDURES (CONTINUED)

L. Initiator Handling and Storage (Continued)

6. Emergency Procedure for Initiator Freezers

If the power should go off, do not open the freezers but do the following:

a. Find out if the power failure is because of a malfunction in the plant.

(1) If trouble is inside the plant, survey the situation and estimate how long the outage will be. Freezers should hold temperature from 3-4 hours, depending on what is in them, the outside temperature, and how many times the door is opened.

(2) If trouble is determined to be outside the plant, call Berl Hill at 369-4731, 369-2159 or 369-2019.

(a) Keep in touch with the Light Department to determine how long the outage will be.

(b) If outage is expected to be over three (3) hours call Jim Barton (369-4755) or Joan Pope. They will arrange for purchase of dry ice.

b. If a compressor should fail and it is not an electrical problem, get in touch with maintenance as soon as possible.

III. OPERATING MANUAL (CONTINUED)

L. Initiator Handling and Storage (Continued)

6. Emergency Procedure for Initiator Freezers (Continued)

b. (1) If help is not available from maintenance, get in touch with Dahlem Sales and Service at 369-2165 or residence 369-4435.

(2) If the problem cannot be fixed, try to move all initiator to other freezers. If not possible get dry ice.

NOTE: If compressors should go out on a freezer, make sure the fans are turned off to that freezer. Middle freezer 1 and 2 fans, west freezer 3 and 4 fans, and chest freezer 5 and 6 fans. The east freezers have two fans, nos. 7 and 8, whose switches are located in the new panel located on the north wall of the east shed.

c. Notify the following if an emergency should arise with the initiator freezers:

Jim Barton - 369-4755

Pete Markey- 369- 6019

7. Circle Chart Responsibility and Change Schedule

a. The "A" operator on each shift will check the charts to be sure they have ink and are rotating.

b. The "A" operator on the 11-7 shift will place new charts in the recorder and trun in the previous day's chart to the shift supervisor.

III. OPERATING PROCEDURES (CONTINUED)

M. Reactor Pressure Check

Prior to the startup of a reactor after an extended outage or following a maintenance outage such as replacing a main dump valve or rodding out the condenser tubes, the reactor must be hydrostically pressure checked. This is to insure that no leakage occurs at the reactor, either inward or outward.

Procedure

1. The lead operator sets up the pressure check as follows:
   a. Place the reactor mode in "emergency" to gain use of both the charge water valve and the rinse valves.
   b. Open both hot water charge pump discharge valves.
   c. Open the reactor charge water valve.
   d. Open the main charge valve.
   e. Open the emergency vent valve.
2. The lead operator then turns on both hot water charge pumps and fills the reactor.
3. The "A" operator stands by to notify the lead operator when the water comes out the atmospheric vent, showing that the reactor is full.
4. The lead operator then shuts down the hot water charge pumps and closes all valves. This must be done immediately to avoid overpressuring the reactor and blowing the rupture discs.
5. The "A" operator then increases the reactor pressure by charging water into the reactor through the initiator injection system.

III. OPERATING PROCEDURES (CONTINUED)

M. Reactor Pressure Check (Continued)

Procedure (Continued)

6. The lead operator monitors the reactor pressure from the control room and instructs the "A" operator to shut off water addition when the pressure reaches 130 psig.

7. The "A" operator then checks the reactor for leaks at the reactor bottom and top side. If an flange or gasket has been changed, check these very closely.

8. The lead operator then monitors the reactor pressure. If the reactor holds 130 psig for ten minutes, the pressure check is terminated. If the reactor loses pressure, instruct the "A" operator to bring the pressure back up to 130 psig with the high pressure service water and reinspect the reactor for leaks. NOTE: Do not charge a reactor that will not hold pressure.

9. When the pressure check is completed, the lead operator dumps the water in the reactor to the sewer. The reactor is now ready to start evacuation procedure.

N. Reactor Cleaning and Entry

1. Reactor Manhead Opening Procedures

One of the most critical parts of the operator's job is the opening of the reactor Lenape* manhead. Following is a list of procedures that must be followed by the "A" operator or anyone else when opening a reactor manhead.

III. OPERATING PROCEDURES (CONTINUED)

N. Reactor Cleaning and Entry

Procedure

a. Check the pressure gauge and/or bleed valve for pressure or vacuum.

b. Unlatch Lenape* lock on Lenape manhead roll-bar and drop down.

NOTE: If the reactor has pressure when the roll-bar arm is lifted, the pressure will start escaping. If this should happen, immediately push lift-bar down and notify the lead operator.

c. Slowly raise manhead four to six inches and hold in that position.

d. Call lead operator and have him cut on the reactor evacuation ejector to pull air inward through the manhead.

e. Finish raising the manhead.

f. Change "O" ring on manhead.

g. Look at the bottom of rupture discs to determine if they are plugged with resin.

h. If the bottom manhead is to be opened, inspect the bottom of the reactor through the open manhead. The reactor should contain no liquids.

i. Go to the bottom of the reactor and make sure that the safety chain and jacking bolts are in proper position on the bottom manhead.

*Registered Trademark

III. OPERATING PROCEDURES (CONTINUED)

N. Reactor Cleaning and Entry (Continued)

Procedure (Continued)

j. Remove bolts in manhead.

k. Carefully open manhead with jacking bolts.

2. Reactor Cleaning and Entry

This section will cover precautions taken prior to entry and during entry and cleaning of the reactor. The following is a check list stating conditions which must be met by anyone entering the reactor.

Procedure

a. The reactor must be empty and flushed with water.

b. The 0_2 content must be greater than 20 percent.

c. The VCM content must be less than 10 ppm.

d. The top and bottom manways must be open.

e. The nitric oxide (NO) piping must be disconnected.

f. The following lines must be blanked or disconnected.

(1) Main eight inch dump line.

(2) Four inch steam stripping lines -- D-700 has two four inch steam stripping lines to be blanked or disconnected.

(3) Six inch condenser lines.

(4) Four inch chem wash and rinse line to condenser.*

(5) Four inch chem wash and rinse line to reactor.*

*When preparing to blank or remove blank in chem wash line, lock out cleaning solution pump, open chem wash line to reactor, and bleed line at discharge of pump before breaking chem wash flange.

III. OPERATING PROCEDURES (CONTINUED)

N. Reactor Cleaning and Entry (Continued)

Procedure (Continued)

f. (6) One inch initiator injection line.

(7) Six inch VCM charge line--only on D-700 reactor.

g. Lock out and tag agitator breaker.

h. Test agitator switch.

i. Special precautions and safety equipment that may be needed are:

(1) Impervious suit.

(2) Continuous flow fresh air mask.

(3) Rubber gloves.

(4) Scaffolding for work above bottom level.

(5) Two-way radio communication plus manway watch.

(6) Safety harness and rope.

j. While cleaning the buildups from the baffles and blade, take extreme care not to scratch the reactor walls. These walls have been polished to eliminate giving the resin being formed during reaction a place to create a buildup.

NEVER SCRAPE THE WALLS.

K. Around the shaft at the bottom of each reactor is carbon throttle bushing. The purpose of the throttle bushing is to protect the reactor seal from resin. The seal water flush will not be effective if the throttle bushing or

III. OPERATING PROCEDURES (CONTINUED)

N. Reactor Cleaning and Entry (Continued)

Procedure (Continued)

k. holder is damaged. If there is any buildup in this area, it is the Maintenance Department's responsibility to remove it. Operators are NOT to clean the throttle bushing. Damage to the throttle bushing may cause seal failure.

l. If hammer and chisel are required to clean the reactor, be careful of chisel placement to avoid it kicking back out of the buildup and causing personal injury.

m. While in the reactor, check the safety discs for buildups, nozzles for plugs, and the bottom of the condenser for plugging.

n. When internal job is completed, remove scaffolding from the reactor and store nearby. Remove any loose buildup on the reactor bottom and close the bottom manhead.

o. Clean up any debris, rags, etc. The job is never complete until the area is clean.

O. Filters

There are numerous filter packs in the Old Unit PVC Reactors. The purpose of any filter is to remove any foreign matter from the flow stream. In doing so, these filters gradually become clogged and dirty which causes a restricted flow and poor filteration. Except in cases of high contamination, these

III. OPERATING PROCEDURES (CONTINUED)

O. Filters

filters must be changed out on a regular basis to prevent equipment damage and product contamination. This procedure will list the filters to be changed, the type filter element to be used and any safety precautions and methods to be used.

1. Dura Seal Oil Filters

Type: Micro-Kleen II, 75 micron, 10 inch

Change: Performed by maintenance

NOTE: Each Dura-Seal unit and reactor has a spare filter. If it is necessary for operations to switch from a fouled unit to the clean one, follow up to make sure the filter element is changed out.

2. Reactor Gear Box Oil Recirculation Filters

Type: Micro-Kleen II, 75 micron, 10 inch

Change: Performed by maintenance

NOTE: Filters can be changed out only when agitator is turned off.

3. Charge Water Filters

Type: Diamond Filter Tube, 10 micron, 30-inch

Change: Performed by operations

III. OPERATING PROCEDURES (CONTINUED)

O. Filters

4. Seal Water Filters

Type: Diamond Filter Tube, 10 micron, 30 inch

Change: Performed by operations.

NOTE: A large amount of resin carry over into the knockout tank will force an early charge. Filters must be changed out immediately after any resin carry over to prevent resin settling out in the filter pack. If neglected, the entire filter pack will have to be removed and drilled out.

NOTE: A continuous flow fresh air mask must be worn when opening a vessel or line that may contain VCM.

5. Vinyl Chloride Charge Filters

Type: Diamond Filter Tube, 10 micron, 40 inch

Change: Performed by operations

NOTE: Extreme caution must be exercised when changing these filters since the filter pack and filter elements are full of VCM and under pressure. Steps to be taken are:

a. Close inlet and outlet valves of filter pack to be changed.

III. OPERATING PROCEDURES (CONTINUED)

O. Filters (Continued)

5. b. Have lead operator pull a vacuum on the blowdown tank using the recovery system.

   c. Open the valve on the 2 inch line to the blowdown tank.

   d. Open the valve on the blowdown tank.

   e. The top of the filter pack will get cold if there is flow to the blowdown tank. If VCM is not going to the blowdown tank check the valves to make sure they are open.

   f. After it has been determined that flow is going to the blowdown tank, open the 1 inch steam valve on the bottom of the pack.

   g. Recover the filter pack until all cold spots disappear and the pack is hot on all surfaces.

   h. Close steam valve and valve to blowdown tank. Put on fresh air mask and remove filter pack manhead.

   i. Remove the old filters and install clean filters. Be sure and install a complete set of filters. Any filters left out will permit a flow of unfiltered VCM to the reactor.

   j. Replace the filter pack o-ring before replacing the manhead. Tighten manhead evenly to insure no leakage. Open vapor to pack. Check for leaks. If none, open inlet and outlet valves.

III. OPERATING PROCEDURES (CONTINUED)

O. Filters (Continued)

6. Recovered VCM Filters

Type: Diamond FIlter Tube, 10 micron, 30 inch

Change: Performed by operations.

NOTE: Take the same precautions and use same procedure as stated in #5 Vinyl Chloride Charge Filters.

NOTE: The VCM recovered filters may become plugged and require frequent changing.

P. Housekeeping

Good housekeeping is a major portion of any task to be undertaken, and no task can be called complete until the work area has been cleaned. Return all tools and materials used to their proper place and do not leave lying around to create a safety hazard.

The housekeeping of the reactor area is the responsibility of all people working there. This includes supervisors, operators, maintenance, and contractors.

IV. EQUIPMENT INDEX

A. Reactors

1. Polymerization Reactors 45-755

a. Purpose

Vessel used to react VCM to PVC in a water suspension.

b. Description

Vertical-mounted, bottom-agitated vessel, 13-foot diameter by 28 foot straight wall height (37 feet overall height), jacketed, and with top-mounted condenser. The reactor is stainless steel, and the cooling water and steam jacket is carbon steel. Approximate capacity is 29,000 gallons.

c. Normal Operating Conditions

The reactor produces various resin types, operating in a pressure range of 28.5 inches Hg vacuum to 155 psig and a temperature range of 80-225^{o}F.

d. Design Conditions

	Shell	Jacket
Temperature, ^{o}F	250	200
Pressure, psig	200(and full vacuum)	45

B. Heat Exchangers

1. Reactor Condensers 55-356

a. Purpose

To remove the heat of reaction from the polymerization reactor by condensing VCM vapor.

IV. EQUIPMENT INDEX (CONTINUED)

B. Heat Exchangers (Continued)

b. Description

Each of the reactor condensers are vertical, mounted on top of the polymerization reactors. Cooling water (shell side. is used to condenser VCM (tube side). Each condenser has 2700 tubes which are ten feet long by one-inch diameter. Materials of construction are stainless steel clad for all surfaces in contact with VCM.

c. Normal Operating Conditions

Condensers operate in a temperature range of 80-225^{o}F and pressure range of 28.5 inches Hg vacuum to 155 psig during the reactor cycle.

d. Design Conditions

	Shell	Tubes
Temperature, ^{o}F	250	250
Pressure, psig	120	200 (and full vacuum)

2. Cleaning Solution Heater 55-357

a. Purpose

To heat and maintain chem wash solution temperature during chem wash of the reactors.

b. Description

Horizonal-mounted shell and type type heat exchanger. Steam is on the shell side, and chem wash solution (caustic) is on the tube side. Surface area of 214 square feet is

IV. EQUIPMENT INDEX (CONTINUED)

B. Heat Exchangers (Continued)

2. Cleaning Solution Heater 55-357 (Continued)

b. Description

provided by 79 tubes 14 feet long by 3/4-inch diameter.

The tubes are stainless stell, and the shell is carbon steel.

c. Normal Operating Conditions

Steam temperature and pressure on the shell side will vary. Cleaning solution on the tube side is estimated to enter at 175°F and leave at 190°F with a pressure of 125 psig.

d. Design Conditions

	Shell	Tube
Temperature, °F	175	200
Pressure, psig	400	400

C. Tanks and Vessels

1. Initiator Injection Pot 45-778

a. Purpose

To inject initiator into the reactor D-700 during charge.

b. Description

Vertical-mounted, two-foot straight wall height with one and one half feet diameter, approximate capacity 15 gallons, stainless steel construction.

c. Normal Operating Conditions

Temperature near 70°F and 180-260 psig.

d. Design Conditions

300°F and 450 psig.

IV. EQUIPMENT INDEX (CONTINUED)

C. Tanks and Vessels (Continued)

2. AMS Emergency Kill Charge Pots 45-780

a. Purpose

To provide a means for injecting short stop solution into D-700 reactor to stop the reaction in the event of a power failure or loss of agitation.

b. Description

Vertical mounted three foot straight wall height, two feet diameter, capacity approximately 60 gallons, stainless steel construction.

c. Normal Operating Conditions

Approximately 70^{o}F and 300 psig.

d. Design Conditions

150^{o}F and 400 psig.

3. Cleaning Solution Tank

a. Purpose

To provide an adequate amount of chem wash solution during reactor chem wash.

b. Description

Vertical-mounted, flat top, cone bottom, eleven foot straight wall height, eleven foot diameter, approximate capcity 8800 gallons, carbon steel construction.

c. Normal Operating Conditions

Atmospheric pressure and 60-190^{o}F

IV. EQUIPMENT INDEX (CONTINUED)

C. Tanks and Vessels (Continued)

3. Cleaning Solution Tank 45-

d. Design Conditions

250^{o}F and $\pm$ five-inch water pressure.

4. Reactor Evacuation Ejector Cyclone Separator 45-768

a. Purpose

To remove any condensate present in the motive steam to the reactor evacuation steam ejector.

b. Description

High efficeincy horizonal separator, Anderson LS-6-175 fourteen inch outside diameter, 34 inches long, carbon steel construction with stainless steel internal baffles.

c. Normal Operating Conditions

Steam in is 125 psig and 353^{o}F.

d. Design Conditions

650^{o}F and 175 psig.

D. Filters

1. Agitator Seal Water Outlet Filters 64-763, 64-764

a. Purpose

To remove dirt and scale from agitator seal water.

b. Description

Filterite model LM010S-3/4 HP, cartridge type, stainless steel element, cotton filter.

IV. EQUIPMENT INDEX (CONTINUED)

D. Filters

1. Agitator Seal Water Outlet Filters 64-763, 64-764

c. Normal Operating Conditions

75°F and 230 psig

d. Design Conditions

105°F, 350 psig, 3 GPM, particle size retention size 10 microns.

2. Mechanical Seal Purge Water Inlet Filters 64-757, 64-762

a. Purpose

To remove dirt and scale from mechanical seal purge water.

b. Description

Filterite model 12 UM0525-2-2UM, cartridge type, stainless steel element, cotton filter- no. C10AK120A.

3. Cleaning Solution Strainer 64-756

a. Purpose

To remove PVC particles from the cleaning solution.

b. Description

Ten-inch Winston line strainer, carbon steel construction- stress relieved.

c. Normal Operating Conditions

2 psig and 180°F.

d. Design Conditions

200°F, 20 psig, 500 gpm, particle retention on four-mesh screen.

IV. EQUIPMENT INDEX (CONTINUED)

E. Pumps

1. Mechanical Seal Purge Water Pumps 72-953, 72-954

a. Purpose

To supply high pressure water to the reactor agitator seals and the reactor cleaning nozzle flush.

b. Description

Centrifugal type, Sundyne P2AFH, 15-HP, 3,500 rpm. The casing and the impeller are stainless steel.

c. Normal Operating Conditions

Rated for 30 GPM at 540 feet of head.

2. Cleaning Solution Pumps 72-951 and 72-952

a. Purpose

To supply chem wash solution to the reactors during chem wash.

b. Description

Centrifugal type, Durco Model Mark II, Group II, 4X3-10/75. 50-HP, 3,550 rpm, stainless steel casing and impeller.

c. Normal Operating Conditions

Rated for 500 gpm at 185 feet of differential head.

F. Agitators

1. Reactor Agitators 51-109

a. Purpose

To keep the colloid, VCM and water in the reactor well mixed.

IV. EQUIPMENT INDEX (CONTINUED)

1. Reactor Agitators 51-109

b. Description

Bottom entering, single speed, four blades at 45° angle, 350 HP, 125 rpm, stainless steel construction.

c. Normal Operating Conditions

25,000 gallons of liquid or slurry in vertical vessel, 28-foot straight wall by 13-foot diameter, at about 120°F and 130 psig.

V. INSTRUMENT INDEX

A. Flow Controllers

Item No.	Service	Type	Set Point
FIRC-101	Reactor Cooling Water Flow Controllers	Meter run with orifice plate, board-mounted indicators and recorders.	Cascade control; the temperature controller of each reactor sets the set point.

NOTE: FIRC-101 controls the cooling water to reactor 45-741.

Item No.	Service	Type	Set Point
FIC-302	Reactor Steam Stripping Flow controllers	Flow nozzle with D/P cell, board mounted indicator	20,000 lbs/hour
FCI-108	Reactor Agitator Mechanical Seal Oil Supply Flow Regulators	Kates Model MFA1-1 Flow Regulator	1.0 gpm

NOTE: FCi-108 controls the seal water flow to reactor 45-741 double mechanical seal.

B. Flow Totalizers

Item No.	Service	Type	Set Point
FQI-103	Initiator Injection Pot Service Water Flow Totalizer	Neptune Rotating Disc Meter, Local Local Readout	None, totalize's only

C. Level Indicator

Item No.	Service	Type	Set Point
LI-101	Chem Wash Tank Level Indicator	D/P Transmitter, Rosemount, board mounted indicator	None, indication only

D. Pressure Controllers

Item No.	Service	Type	Set Point
PIC-325	Recovery System	Absolute D/P Transmitter Rosemount with Foxboro board mounted controller	35- psig

V. INSTRUMENT INDEX (CONTINUED)

D. Pressure Controllers (Continued)

Item No.	Service	Type	Set Point
PCV-100	AMS Emergency Kill System Nitrogen Supply Pressure Regulator	Self-Contained Pressure Regulator	275 psig
PIC-102	Evacuation Ejector EE-100 Steam Supply Pressure Controller	Local, Fisher 4160 FR Controller	100 psig
PCV-113	Reactor Agitator 51- Seal Oil Pressure Controller	Self-Contained Pressure Regulator	230 psig
PCV-119	Steam Tracing Header Pressure Regulator	Self-contained Pressure Regulator	15 psig

E. Temperature Controllers

Item No.	Service	Type	Set Point
TIRC-101	Reactor Polymerization Temperature Controllers	Resistance Bulb with Foxboro Controller	Determined by Specific Batch Recipe

NOTE: TIRC-101 controls reactor 45-101 polymerization temperature.

TIRC-102	Reactor Stream Stripping Temperature Controller	Resistance Bulb with board-mounted Foxboro Controller	$225^{o}F$

NOTE: TIRC-102 controls reactor 45-101 steam stripping temperature.

TIC-104	Cleaning Solution Heater Outlet Temperature Controller	Filled System with Local Foxboro Controller	$190^{o}F$

VI. ALARMS AND SAFETY EQUIPMENT

A. Continuous Flow Fresh Air System

In order to provide personnel protection, a continuous flow fresh air system has been installed. This system consists of personnel fresh air masks and a constant flow breathing air supply. The supply lines are piped to all affected areas of the plant. The individual hookup stations consist of quick connect/disconnect-type fittings.

The individual lines to the designated areas are designed to allow a minimum flow of 6 SCFM to each mask at approximately 10-15 psig. An air pressure regulator, shutoff valve, and an air filter are provided at the piping header to each individual area.

The air supply system utilizes two Nash compressors supplying 100 SCFM each at a maximum pressure of 80 psig. Each compressor will supply about fifteen masks with air at one time. The compressors normally are both in operation at the same time, except in cases of mechanical failure.

The system is equipped with both visable and audible low pressure alarms which are activated at 50 psig. The revolving beacon light is mounted on a pole to give wider visibility, and the horn is mounted at the compressor. An on-off switch is provided at each compressor.

VI. ALARMS AND SAFETY EQUIPMENT (CONTINUED)

A. Continuous Flow Fresh Air System (Continued)

The following job operations will REQUIRE the wearing of a continuous flow fresh air mask supplied through the fresh air lines or a Scott Air Pak:

1. Venting or changing filters in any VCM vessel.

   NOTE: No vessel or line should be vented unless there is no alternative, such as using pipe or hose to transfer VCM into the recovery system or blowdown tank.

2. Entering any vessel that normally contains VCM, such as reactors, blowdown tanks, knockout drums, receivers, etc. (except for scaffolding construction).

3. Opening large reactor manhead (wear mask until the manway is partially open and the evacuation jet is moving air through the manway).

4. Opening any line that may possibly contain VCM vapors.

5. At ANY location where the VCM concentration is above the current allowable limit. Anytime VCM is detected by sight or smell, the concentration is well above the limits and precaution is mandatory.

VI. ALARMS AND SAFETY EQUIPMENT (CONTINUED)

B. Alarms and Switches

1. Amperage Alarms

Item No.	Service	Type	Set Point
AAHL-101	Low or High Amperage to the Reactor Agitator Motor	Board-Mounted Alarm	To be determined in the field.

NOTE: AAHL-101 indicates abnormal amperage to reactor 45 agitator motor.

2. Level Alarms and Switches

Item No.	Service	Type	Set Point
LAH-105	High Level in Clean-Cleaning Solution Tank 45-767	Board-Mounted Alarm	6 Inches from Top of Tank
LSL-106	Low Level in Emergency AMS Kill Pot 45-780	Switch will close CV-144 and CV-145	3 Inches from Bottom of Pot

3. Pressure Alarms and Switches

Item No.	Service	Type	Set Point
PS-105	Low Pressure in Reactor During Recovery	Switch prevents opening of reactor dump valve unless pressure during recovery has been at least as low as set point.	8 psig

NOTE: PS-205 senses pressure in reactor 45

Item No.	Service	Type	Set Point
PS-116	Low Pressure in Initiator Injection Pot	Board-Mounted Alarm	275 psig
PAH-106	High Pressure in Reactors	Board-Mounted Alarm	160 psig

NOTE: PSH-106 indicates high pressure in reactor.

VI. ALARMS AND SAFETY EQUIPMENT (CONTINUED)

B. Alarms and Switches (Continued)

4. Temperature Alarms and Switches

Item No.	Service	Type	Set Point
TAH-101 A&B	High Temperature in the Reactors	Board-Mounted Alarm	160^{o}F

NOTE: TAH-101 A&B indicates high temperature in reactor.

C. Firewater System

The firewater system consists of a deluge system, combustible hydrocarbon analyzer, and fire monitors with hose connections.

1. Fire Monitors

The fire monitors are normally supplied from the city water system. A tie-in with the firewater system allows the fire monitors to operate off either water system. There are four fire monitors located around the perimeter of the reactor area.

2. Hydrocarbon Analyzer

A continuous combustible hydrocarbon analyzer is used to detect major VCM leaks. When the VCM level at any sample point reaches the set point, the deluge system is activated automatically.

3. Deluge System

The deluge system is normally supplied from the firewater system. It can be operated on process water. The deluge system is a sprinkler system which will cover the reactors, dump system, fresh and recovered VCM storage tanks, and both floors of the

VI. ALARMS AND SAFETY EQUIPMENT (CONTINUED)

C. Firewater System (Continued)

3. Deluge System (Continued)

recovery building with a water spray. The deluge system is designed to lower VCM concentrations in the reactor and recovery building area in the event of a VCM leak and as a sprinkler system to help put out fires. The deluge system can be activated manually, by the combustible hydrocarbon analyzer, or by thermal sensors.

The revised firewater system contains three new post indicator valves (PIV) and one PIV was relocated. These are valves which have indicators on them to show whether the valve is open or closed. These valves are used to direct water to either the D-700 reactor area of the V-11 area.

The valves are located at:

1. The southwest corner of the new cooling water tower.
2. East wall of the V-11 building.
3. Two are located at the northwest corner of the intersection of the entrance road and second street.

D. Fixed Point VCM Monitor

A fixed point VCM monitor is used to detect VCM and record the VCM concentration at various locatinos in the reactor and recovery building.

APPENDIX A

EQUIPMENT LIST

Reactors		Service
45-755		Polymerization Reactor
Heat Exchangers		
55-356		Reactor 45-755 Condenser
55-357		Cleaning Solution Heater
Educators and Edjectors		
EE-101 A, B, & C		Reactor 45-755 Jacket Educator
EE-100		Reactor Evacuation Ejector
Tanks and Vessels		
45-778		Initator Injection Pot for Reactor 45-755
45-780		AMS Emergency Kill Pot for Reactor 45-755
45-776		Cleaning Solution Tank
Filters		
64-757		Mechanical Seal Purge Water Filter
64-762		Mechanical Seal Purge Water Filter
64-763		Seal Water Filter for Reactor Agitator 51-109
64-764		Seal Water Filter for Reactor Agitator 51-109
Pumps	**Motors**	**Service**
72-951	70-951	Cleaning Solution Pump
72-952	70-952	Cleaning Solution Pump
72-953	70-953	Mechanical Seal Purge Water Pump
72-954	70-954	Mechanical Seal Purge Water Pump
Agitator		
51-109	70-970	Reactor 45-755 Agitator
Package Units		**Service**
PA-200		Emergency NO Short Stop Bottle
PA-201		Nitrogen Supply Bottle for AMS Emergency Kill Pot

APPENDIX B

INSTRUMENT LIST

Item No.	Service
Amperage Instruments	
II-100	Reactor Agitator 51-109 Motor Amperage Indicator
IR-100	Reactor Agitator 51-109 Motor Amperage Recorder
IAH-100	Reactor Agitator 51-109 Motor High Amperatue Alarm
IAL-100	Reactor Agitator 51-109 Motor Low Amperage Alarm
Control Valves	
CV-100	Reactor 45-755 Main Charge Valve
CV-101	Reactor 45-755 VCM Charge Valve
CV-102	Reactor 45-755 Slurry Dump Valve
CV-103	Reactor 45-755 Chem Wash Return Valve
CV-104	Reactor 45-755 Hot Water Charge Valve
CV-105	Reactor 45-755 Sewer Drain Valve
CV-106	Reactor 45-755 Steam Stripping Valve
CV-107	Reactor 45-755 Steam Stripping Valve
CV-108	Reactor 45-755 Colloid Vharge Valve
CV-109	Reactor 45-755 Initiator Charge Valve
CV-110	Reactor 45-755 Reactor Sampling Valve
CV-111	Reactor Jacket Educator EE-101 A, B, & C Steam Valve
CV-113	Reactor 45-755 Chem Wash Supply Valve
CV-114	Reactor 45-755 Rinse Supply Valve
CV-115	Reactor Condenser 55-356 Cleaning and Rinse Valve
CV-116	Reactor 45-755 Cleaning and Rinse Valve
CV-117	Reactor 45-755 Evacuation Valve
CV-118	Reactor 45-755 Recovery Valve
CV-119	Reactor 45-755 Evacuation and Recovery Valve
CV-120	Reactor Condenser 55-356 Inert Vent Valve
CV-121	Reactor 45-755 Vent Valve
CV-122	Chem Wash Pumps 72-951 and 72-952 Suction Valve
CV-123	Chem Wash Heater 55-357 Inlet Valve
CV-124	Chem Wash Tank 45-776 Top Inlet Valve
CV-125	Reactor Chem Wash Return Valve to Chem Wash Tank 45-776
CV-126	Reactor 45-755 Chem Wash Return Valve
CV-127	Reactor 45-755 Chem Wash Return Valve
CV-128	Reactor 45-755 Chem Wash Return Valve
CV-129	Reactor 45-755 Chem Wash Return Valve
CV-131	Evacuation Ejector EE-100 First Stage Steam Valve
CV-132	Evacuation Ejector EE-100 Second Stage Steam Valve
CV-134	Reactor 45-755 VCM Charge Valve
CV-136	Chem Wash Recirculation Valve
CV-137	Chem Wash Tank 45-776 Drain Valve
CV-144	Reactor 45-755 AMS Emergency Kill System Supply Valve
CV-145	Reactor 45-755 AMS Emergency Kill System Supply Valve

APPENDIX B

INSTRUMENT LIST (CONTINUED)

Item No.	Service
Flow Instruments	
FQI-103	Initiator Injection Pot 45-778 Service Water Flow Totalizer
FRC-101	Reactor 45-755 Cooling Water Flow Controller
FI-100	Reactor Agitator 51-109 Lip Seal Flush Rotameter
FI-102	Reactor 45-755 Spray Nozzle Flush Rotameter
FI-105	Reactor Agitator 51-109 Mechanical Seal Water Inlet Flow Indicator
FCV-108	Reactor Agitator 51-109 Mechanical Seal Water Flow Controller
FI-109	Reactor Agitator 51-109 Mechanical Seal Water Outlet Flow Indicator
OF-106	Reactor Condenser 55-356 Cooling Water Orifice
RO-107	Reactor 45-755, Inlet Vent Restriction Orifice
FIC-302	Reactor Steam Stripping Flow Controller
Pressure Gauges	
PS-105	Reactor 45-755 Pressure Switch (Prevents dump before recovery)
PAH-106 A&B	Reactor 45-755 High Pressure Alarm
PR-106	Reactor 45-755 Pressure Recorder
PT-106	Reactor 45-755 Pressure Transmitter
PI-114	Reactor 45-755 Pressure Indicator (Manometer)
PS-116	Initiator Injection Pot 45-778 Pressure Switch
PAL-116	AMS Emergency Kill Pot 45-780 Low Pressure Alarm
Rupture Discs	
RD-100	Reactor 45-755 Rupture Disc
RD-101	Reactor Condenser 55-356 Rupture Disc
RD-102	Reactor 45-755 Rupture Disc
RD-103	Reactor 45-755 Rupture Disc
RD-104	Initiator Charge Pot 45-778 Rupture Disc
RD-106	Reactor 45-755 Rupture Disc
RD-107	Reactor 45-755 Rupture Disc
RD-108	AMS Emergency Kill Pot 45-780 Rupture Disc
RD-109	Reactor Condenser 55-356 Rupture Disc

APPENDIX B

INSTRUMENT LIST (CONTINUED)

Item No.	Service
Safety-Relief Valves	
PSV-100	Reactor 45-755 Relief Valve
PSV-101	Reactor Condenser 55-356 Relief Valve
PSV-102	AMS Emergency Kill Pot Relief Valve
PSV-103	VCM Charge Header Relief Valve
PSV-105	Chem Wash Heater 55-357 Relief Valve
PSV-106	Chem Wash Strainer 64-756 Relief Valve
PSV-108	Chem Wash Return Header Relief Valve
PSV-109	Reactor 45-755 Relief Valve
PSV-110	Reactor 45-755 Relief Valve
PSV-111	Reactor 45-755 Relief Valve
PSV-112	Reactor 45-755 Relief Valve
PSV-113	Mechanical Seal Purge Water Filter 64-757 Relief Valve
PSV-114	Mechanical Seal Purge Water Filter 64-762 Relief Valve
PSV-116	Reactor Condenser 55-356 Shell Relief Valve
PSV-117	Reactor 45-755 Jacket Relief Valve
PSV-118	Reactor Condenser 55-356 Relief Valve
Temperature Gauges	
TG-101	Reactor 45-755 Jacket Cooling Water Return Temperature
TG-102	Reactor 55-358 Cooling Water Return Temperature
Temperature Instruments	
TRC-101	Reactor 45-755 Temperature Controller
TAH-101 A&B	Reactor 45-755 High Temperature Alarms
TRC-102	Reactor 45-755 Steam Stripping Temperature Controller
TR-103	Reactor Condenser 55-356 Temperature Recorder
TW-110	Reactor 45-755 Cooling Water Return Temperature