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# SUMMARY REPORT ON THE PUREX CANYON VENTILATION EXHAUST FILTER

by

J. P. Duckworth, C. C. Herrington, and

members of Purex Process Control

Purex Operation

CHEMICAL PROCESSING DEPARTMENT

May 28, 1964

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

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# SUMMARY REPORT ON PUREX CANYON VENTILATION EXHAUST FILTER

## INTRODUCTION

The Purex Plant Canyon exhaust system experienced a change in operating conditions during the first week of April, 1964. To prevent serious damage to the filter or an accidental release of radiation to the environment, the plant was shut down until a detailed investigation was completed.

On April 3, 1964, after completing the weekly survey of the ventilation system status, it was noted that the ventilation air flow had dropped and the differential pressure across the canyon exhaust filter had increased since the previous reading on March 27, 1964. As minor variations have occurred in the past, note was made of the status and a special set of readings was scheduled and taken on Monday, April 6, 1964. The second reading showed the restrictive trend to be increasing and initiated additional readings and tests. After April 8, 1964 sufficient data was available to motivate the decision to shut down the plant and start a detailed investigation of the cause and possible sources of the problem.

The Purex Canyon Ventilation system was designed to deliver 125,000 c.f.m. of processed air under controlled conditions. It consists of a 2-unit supply system which heats, filters, and washes the air prior to its entrance to the canyon; an exhaust system made up of the 2-section fibrous glass filter, 3 electrically-driven exhaust fans and 1 steam turbine-driven exhaust fan for emergency use, a 200 foot stainless steel-lined concrete stack and auxiliary, air sampling and monitoring equipment.

## CONCLUSIONS

As a result of the investigation to date, it is concluded that the ventilation filter has met or exceeded design expectations as to efficiency, particulate loading and minimum expected life; that the filter is extremely sensitive to changes in particle content and humidity of the ventilation air, and that from the solids loading in the glass fiber the filter is approaching the end of its useful life.

The change in the operating conditions of the ventilation system in the first week of April and again on April 20, 1964 is considered to be a combination of several factors which include the particle content and humidity of the ventilation exhaust air, the varying porosity of the gradually growing crust, and the hydraulic stability and response of the glass fiber. The apparent continual cycling of particulate matter in the ventilation air, particularly ammonium nitrate from the coating removal operation and from the vessel vent system, has slowly filled the filter with solids and the exposure of these solids to an occasional high amount of moisture has attributed to the formation of a crust on the top of the filter. The thickness of the crust has been increasing which reduced the porosity until recently when a peak quantity of particulate matter was released to the air tunnel. The restriction to flow through the filter became so great that the compression strength of the glass fiber was exceeded and the filter started to compress. The compression increased the pressure drop across the filter and accelerated the restriction to air flow.

The recovery of acceptable operating conditions by "bumping" or flexing the fiber glass, which breaks up the crust and expands the glass fibers, supports this reasoning and suggests that plugging of the filter or restrictions of ventilation air flow should be expected to continue with use at an ever increasing frequency.

Chemical and physical analysis of the filter shows that ammonium nitrate was not the sole contributing factor to the problem. Fission product distribution data

## SUMMARY

A comprehensive series of tests and investigations was conducted to determine the cause of the ventilation filter problem so that, once discovered, a course of remedial action could be plotted. Where equipment or procedures existed for obtaining the required data, these were used. Where none existed, or where the existing equipment or procedures were found to be inadequate, new installations, modifications or revisions were made to suit the tests or studies that were involved. This attention given to the integrity of the data provides a sound base for the conclusions drawn from them.

At the first indication of a reduction of flow through the filter, the frequency of air flow and differential pressure (d/p) readings was increased from weekly to daily and finally to a two-hour basis. From these readings the trend of the drop in flow could be extrapolated so that the time at which the air flow would reach an unsafe level for operating the process was anticipated, and shut down proceedings were started.

The FEO air balance crew was requested to read air flows and filter d/ps as a check on the instrument readings, which proved to be correct. Readings of humidity by the FEO crew indicated that excessive moisture in the filter was not the primary problem.

The air entering the filter was sampled by Occupational Hygiene personnel, for its content of solid particles. The first sample indicated that the particle content was ten times greater than an estimated operating average. The solids content decreased to below average when the process was shut down. Impactor samples of the air proved the particle size to be relatively small and analysis of the slides showed the presence of ammonium nitrate crystals.

SUMMARY (Cont.)

Six-inch diameter holes were cored through the cover blocks in the center of the three primary filter bays. Visual examination of the fiber glass surface of the filter showed that the surface was two feet below the upper retaining screen. In addition, the surface of the fiber glass was covered with a grey crust. Core samples of the crust and filter were obtained and analyzed. These analyses indicated sand, rust particles and considerable ammonium nitrate in the crust. An even larger percentage of ammonium nitrate was found in white crystals dispersed in the glass fibers below the crust.

A 14 inch inspection hole was cored through the filter structure near the secondary filter and low enough to provide for inspection of the bottom support structure. No corrosion of the filter support or water damage to the secondary filter was observed.

A vertical set of pressure taps was drilled in the side of the south bay of the primary filter. These taps ranged from above the filter bed to one inch below the filter surface to three inches below the bottom support. A d/p traverse showed that most of the pressure drop was across the surface crust.

All process vessels, AMU tanks and make-up chemicals were sampled for ammonium ion with no appreciable amounts of ammonium ion being detected.

A continuous program for sampling filter inlet air for particle deposition and humidity and filter outlet air for humidity was implemented and initiated. No readings were recorded that were unusual except during the relapse of April 20.

The process was shut down on April 10 when it was apparent that the ventilation flow would decrease to below the safe operating limits. Ventilation fans were shut off to control the d/p on the filter until finally only one exhaust fan was running, pulling

SUMMARY (Cont.)

its supply through the supply fan dampers. After the reduced flow had remained stable for a time, the filter was "bumped" by starting a second exhaust fan briefly and then stopping it again. By repeating this "bumping", the filter improved to the point that it would support the flow of two supply and two exhaust fans. On April 18 the process was restarted at these slightly lower than normal values of ventilation flow. Concurrent with the first dejacketing operation after restarting (April 20), the air flow decreased and d/p increased again. Air solids deposition samples showed an increase to above average rates and the relative humidity measurements showed an increase. The filter was "bumped" again and all readings returned to normal.

On April 23 the process was shut down for inventory. Cell air samplers were installed in the dissolver cells to sample for ammonia gas and particulate matter. These samplers were operated when dissolving started on April 27. No appreciable amount of ammonia gas was detected. The results of the solids deposition samples indicated cross flow between the dissolver cells. Ammonia balances were made in 216A Tank 2 but the data proved to be unreliable.

The process was started on April 29. On May 7 a cell air sampler was installed in D -Cell. No significant results have been forthcoming.

Currently, the ventilation filter remains operable at the reduced flow rates, but the remaining life is undetermined.

## INVESTIGATIONS

As soon as the problem with the ventilation filter had been isolated to the primary or fiberglass filter, steps were taken to determine the condition of the filter and to locate the source of aggravation to the filter. A series of investigations were made, including visual observations; measurement of the physical characteristics of the filter and air stream in contact with the filter; and chemical analyses of the filter media and other possible chemical sources of the difficulty. In order to evaluate these investigations, a review of the original engineering design concepts was required.

### ENGINEERING

The design* for the fibrous glass filter was developed according to the available engineering data on the basis that it was a sound and economic alternate to a sand filter. The fibrous glass filter was less expensive than an equal sand filter because the allowable superficial velocity was 50 ft/min. vs 5 ft/min. in the sand filter. Also, the size of a fibrous glass filter lent itself to a smaller plot plan area; viz. 4,300 sq. ft. vs 30,800 sq. ft. for a sand filter.

The first section or fore filter is a down flow filter composed of "free-packed" 115K** media serving primarily to protect the second high efficiency cleanup section. This second section is composed of American Air Filter Company Deep-Bed Filter Units packed with one-half inch of AA media at 1.2 lb./cu.ft. density and one-half inch of B media at 1.4 lb./cu.ft. The fore filter was designed for a superficial velocity of 50 ft/min. and the cleanup filter section was designed for 20 ft/min. superficial velocity.

*HW-30142 - Comparative Study of Alternative Fibrous Glass and Sand Exhaust Ventilation Air Filter Installation for Purex.

**Owen-Corning Fiberglas Corporation designation

ENGINEERING (Cont.)

The allowable cumulative dust loading, E, for each of the filter media was estimated from the fibrous glass life test data. This factor is expressed in each case as the cumulative methylene blue dust load to the media, grains per square foot of superficial filter area, necessary to produce a pressure drop increase of four inches of water across the media layer.

| Filter Media | Packed Density lb/cu.ft. | Est. Allowable E Grains/sq.ft. |
|---|---|---|
| 115K | 0.7 | 1150 |
| B | 1.4 | 50 |
| AA | 1.2 | 20 |

By comparison with known life of the sand filter and allowable loading of 115 grains/sq.ft. for sand filter, the minimum life of any one bed in the fibrous filter was designed for 5 years. The final estimated life characteristics of the individual layers were as follows:

| Filter Media Layer | Est. Minimum Life Years | Superficial Velocity ft./min. | Filter Layer Log, DF | Filter Layer Depth, in. |
|---|---|---|---|---|
| 115K | 5.0 | 50 | 1.10 | 84 |
| B | 6.8 | 20 | 0.30 | 0.50 |
| AA | 5.4 | 20 | 1.67 | 0.50 |

The life and loadings are based on the ability of the filter to take a loading of methylene blue dust. The loading would be different for different particle distributions such as the plant ventilation dust which includes ammonium nitrate particles.

Samples of the filter media taken from the surface show that the loading is much higher than for methylene blue dust.

From this design data and the results of the examination of the filter core samples, it can be concluded that the filter has met the original design life even with the apparent greater-than-expected particle loading. The formation of the crust on the

ENGINEERING (Cont.)

filter was the major contributing factor to the present problem; however, with greater than expected loading of fines throughout the filter, it should be expected that pressurization will increase with continued use until operation becomes prohibitive.

VISUAL

In order to determine the cause of the flow restrictions across the filter, it was decided to inspect the filter from the top and bottom. Four inspection holes were drilled through the concrete vault that houses the fiber glass filter, three on top, in the center of each bay, and one on the side, below the bottom filter support (see Figure 3). The first hole in the top was completed on swing shift, April 9.

Visual inspection of the filter bed showed that the surface of the fiber glass was approximately two feet below the retaining screen. The surface of the bed measured 73-3/4 inches from the top of the cover block. The bed appeared to be crusted over with a gray, sand-like layer (Photograph 2). When the fiber glass was originally installed, the retaining screen had to be weighted down with concrete blocks in order to compress the fiber glass enough to bolt the screen in place at a level of 50 inches below the cover blocks.

Further measurements of the depth of the bed were made in conjunction with ventilation stability tests and changes in flow and pressure drop conditions (see Table 6 and Figure 5B). On April 10, when the differential pressure and air flow dropped to 3.5 inches and 43,200 c.f.m. respectively by turning off two exhaust and one supply fan, the level of the bed rose 6.75 inches. After the unexplained flow improvement on April 14 which caused the d/p to drop to 3.3 inches, the surface of the bed rose another 4.5 inches to a depth of 62.5 inches below the cover blocks.

VISUAL (Cont.)

When the process was restarted on April 18, with two supply and two exhaust fans, the bed level rode at 67.5 inches or 6 inches higher than it had been when first observed.

Holes No. 2 and No. 3 (see Figure 3) showed the same crust and had a bed level essentially the same as in hole No. 1.

A larger hole (14 inch diameter) was drilled through the east side of the filter. This hole was located at the downstream end of the vault (secondary filter) and near the bottom support structure, under the glass bed. Inspection showed the supporting members to be sound with no glass media falling through the support. The secondary filter appeared to be in good condition with no evidence of water damage. Some dust particles were noted in a small area near the inspection opening (see Figure 3).

Several samples were cored out of the filter through holes 1, 2 and 3. These varied in size from one half inch diameter by six inches long to four inch diameter by two feet long (Photograph 1). Description and analyses of these samples are presented in the CHEMICAL section of this report and in Tables 5A, 5B, 5C, and 7.

Holes were drilled through the south side of the filter vault to provide taps for a differential pressure traverse (vertical) of the filter (see Figure 3). The initial readings, made on April 15 (see Table 1A) showed the pressure drop through the first inch of the filter crust was from 5.6 to 15.7 times greater than for any other inch of filter.

The total pressure drop, flush with the inner wall of the vault was three and one quarter percent less than the pressure drop as read fifteen inches into the fiber glass. The pressure drop across the first inch, or crust of the filter was 68 percent lower at the wall than the reading fifteen inches into the fiber glass.

VISUAL (Cont.)

This indicates that the air flow is channeling around the crust at its edges, and is further proof of the high pressure drop through the thin crust.

This traversing equipment has been made permanent, with valves and an inclined manometer mounted above grade directly over the tapped holes and also in the No. 2 (outlet) Sample House.

PHYSICAL

With the limited access to the filter that was provided by the inspection holes, only the vertical movement of the surface of the filter media could be measured. However, when this bed level information is combined with the status of the filter differential pressure and air flow, a more complete picture of the physical characteristics may be obtained. For further enlightenment, properties of the air being filtered are included. These are the humidity of the air entering and leaving the filter and the solid particle content of this air.

Air Flow and Filter Differential Pressure - The first indication of decreased air flow was recorded on March 27. On this date, the scheduled weekly reading of stack air flow from the recorder in the 293-A building was 117,500 c.f.m. For twelve weeks prior to March 27, the flow had averaged 127,800 c.f.m. The range of these twelve readings (Figure 5A) was from 124 to 131.4 thousand c.f.m. or 7,400 c.f.m. difference. The next weekly reading on April 3 was 109,800 c.f.m. The downward trend continued on April 6 and 7, the latter reading being 102,600 c.f.m. The average differential pressure (total pressure drop across the filter) since January, 1964 had been 6.6 inches of water, gauge. When the March 27 flow reading was made, the differential pressure was still 6.6 inches w.g. On April 3, the d/p had increased to 9.0 and by April 7 it had reached 10.6 inches. The total change in

PHYSICAL (Cont.)

pressure drop was taking place across the primary filter. The secondary (final) filter was responding normally and decreasing as the flow dropped.

At first, the problem was thought to be the result of excessive moisture in the primary filter, causing an increased pressure drop and consequently, a decrease in flow. On this basis, remedial actions were taken. On April 8, the frequency of air flow and pressure drop reading was increased to one set per shift and then further increased to one set every two hours. The flow continued to drop at an accelerating rate until, at 2230 hours on April 9 it was 88,200 c.f.m., with a pressure drop across the filter of 13.5 inches. Plant shut down proceedings had just begun at the time of these readings.

Concern over the high pressure drop and the possibility of completely collapsing the fibrous filter dictated the next step. At 0045 hours, April 10, one exhaust and one supply fan were turned off (previous to this, the system had been operating with two supply and three exhaust fans). After the change, the air flow was 78,300 c.f.m. and the pressure drop 11.6 inches. The air flow continued to decrease over the next several hours, while the pressure drop fluctuated from 12.2 to 7.4 inches in response to further testing which included substituting the turbine exhaust fan for one of the electric exhaust fans and varying the canyon d/p. At 1515 hours, in an effort to halt the drop in flow, the single supply fan was stopped and one of the two electric exhaust fans was stopped. This dropped the flow and pressure drop to 43,200 c.f.m. and 3.5 inches respectively. Over the next forty-eight hours, the flow leveled out at 36,000 c.f.m. with a 7.3 inch pressure drop.

On April 12, at 2045 hours, a test was performed to determine whether the response of the filter to increased flows had changed. A second exhaust fan was turned on for a short time while flow and d/p readings were taken. There was not any improvement

PHYSICAL (Cont.)

in the pressure drop with this increased flow. When the second fan was turned off, though, the flow had increased from 36 to 37.8 thousand c.f.m., and the d/p had dropped from 7.3 to 7.0 inches. (This type of maneuver has come to be known as "bumping" the filter.)

A similar test was run at 0500 hours on April 13. The measurements improved again after the extra exhaust fan was stopped, with readings of 39,600 c.f.m., and 6.9 inches pressure drop.

The readings at 1430 hours on April 14 showed a marked improvement in filter throughput. The pressure drop was down to 3.2 inches with a flow of 46,800 c.f.m. Several things had happened that morning which could relate to the change. Non-allied electrical testing by the Power Operation may have interrupted power to fans and controls, and repair work on the supply fan modulating dampers may have changed their position.

These same filter conditions prevailed for another fifty hours, during which time testing again was done to check response to increased flow. At 1600 hours on April 16, a second exhaust fan and two supply fans were started. A flow of 93,600 c.f.m. and a 6.6 inch pressure drop were recorded. This condition remained stable and at noon the following day a third exhaust fan was tried. The flow returned to near normal at 115,200 c.f.m., but the pressure drop of 8.8 inches was considered to be too high for continuous operation. The status was returned to two supply and two exhaust fans. The 93,600 c.f.m. flow at 6.6 inches of pressure drop was concluded to be adequate for safe operation of the process and preparations were begun for starting up.

Since start up on April 18, conditions have remained fairly constant at this level,

PHYSICAL (Cont.)

93 to 90 to 98 thousand c.f.m., and 6.6 to 6.0 inches w.g., with two exceptions. On April 20 at approximately 1500 hours, the flow fell off and d/p increased. Final values for both were 84,600 c.f.m. and 9.7 inches. The filter was "bumped" again, and improvement began immediately. The readings rose eventually to 91,800 c.f.m. and 6.3 inches.

The second exception to the normal occurred on April 29 on graveyard shift, when the air flow was measured at 102,600 c.f.m. Early on day shift, the exhaust modulating damper closed, causing the emergency turbine to start. When the malfunction was repaired, the conditions returned to the normal range.

Humidity and Dew Point - It was first thought that the increasing pressure drop and decreasing flow were caused by excessive moisture in the filter. Special tests and measurements were made and additional equipment was installed to determine how serious the problem was. From the data collected to date, there is no evidence that the filter problem was precipitated solely by excessive moisture.

At the first indications of filter restriction, steps were taken to eliminate sources of excessive moisture in the canyon and process cells. The jet gang valves in the P and O gallery were checked, and those that indicated steam leakage (hot vent lines) were valved off of the steam header. Other steam and moisture sources were eliminated, such as: the vessel vent jet was changed to air motivation, steam was turned off of the F cell vent gas silver reactor heater and the spray water was turned off in the ventilation supply fans. The humidity of the air at the outlet of the ventilation filter was measured on April 9 and found to be 18 per cent. This indicated that the difficulty was something other than moisture.

Initially, humidity readings were taken by the FEO air balance crew, using a sling

PHYSICAL (Cont.)

psychrometer at the stack inlet (see Table 3A). On April 18, equipment was installed in the filter inlet sample house to read the dew point of the inlet air to the filter. These readings were made in Cloud-Cup apparatus (Table 3C) and in a G.E. Dewpoint apparatus (Tables 3D and 3E). There is some question as to the accuracy of the initial readings taken at the filter inlet sample house. A continuous dew point instrument was installed in the air tunnel, through a sample port on April 20. This signal is recorded in the Power Control Room. On April 24, a similar instrument was installed in the filter outlet line. Data from these recorders is in Table 3B. Temperature indicators were installed adjacent to both inlet and outlet dew point indicators to make possible the calculation of relative humidities. The temperatures stayed relatively constant at 84 degrees F. inlet and 95 degrees F. outlet.

The plot of dew point data (Figure 7) shows two unusual areas. On April 20 the dew point increased to its highest reading at 65 degrees. This increase corresponded to an increase of filter d/p on that date. The dew point plot shows another peak on the outlet side of the filter on April 27, the day the dissolver operations were restarted.

The relative humidity did not exceed 51 per cent at any time, and except for the peak on April 20, it remained below 30 per cent. This indicates that the filter performance is affected, to a degree, by high humidity conditions.

Millipore Data - On April 9, in response to a request from Purex management, D. E. Wisehart of Occupational Hyg. began sampling the ventilation filter inlet stream for the presence of solid matter. Samples were taken both for total deposition and for relative particle size (Cascade Impactor). Starting April 18, these duties were taken over by Purex Processing personnel.

PHYSICAL (Cont.)

The first sample, taken on April 9 by Occupational Hygiene, showed 200 milligrams of solids per thousand cubic feet of air tunnel flow (see Figure 6). This rate was ten times greater than the estimated average rate of solid deposition on the filter and one hundred times greater than the rate of deposition from atmospheric solids alone. Twenty-four hours later the rate had decreased to 88 mg per thousand cubic feet. On the following day, April 11, the rate was 34 mg per thousand cubic feet and after that, it remained below the average rate except for one reading on April 20 when it rose to 86 mg. This high reading corresponds to the increase of pressure drop across the filter on that date.

Samples for total deposition were drawn from the regular sampling lines in the filter inlet sample house using a Motoair pump, and collected on a porous ceramic (millipore) filter. These filters were dessicated and tared and then dessicated again after use to arrive at the deposition weight. On April 25, the use of ceramic filters was discontinued and glass fiber filter papers were used instead. This eliminated the need for dessicating the papers before and after use.

4 in. x 8 in. Filter Paper - On April 10, the standard Radiation Monitoring 4 in. x 8 in. sampling head was fitted for use in checking solid deposition at the No. 1 (filter inlet) sample house. The sampling head was dismantled and the unused lines were found to be packed full of a white, powdery substance. Those lines were rodded out and used to re-connect the sampler.

The program of determining deposition as well as radioactivity on 4 x 8 filters was not successful, so starting April 30, the deposition samples were taken only on millipore filters. The data in Table 2B demonstrates the uncertainty of the 4 x 8 deposition measurements.

PHYSICAL (Cont.)

A correlation between the increase of particle deposition and the reduction of air flow and increase of primary filter differential pressure can be seen in the data and graphs. For the results of investigations into the source of these particles, see AMMONIA SOURCES below.

CHEMICAL

A total of six samples of the fiber glass filter was taken for physical and chemical analysis. The first three were 1/2 inch diameter, up to 12 inches in length, samples on which solubility and spectrographic studies (Table 7) were made. The three later samples of the fiber glass filter were sent to Analytical Laboratories, 300 Area for chemical analysis. One sample, taken 4/13/64, was a 1/2 inch diameter core; one taken 4/15/64 was a 4 inch diameter, 12 inch long core, and one taken 4/27/64 was a 4 inch diameter, 24 inch long sample. A summary of the chemical composition is in Table 5A.

An intensive analysis was made of pieces of the 4 inch diameter, 12 inch long sample of the fiber glass filter. The entire core was made up of four readily distinguishable parts: a grey dirt; white powder; a grey crust and the fiber glass itself. About 80% of the white powder was ammonium nitrate. The grey crust was made up of 44-53% ammonium nitrate; 8-11% iron; 7-12% silicon dioxide; 5-9% water; and 3-6% organic material. Some 41-54% of the glass fiber, free of foreign matter, was represented by water soluble material, largely ammonium nitrate deposited as a film or very fine encrustation on the fiber. A detailed breakdown is shown on Table 5B.

Chemical analyses were performed on all canyon vessel solutions, aqueous make-up tank solutions, dry chemicals and other possible emitters of ammonium salts to determine if an unusual amount of ammonia was present. None of the results indicated a higher

CHEMICAL (Cont.)

than normal amount of ammonium salts were present. A summary of results is shown in Table 4.

Initial solubility data, shown in Table 5C, gave evidence of the presence of iron salts but was not quantitative to the degree to show ammonium salts. The only major anion present was $NO_3^-$.

An initial spectographic analysis of an air impactor sample taken by D. E. Wisehart indicated that 100% of the crystaline matter was ammonium nitrate.

AMMONIA SOURCES

The number of possible methods of introducting ammonia to the Purex Process, in a manner such that it could cause deposition of ammonium salts on the ventilation filter is limited. The dejacketing operation in the dissolvers is the largest producer of ammonia gas. Other possible sources are the "waste neutralization--vessel vent-backcycle system" complex, the possible (not probable) ammonia producing reactions with the process chemicals, sulfamic acid, hydrazine and sugar, and the unexpected antics of the storage and piping systems that might provide access for ammonia to the process through devious inter-ties and connections. These sources have been examined in depth. The findings are reported below.

Dissolver Operations - The off-gas from each dissolver passes through a downdraft tower, a knock-out pot, an mmonia scrubber, steam and electric heaters, a silver reactor, and a fibrous glass filtering system. The path then divides, the gas from the coating removal operation going through vacuum jets to the 291-A process stack, and the gas from the dissolving operation going through two nitric acid absorbers, through vacuum jets and out to the stack (see Figure 4). A manual, operator-controlled,

AMMONIA SOURCES (Cont.)

bypass switch selects one or the other of the final routings. The largest source of ammonia gas in the Purex Process is the coating removal operation. Up to 110 pounds of ammonia are created in the dissolver for each charge of metal processed. It is the function of the ammonia scrubber in the off-gas train to absorb this ammonia gas by counter current contact, on four bubble cap trays, with water flowing at nine gallons per minute. The rich ammonia liquor then drains from the scrubber, through a vented jumper with a 40 inch seal loop, to a header in the hot pipe trench that serves all three dissolver cells. The header drains to the bottom of 216A Tank 2 through a sealed dip leg (see Figure 8).

At random intervals in the past, the ammonia scrubber water, instead of following the above route, has backed up into any of the other dissolvers. The common scrubber water header in the pipe trench provides an inter-tie making this possible. A plug in the 216A Tank 2 dip leg, or an air lock in the line are possible reasons for backing up of the water. If ammonia liquor dropped into a dissolver that was on the acidic dissolving step, the ammonia would go into solution as ammonium ion and would carry over with the feed into the Purex Process, eventually ending up in the concentrated waste (1WW). From there, the ammonia could find its way to the ventilation filter as described in the next section, Backcycle System.

Another, more direct route for coating removal ammonia to get to the ventilation filter is through the vents on the scrubber water jumpers. It has been calculated that less than half of the inside area of scrubber water jumper and common header is required to provide the nine gallon per minute flow. An open air inter-tie may, therefore, exist between dissolver cells. Vernier measurements of intra-cell differential pressures show that slight differences exist with all cells closed, and considerable differences exist if one of the dissolver cells has cover blocks

AMMONIA SOURCES (Cont.)

removed. Therefore, the air will flow through the jumper vents, over the concentrated ammonia scrubber water, stripping out ammonia vapor, and discharging the ammonia into the low pressure cell. From the cell it will flow with the canyon ventilation air into the air tunnel and to the ventilation filter.

Cell air samplers were installed to test the foregoing postulation. Bubblers were set up containing dilute nitric acid to detect gaseous ammonia and millipore filters were included in the sample line to measure solid particle deposition. The samples were pulled from the vicinity of the ammonia scrubbers. No ammonia vapor has been detected in the bubblers to date. The solid filters, however, have picked up large amounts of particles at various times, predominantly ammonium ion, indicating that there may be an intra-cell air flow that combines ammonia from a dissolver on the coating removal cycle and gaseous nitrogen oxides from a dissolver on the dissolving cycle. Further validification of the concept of cell air flow through the ammonia scrubber water header and jumper vents was provided during the period when the B-Cell silver reactor was being regenerated. During much of this time, beginning May 4, B-Cell cover blocks were off while jumper work was being done. As noted above, this would create a greater difference in static pressure between dissolver cells A & C with reference to B-Cell. Millipore filter deposits during this time showed a much higher frequency of high solids deposition than during the previous period of normal operation of the three dissolvers.

A third possible route from dissolver to filter for ammonia from the dejacketing cycle requires a sequence of process and operator errors. First, it is required that insufficient scrubber water be flowing through the ammonia scrubber, thus allowing ammonia gas to pass through the scrubber. This requirement could be fulfilled either by setting the flow at an incorrect rate (operator) or by having a

AMMONIA SOURCES (Cont.)

leak in the water line downstream of the rotameter (process). The second requirement is that the acid absorber by-pass valve be positioned to route the ammonia carrying off-gas through the acid absorbers (operator or process). If both requirements are met, the ammonia will combine with the recovered acid and finally end up in the concentrated waste (1WW).

In order to preclude the possibility of a process malfunction being the cause of a prolonged reduction of scrubber water flow, a routine check of the flow rate on each dejacketing operation is being made once each day. To detect the occurrence of dejacketing off-gas being routed through the acid absorbers, samples of the XC and XD absorbers have been taken. No ammonia has been found in these samples.

Material balances of the ammonia produced during the dejacketing operations from April 26 through May 13 were made using the volume and analyses of ammonia scrubber water that was delivered to 216A Tank 2 (see Table 9). The balances varied from 4.5 to 223 per cent of the theoretical weight of ammonia expected. The average was 75 per cent of theoretical. These results are not precise enough to use as a true measurement of ammonia loss to the ventilation system. The total volume of scrubber solution generated during a dejacketing cycle is more than twice the effective volume of 216A Tank 2. This tank must, therefore, be sampled and jetted empty several times during each run. The tank is not agitated and does not have an operating sampler, so it is necessary to take dip samples, through the vent riser. The combination of these shortcomings diminished the accuracy and precision of the balances.

Backcycle System - The backcycle, vessel vent, condenser vent and waste treatment systems constitute a continuous ammonia recycle complex (see Figure 4). All process waste eventually finds its way to the 1WW system and tank F16 except cell sumps and

AMMONIA SOURCES (Cont.)

flushes which go instead to tank F18. When these acidic solutions, containing ammonium ion are neutralized, ammonia gas is liberated. This gas will pass through the vessel vent system to the vessel vent condenser, E-F1, where it will be absorbed in the acidic condensate from the vent steam jet. It will drain back, in solution, to tank F10, from which it will again travel to F16. When F18 is neutralized, any ammonium ions will be liberated as ammonia and will follow the same vessel vent path to final residence in solution in F16. Ammonia will continue to build up in this complex until equilibrium is reached or, until the vessel vent and condenser vent jets are switched to air motive power. When the jets are "on air", any ammonia gas released by neutralization of F16 or F18 will pass through the vent condenser and go to the ventilation filter. As ammonia gas it will pass through the filter and go out the stack. However, it is likely that enough oxides of nitrogen are encountered to form ammonium nitrate crystals and thus cause deposition on the filter.

Samples of process streams, including the backcycle and waste treatment systems, were analyzed for ammonium ion. No appreciable amounts were found (see Table 4).

Chemicals - Some of the chemicals used in the Purex Process could, possibly react with process concentration reagents to form ammonium ion. These are sulfamic acid, ferrous sulfamate and hydrazine, all nitrogen-containing compounds, and sugar, which is used for denitrating acid wastes. The former three chemicals all accumulate in the backcycle system and wind up in the concentrated waste. The actual potential for producing ammonia has not been estimated, however converting all the nitrogen to ammonia through unknown or doubtful reactions, the maximum production of ammonia per day could be:

| | |
|---|---|
| Sulfamic Acid | 0.5 lb. |
| Hydrazine | 20.0 lb. |
| Sugar | 5.0 lb. |

AMMONIA SOURCES (Cont.)

Considering the devious means used to arrive at these totals, they are not regarded as being significant, possible contributors.

Systems - In the Purex Process vessel, piping and ventilation systems, there necessarily exist incidental routings and inter-ties that are unusual with respect to the ordinary flow pattern of the plant. These may or may not be part of a double failure safety system but in either case they require the previous staging of an unusual set of circumstances in order to become a reality.

One such area is U-Cell, the recovered acid storage cell. Tanks U3 and U4 collect laboratory waste and are emptied by jet to 216A Tank 2. A liquid heel is maintained in these tanks by operator control, to act as a seal. If the tanks were jetted to a minimum heel, a path would be open for ammonia vapors to return from 216A Tank 2 to U3 or U4 tanks. A separate blower vents U3 and U4 to the ventilation tunnel and filter. The potential of ammonia escaping by this route is low because special labels on the U3 and U4 instruments warn against jetting them below the safe heel level.

A second system that vents directly to the ventilation tunnel via a separate blower is R-Cell. There is little chance, however, of having ammonia vapors in R-Cell.

There are seven separate lines that deliver drainage to 216A Tank 2. Besides laboratory waste and ammonia scrubber water, it receives floor drainage from the ventilation filter pit, and the 216A Building (the jet and control cellar for 216A Tank 2). Also, it receives stack, stack liner and stack sample house drainage. Occasionally, the automatic jet that empties 216A Tank 2 does not function and the tank overfills and backs up through the 216A Building drain. At this elevation (697 ft.), the solution could run into the dissolvers through the ammonia scrubber

AMMONIA SOURCES (Cont.)

(695 ft. 11-1/2 in.) or into the ventilation filter through the pit floor drain (691 ft.). However, no flow to these locations has been observed.

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## LIST OF TABLES, FIGURES, AND PHOTOGRAPHS

LIST OF TABLES, FIGURES, AND PHOTOGRAPHS (Cont.)

TABLE 1. PUREX VENTILATION - AIR FLOW - CANYON D/P
FILTER D/P - SUPPLY & EXHAUST FANS

| Date | Time | Air Flow 1000 CFM | Differential Pressure Inches of Water Gauge Fore Filter | After Filter | Filter Total | D/P Inches W.G. Canyon to P&O | Supply Fans On | Exhaust Fans On |
|---|---|---|---|---|---|---|---|---|
| 1/3 | | 124.0 | | | 6.4 | 0.36 | 2 | 3 |
| 1/10 | | 127.8 | | | 6.4 | " | " | " |
| 1/17 | | 129.6 | | | 6.4 | " | " | " |
| 1/24 | | 131.4 | | | 6.5 | " | " | " |
| 1/31 | | 127.8 | | | 6.6 | " | " | " |
| 2/7 | | 129.6 | | | 6.5 | " | " | " |
| 2/14 | | 127.8 | | | 6.6 | " | " | " |
| 2/21 | | 127.8 | | | 6.6 | " | " | " |
| 2/28 | | 127.8 | | | 6.6 | " | " | " |
| 3/6 | | 126.0 | | | 6.6 | " | " | " |
| 3/13 | | 127.0 | | | 6.6 | " | " | " |
| 3/20 | | 127.0 | | | 6.6 | " | " | " |
| 3/27 | | 117.5 | 4.4 | 2.2 | 6.6 | " | " | " |
| 4/3 | | 109.8 | 7.0 | 2.0 | 9.0 | " | " | " |
| 4/6 | | 106.2 | 8.0 | " | 10.0 | " | " | " |
| 4/7 | | 102.6 | 9.6 | 1.0 | 10.6 | " | " | " |
| 4/8 | 1000 | 99.0 | 9.3 | 1.8 | 11.1 | 0.36 | 2 | 3 |
| | 1730 | 97.2 | 9.5 | " | 11.3 | " | " | " |
| | 1930 | 96.3 | 9.9 | " | 11.7 | " | " | " |
| | 2130 | 95.4 | 10.1 | " | 11.9 | " | " | " |
| | 2330 | 93.6 | 10.3 | 1.7 | 12.0 | " | " | " |
| 4/9 | 0130 | 92.7 | 10.3 | 1.8 | 12.1 | 0.36 | 2 | 3 |
| | 0330 | 95.76 | 9.8 | " | 11.6 | " | " | " |
| | 0530 | 95.94 | 9.7 | " | 11.5 | " | " | " |
| | 0730 | 91.8 | 10.1 | " | 11.9 | " | " | " |
| | 0900 | " | 10.3 | " | 12.1 | " | " | " |
| | 1000 | " | 10.7 | 1.7 | 12.4 | " | " | " |
| | 1130 | 90.0 | 11.0 | " | 12.7 | " | " | " |
| | 1330 | | 11.2 | " | 12.9 | " | " | " |
| | 1515 | 93.6 | | | | " | " | " |
| | 1830 | 91.8 | 11.6 | 1.6 | 13.2 | " | " | " |
| | 2030 | 90.0 | 11.8 | " | 13.4 | " | " | " |
| | 2230 | 88.2 | 12.0 | 1.5 | 13.5 | " | " | " |

Table 1 - Page 2

| Date | Time | Air Flow 1000 CFM | Differential Pressure Inches of Water Gauge: Fore Filter | After Filter | Filter Total | D/P Inches W.G. Canyon to P&O | Supply Fans On | Exhaust Fans On |
|---|---|---|---|---|---|---|---|---|
| 4/10 | 0130 | 78.3 | 10.4 | 1.2 | 11.6 | 0.36 | 1 | 2 |
| | 0330 | 79.2 | 10.5 | " | 11.7 | " | " | " |
| | 0530 | 76.5 | 10.9 | 1.1 | 12.0 | " | " | " |
| | 0730 | 74.7 | 11.0 | 1.2 | 12.2 | " | " | " |
| | 0800 | | | | | " | " | " |
| | 0930 | | | | | 1.00 | " | 1 elec., 1 turbine |
| | 0950 | | | | 12.6 | 0.36 | " | 2 |
| | 1000 | | | | 7.4 | " | " | " |
| | 1030 | 73.8 | 7.8 | 1.3 | 9.1 | " | " | " |
| | 1100 | 72.0 | | | 10.2 | 0.26 | " | " |
| | 1105 | 68.4 | 9.3 | " | 10.6 | " | " | " |
| | 1130 | " | 9.6 | 1.2 | 10.8 | " | " | " |
| | 1200 | 64.8 | 10.3 | " | 11.5 | " | " | " |
| | 1330 | | | | " | " | " | " |
| | 1400 | 64.8 | | | " | " | " | " |
| | 1430 | " | | | " | 0.50 | " | " |
| | 1500 | " | | | " | 0.60 | " | " |
| | 1530 | 43.2 | | | 3.5 | 0.34 | 0 | 1 |
| | 1630 | 39.6 | | | 4.1 | 0.32 | " | " |
| | 1830 | 37.8 | | | 5.5 | 0.34 | " | " |
| | 2030 | 36.0 | | | 5.9 | " | " | " |
| | 2230 | " | | | 6.3 | " | " | " |
| 4/11 | 0050 | 36.0 | 5.85 | 0.65 | 6.5 | 0.34 | 0 | 1 |
| | 0250 | " | 6.0 | " | 6.65 | 0.30 | " | " |
| | 0450 | " | 6.17 | " | 6.82 | " | " | " |
| | 0635 | 34.4 | 6.30 | " | 6.95 | 0.33 | " | " |
| | 0825 | 34.2 | 6.43 | " | 6.08 | 0.32 | " | " |
| | 1030 | " | 6.50 | 0.68 | 7.18 | " | " | " |
| | 1230 | " | 6.52 | " | 7.20 | " | " | " |
| | 1430 | " | " | " | " | " | " | " |
| | 1630 | 36.0 | 6.60 | 0.70 | 7.30 | 0.34 | " | " |
| | 1830 | " | " | " | " | 0.36 | " | " |
| | 2030 | " | 6.40 | 0.70 | 7.10 | " | " | " |
| | 2230 | " | 6.50 | " | 7.20 | " | " | " |
| 4/12 | 0030 | 36.0 | 6.60 | 0.60 | 7.20 | 0.36 | 0 | 1 |
| | 0230 | " | " | 0.70 | 7.30 | " | " | " |
| | 0430 | " | " | " | " | " | " | " |
| | 0630 | " | 6.70 | " | 7.40 | " | " | " |
| | 0835 | 35.1 | 6.72 | 0.64 | 7.36 | " | " | " |
| | 1030 | " | " | 0.66 | 7.38 | 0.34 | " | " |
| | 1230 | " | 6.78 | 0.62 | 7.40 | " | " | " |
| | 1430 | " | 6.75 | 0.63 | 7.38 | " | " | " |
| | 1630 to 2030 | 36.0 | 6.8 | 0.7 | 7.5 | 0.36 | " | " |
| Test | 2045 | 73.8 | 8.8 | 1.6 | 10.4 | 0.70 | 0 | 2 Test: Bump Filter w/2nd E.F. |
| | 2055 | 39.6 | 5.9 | 0.7 | 6.6 | 0.36 | 0 | 1 |
| | 2230 | 37.8 | 6.1 | 0.7 | 6.8 | " | " | " |

Table 1 - Page 3

| Date | Time | Air Flow 1000 CFM | Differential Pressure Inches of Water Gauge: Fore Filter | After Filter | Filter Total | D/P Inches W.G. Canyon to P&O | Supply Fans On | Exhaust Fans On | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 4/13 | 0030 | 37.8 | 6.3 | 0.6 | 6.9 | 0.36 | 0 | 1 | |
| | 0230 | " | 6.6 | 0.4 | 7.0 | " | " | " | |
| | 0430 | " | 6.4 | 0.6 | 7.0 | " | " | " | |
| Test | 0500 | 73.1 | 8.8 | 1.6 | 10.4 | 0.74 | 0 | 2 | Test: Bump Filter w/2nd E.F. |
| | 0510 | 39.4 | 6.0 | 0.7 | 6.7 | 0.36 | 0 | 1 | |
| | 0630 | 37.8 | 6.2 | 0.6 | 6.8 | " | " | " | |
| | 0830 | 39.6 | 6.3 | 0.6 | 6.9 | " | " | " | Test Tunnel Door Opening — Vent Cover / Vertical Door |
| Test | 0903 | " | " | 0.7 | 7.0 | 0.23 | " | " | Open / Closed |
| Test | 0915 | " | " | 0.6 | 6.9 | 0.43 | " | " | Closed / " |
| Test | 0927 | " | " | " | " | " | " | " | " / Open |
| Test | 0928 | " | " | 0.7 | 7.0 | " | " | " | " / Closed |
| | 1105 | 41.4 | 5.2 | " | 5.9 | 0.37 | " | " | |
| | 1205 | " | 5.3 | " | 6.0 | 0.36 | " | " | |
| | 1430 | " | 5.8 | 0.6 | 6.4 | 0.35 | " | " | |
| | 1630 | 39.6 | " | 0.7 | 6.5 | " | " | " | |
| | 1830 | " | " | " | " | " | " | " | |
| | 2030 | " | 5.9 | 0.6 | " | " | " | " | |
| | 2230 | 41.4 | 5.7 | 0.7 | 6.4 | 0.28 | " | " | |
| 4/14 | 0030 to 1230 | 41.4 | 5.6 | 0.7 | 6.3 | 0.36 | 0 | 1 | |
| | 1430 | 46.8 | 2.4 | 0.8 | 3.2 | 0.48 | " | " | |
| | 1545 | " | " | " | " | 0.49 | " | " | |
| | 1630 | " | 2.8 | 0.5 | 3.3 | 0.48 | " | " | |
| | 1830 | " | 2.4 | 0.9 | 3.3 | 0.46 | " | " | |
| | 2030 | " | " | " | " | 0.45 | " | " | |
| | 2230 | " | " | " | " | 0.46 | " | " | |
| 4/15 | 0030 to 1630 | 46.8 | 2.4 | 0.9 | 3.3 | 0.48 | 0 | 1 | |
| | 1830 to 2230 | 45.4 | 2.4 | 0.9 | 3.3 | 0.47 | " | " | |
| 4/16 | 0030 to 0630 | 45.4 | 2.4 | 0.9 | 3.3 | 0.46 | 0 | 1 | |
| | 0830 | 46.8 | " | " | " | " | " | " | |
| | 1030 | " | 2.2 | 0.9 | 3.1 | " | " | " | |
| | 1115 | " | 2.4 | 0.9 | 3.3 | " | " | " | |
| | 1630 to 2230 | 93.6 | 5.0 | 1.6 | 6.6 | 0.36 | 2 | 2 | |

Table 1 - Page 4

| Date | Time | Air Flow 1000 CFM | Differential Pressure Inches of Water Gauge Pre Filter | After Filter | Filter Total | D/P Inches W.G. Canyon to P&O | Supply Fans On | Exhaust Fans On | |
|---|---|---|---|---|---|---|---|---|---|
| 4/17 | [illegible] to 0925 | 93.6 | 5.0 | 1.6 | 6.6 | 0.36 | 2 | 2 | |
| | 0930 | 93.6 | | | 6.6 | " | 2 | 2 | Test Block G2 off @ 0945 |
| | 1000 | " | | | " | " | " | " | Block K4 off @ 0955 |
| | 1010 | " | | | " | " | " | " | G2 & K4 on, F7 off @ 1011 |
| | 1030 | " | | | " | " | " | " | F9 off @ [illegible] |
| | 1040 | " | | | " | " | " | " | F8 off @ [illegible] |
| | 1124 | 113.4 | 6.4 | 2.2 | 8.6 | 0.55 momentary 0.36 | " | 2 | Test |
| | 1140 | 115.0 | | | 8.6 | " | " | " | Test |
| | 1145 to 2230 | 93.6 | 5.0 | 1.6 | 6.6 | " | " | 2 | |
| 4/18 | 0030 to 1200 | 93.6 | 4.9 | 1.7 | 6.6 | 0.36 | 2 | 2 | |
| | 1330 | 95.4 | " | " | 6.6 | " | " | " | |
| | 1430 to 2030 | 93.6 | 4.9 | 1.7 | 6.6 | " | " | " | |
| | 2130 | 91.6 | | | 6.5 | " | " | " | |
| 4/19 | 0100 | 92.7 | 4.6 | 1.8 | 6.4 | 0.36 | 2 | 2 | |
| | 0250 | " | " | 1.7 | 6.3 | " | " | " | |
| | 0500 | " | " | " | " | " | " | " | |
| | 0630 | " | " | 1.8 | 6.4 | " | " | " | |
| | 0900 | 93.6 | 4.5 | 1.8 | 6.3 | " | " | " | |
| | 1130 | " | 4.6 | 1.7 | 6.3 | " | " | " | |
| | 1330 to 2230 | 93.6 | 4.7 | 1.6 | 6.3 | " | " | " | |

Table 1 - Page 5

| Date | Time | Air Flow 1000 CFM | Differential Pressure Inches of Water Gauge Fore Filter | After Filter | Filter Total | D/P Inches W.G. Canyon to P&O | Supply Fans On | Exhaust Fans On | |
|---|---|---|---|---|---|---|---|---|---|
| 4/20 | 0030 to 0630 | 93.6 | 4.7 | 1.6 | 6.3 | 0.36 | 2 | 2 | |
| | 0900 | 91.8 | 4.7 | 1.7 | 6.4 | " | " | " | |
| | 1100 | " | " | " | " | " | " | " | |
| | 1345 | " | 4.8 | 1.7 | 6.5 | " | " | " | |
| | 1545 | 88.2 | 5.9 | 1.6 | 7.5 | " | " | " | |
| | 1710 | 84.6 | 7.3 | 1.4 | 8.7 | " | " | " | |
| | 1800 | " | 8.0 | 1.4 | 9.4 | " | " | " | |
| | 1815 | " | 8.1 | 1.6 | 9.7 | " | " | " | |
| | 1830 | " | " | 1.4 | 9.5 | " | " | " | |
| | 1845 | " | 7.8 | 1.5 | 9.3 | " | " | " | |
| | 1900 | " | 7.9 | 1.4 | " | " | " | " | |
| | 1930 | " | " | " | " | " | " | " | |
| | 1945 | " | " | 1.5 | 9.4 | " | " | " | |
| | 2000 | " | " | " | " | " | " | " | |
| | 2015 | " | " | " | " | " | " | " | |
| | 2030 | " | " | " | " | " | " | " | |
| | 2100 | 84.7 | 7.7 | 1.5 | 9.2 | 0.34 | " | " | |
| | 2200 | 88.2 | 5.7 | 1.6 | 7.3 | 0.36 | " | " | |
| | 2230 | 90.0 | 5.2 | 1.6 | 6.8 | " | " | " | |
| | 2245 | " | " | " | " | " | " | " | |
| | 2330 | " | 4.7 | 1.7 | 6.4 | " | " | " | Bumped filter w/ex. fan @ 2315 |
| 4/21 | 0040 to 0615 | 90.0 | 4.7 | 1.7 | 6.4 | 0.36 | 2 | 2 | |
| | 0900 to 1530 | 91.8 | 4.5 | 1.7 | 6.2 | " | " | " | |
| | 1630 to 1830 | 91.8 | 4.5 | 1.8 | 6.3 | " | " | " | |
| | 1930 | 93.6 | 4.6 | 1.7 | 6.3 | " | " | " | |
| | 2130 | 91.8 | " | " | " | " | " | " | |
| | 2330 | " | " | " | " | " | " | " | |
| 4/22 | 0130 to 2130 | 91.8 | 4.5 | 1.8 | 6.3 | 0.36 | 2 | 2 | |
| | 2330 | 90.9 | 4.5 | 1.7 | 6.2 | " | " | " | |
| 4/23 | 0045 to 0030 | 90.9 | 4.5 | 1.8 | 6.3 | 0.36 | 2 | 2 | |
| | 0900 to 1325 | 90.0 | 4.5 | 1.7 | 6.2 | " | " | " | |
| | 1525 to 2330 | 90.0 | 4.4 | 1.7 | 6.1 | " | " | " | |

Table 1 - Page 6

| Date | Time | Air Flow 1000 CFM | Differential Pressure Inches of Water Gauge Fore Filter | After Filter | Filter Total | D/P Inches W.G. Canyon to P&O | Supply Fans On | Exhaust Fans On |
|---|---|---|---|---|---|---|---|---|
| 4/24 | 0030 to 0630 | 90.0 | 4.5 | 1.8 | 6.3 | 0.36 | 2 | 2 |
| | 0845 to 1530 | 90.0 | 4.2 | 2.1 | 6.3 | " | " | " |
| | 1730 to 2230 | 90.0 | 4.4 | 1.7 | 6.1 | " | " | " |
| 4/25 | 0030 to 0625 | 90.0 | 4.4 | 1.7 | 6.1 | 0.36 | 2 | 2 |
| | 0830 | 90.0 | 4.1 | 2.2 | 6.3 | " | " | " Stack flush 0950 |
| | 1130 | 91.8 | 4.0 | 2.2 | 6.2 | " | " | " |
| | 1330 to 2330 | 95.4 | 4.4 | 1.7 | 6.1 | " | " | " |
| 4/26 | 0030 | 95.4 | 4.4 | 1.7 | 6.1 | 0.36 | 2 | 2 |
| | 0330 | " | 4.3 | 1.8 | " | " | " | " |
| | 0530 | 99.0 | " | " | " | " | " | " |
| | 0730 | " | " | " | " | " | " | " |
| | 0930 | " | 4.4 | 1.8 | 6.2 | " | " | " |
| | 1108 to 1310 | 100.8 | 4.4 | 1.8 | 6.2 | " | " | " |
| | 1515 | 99.0 | 4.4 | 1.8 | 6.2 | " | " | " |
| | 1730 to 2330 | 99.0 | 4.3 | 1.7 | 6.0 | " | " | " |
| 4/27 | 0100 to 0700 | 95.4 | 4.3 | 1.8 | 6.1 | 0.36 | 2 | 2 |
| | 0900 to 2330 | 97.2 | 4.0 | 2.3 | 6.3 | " | " | " |
| 4/28 | 0030 to 2100 | 97.2 | 4.2 | 2.0 | 6.2 | 0.36 | 2 | 2 |
| 4/29 | 0145 to 0530 | 102.6 | 4.2 | 2.0 | 6.2 | 0.36 | 2 | 2 |
| | 0830 | 68.4 | 2.0 | 2.0 | 4.0 | " | 1 | 1 Turbine exhaust dampers closed 8:22-9:05 |
| | 0900 to 2230 | 97.2 | 4.2 | 1.8 | 6.0 | " | 2 | 2 |

Table 1 - Page 7

| Date | Time | Air Flow 1000 CFM | Differential Pressure Inches of Water Gauge: Fore Filter | After Filter | Filter Total | D/P Inches W.G. Canyon to P&O | Supply Fans On | Exhaust Fans On |
|---|---|---|---|---|---|---|---|---|
| 4/30 | 0130 to 1900 | 97.2 | 4.2 | 1.9 | 6.1 | 0.36 | 2 | 2 |
| | 2300 | 96.3 | 4.2 | 1.9 | 6.1 | " | " | " |

DATA TAKEN BY F.E.O. AIR BALANCE CREW

| Date | Time | Air Flow 1000 CFM | Differential Pressure Inches of Water Gauge: Fore Filter | After Filter | Filter Total | D/P Inches W.G. Canyon to P&O (Neg.) | Stack Air Temperature W.B. °F | D.B. °F |
|---|---|---|---|---|---|---|---|---|
| 4/8 | | 105.6 | | | 11.1 | | | |
| 4/9 | | 103.0 | | | 12.15 | | | |
| | | 105.0 | (Open dampers) | | | | | |
| | 1400 | 99.890 | | | | | 63 | 90 |
| | 1500 | 98.680 | | | | | 63 | 90 |
| 4/16 | 1045 | 62.5 | | | | | | |
| | 1500 | 96.325 | | | | | | |
| 4/20 | 0900 | 99.1 | | | 6.4 | | 67 | 95 |
| | 1500 | 83.8 | | | 7.1 | | 70 | 94 |
| 4/21 | 0900 | 95.32 | 4.5 | 1.7 | 6.2 | | 72 | 96 |
| | 1245 | 95.8 | | | 6.3 | | 69 | 98 |
| | 1330 | 97.66 | | | 6.3 | | 69 | 98 |
| | 1430 | 97.32 | | | 6.3 | | 69 | 97 |
| | 1530 | 98.0 | | | 6.3 | | 69 | 97 |
| 4/22 | 1000 | 97.15 | | | 6.3 | | 63 | 94 |
| | 1400 | 95.0 | | | 6.3 | | 66 | 95 |
| 4/23 | 1000 | 88.9 | | | 6.2 | | 66 | 93 |
| | 1500 | 91.3 | | | | | 67 | 95 |
| 4/24 | 1000 | 93.5 | | | 6.2 | | 67 | 96 |
| 4/27 | 1000 | 92.675 | | | 6.1 | | 66 | 93 |
| | 1430 | 93.130 | | | 6.1 | | 77 | 93 |
| 4/28 | 1030 | 94.94 | | | 6.0 | | 66 | 96 |

# TABLE I-A

## PUREX VENTILATION

## VENTILATION FILTER D/P TRAVERSE

| Tap Location Hole Numbers | At Wall D/P Inches | 15 In. Into Glass D/P Inches | D/P Inches/Inch |
|---|---|---|---|
| 1-7 | 2.45 | 2.54 | 0.0438 |
| 1-2 | 0.12 | 0.38 | 0.38 |
| 2-3 | 0.23 | 0.29 | 0.0242 |
| 3-4 | 0.49 | 0.56 | 0.0467 |
| 4-5 | 0.67 | 0.35 | 0.0292 |
| 5-6 | 0.35 | 0.35 | 0.0292 |
| 6-7 | 0.60 | 0.61 | 0.0678 |

TABLE 2A - PUREX VENTILATION

FILTER INLET (E-7-1) SOLIDS DEPOSITION
MILLIPORE FILTER DATA

| Date | Sample No. | Time On | Time ΔT | Deposited Weight, mg | Flow $ft^3$ | Deposition Rate $mg/ft^3 \times 10^{-3}$ |
|---|---|---|---|---|---|---|
| 4/9/64 | | 1520 | 10 | 2.2 | 7.85 | 220.0 |
| 4/10/64 | | 1815 | 30 | 3.6 | 23.5 | 85.0 |
| 4/12/64 | 6 | 1317 | 103 | 0.7 | 80 | 6.8 |
| 4/18/64 | 7 | 1122 | 30 | .1 | 23.6 | 4.2 |
| | 9 | 1704 | 226 | 1.8 | 177 | 10.0 |
| 4/19/64 | 12 | 0645 | 250 | 1.0 | 196 | 5.1 |
| | 13 | 1150 | 310 | 0.6 | 243 | 2.5 |
| | 14 | 1714 | 245 | 0.9 | 192 | 4.7 |
| 4/20/64 | 16 | 0117 | 233 | 2.2 | 183 | 12.0 |
| | 18 | 0955 | 185 | 1.9 | 145 | 13.0 |
| | 19 | 1445 | 112 | 7.6 | 87.9 | 86.0 |
| | 21 | 2120 | 215 | 3.0 | 169 | 18.0 |
| 4/21/64 | 22 | 0105 | 195 | 2.0 | 153 | 13.0 |
| | 24 | 2145 | 205 | 0.9 | 161 | 5.6 |
| 4/22/64 | 25 | 0125 | 225 | 3.0 | 177 | 17.0 |
| | 26 | 0630 | 195 | 1.3 | 153 | 8.5 |
| | 27 | 1012 | 243 | 1.3 | 191 | 6.8 |
| | 29 | 1440 | 280 | 1.8 | 218 | 8.3 |
| | 28 | 1900 | 200 | 2.4 | 156 | 15.0 |
| 4/23/64 | 32 | 1100 | 85 | 0.6 | 66.3 | 9.0 |
| | 34 | 2135 | 190 | 0.2 | 202 | 1.0 |
| 4/24/64 | 35 | 0320 | 200 | 1.1 | 157 | 7.0 |
| | 37 | 1446 | 314 | 1.2 | 246 | 4.9 |
| 4/25/64 | 38 | 0325 | 170 | 0.4 | 134 | 3.0 |
| | 43 | 0944 | 318 | 0.4 | 250 | 1.6 |
| 4/26/64 | 46 | 0440 | 155 | 0.4 | 122 | 3.3 |
| | 47 | 0728 | 152 | 0.0 | 119 | 0.0 |
| | 49 | 1025 | 475 | 5.7 | 373 | 15.0 |
| | 48 | 1820 | 570 | 1.5 | 448 | 3.3 |
| 4/27/64 | 52 | 0355 | 385 | 1.4 | 302 | 4.4 |
| | 53 | 1033 | 272 | 2.5 | 214 | 16.0 |
| | 54 | 1403 | 387 | 1.9 | 304 | 6.1 |
| | 58 | 2030 | 240 | 0.3 | 188 | 1.6 |
| 4/28/64 | 57 | 0100 | 315 | 0.6 | 247 | 2.4 |
| | 61 | 0625 | 190 | 0.5 | 149 | 3.4 |
| | 63 | 0938 | 236 | 0.8 | 185 | 4.8 |
| | 64 | 1335 | 515 | 1.6 | 428 | 3.7 |
| | 67 | 2210 | 290 | 0.6 | 228 | 2.7 |
| 4/29/64 | 68 | 0300 | 215 | 0.7 | 169 | 4.14 |
| | 69 | 0635 | 195 | 0.2 | 153 | 1.31 |
| | 70 | 0952 | 206 | -0.3 | 162 | -- |
| | 100 | 1320 | 310 | 2.5 | 243 | 10.0 |
| 4/30/64 | 75 | 0220 | 645 | 3.4 | 506 | 6.14 |
| | 81 | 1407 | 353 | | | |

## TABLE 2B - PUREX VENTILATION

### FILTER INLET (E-7-1) SOLIDS DEPOSITION
### 4 in. x 8 in. FILTER PAPER DATA

| Date | Sample No. | Time | | Flow | | Deposited Weight, mg | Deposition Rate mg/ft$^3$ x 10$^{-3}$ |
|---|---|---|---|---|---|---|---|
| | | On | Off | cfm | ft$^3$ | | |
| 4/10/64 | -- | 2315 | (4/11) 1345 | 2.1 | | 0.0 | 0.0 |
| 4/11/64 | -- | 1635 | 0900 | 2.1 | 2079 | 12.0 | 5.8 |
| 4/12/64 | -- | 1000 | (4/13) 1030 | 2.4 | 3528 | 86.8 | 25 |
| 4/13/64 | -- | 1030 | (4/15) 1100 | 2.1 | 6984 | 19.4 | 2.8 |
| 4/17/64 | 1 | 1430 | 0100 | 2.1 | 1323 | 2.2 | 1.7 |
| 4/18/64 | 2 | 0100 | 0630 | 2.1 | 693 | 13.8 | 20 |
| | -- | 0900 | 2100 | 2.1 | 1512 | 29.6 | 20 |
| | -- | 2100 | 0225 | 2.1 | 682 | 38.1 | 61 |
| 4/19/64 | -- | 0230 | 0930 | 2.1 | 882 | 42.4 | 48 |
| 4/20/64 | -- | 0600 | 0840 | 2.5 | 400 | 128.1 | 320 |
| | -- | 0840 | 0940 | 2.2 | 132 | 14.9 | 110 |
| | -- | 1305 | 1515 | 2.2 | 286 | 2.9 | 10 |
| | 2 | 1635 | 1755 | 2.6 | 156 | 0.0 | 0.0 |
| | 3 | 1755 | 1910 | 2.6 | 195 | 1.1 | 5.6 |
| 4/21/64 | 4 | 0530 | 0610 | 2.2 | 154 | 4.3 | 28 |
| | 5 | 1500 | 1600 | 2.2 | 132 | 0.0 | 0.0 |
| | 6 | 2210 | 2310 | 2.2 | 132 | -26.6 | -- |
| 4/22/64 | 7 | 1307 | 1415 | 2.2 | 150 | 24.1 | 160 |
| | 8 | 1645 | 1715 | 2.0 | 60 | -22.1 | -- |
| 4/23/64 | 9 | 0225 | 0240 | 2.2 | 33 | -8.6 | -- |
| | 10 | 1307 | 1344 | 2.1 | 78 | -3.5 | -- |
| | 11 | 1815 | 1845 | 2.1 | 63 | -0.7 | -- |
| 4/24/64 | 12 | 0155 | 0225 | 2.2 | 66 | 3.6 | 54 |
| | 13 | 1325 | 1355 | 2.2 | 22 | 3.6 | 160 |
| | 14 | 1700 | 1730 | 2.1 | 63 | 3.2 | 51 |
| 4/25/64 | 15 | 0050 | 0120 | 2.3 | 69 | 2.5 | 36 |
| | 16 | 1015 | 1110 | 2.2 | 121 | 0.6 | 5 |
| | 17 | 1645 | 1715 | 2.0 | 60 | 0.2 | 3.3 |
| 4/26/64 | 18 | 0030 | 0100 | 2.2 | 66 | -- | -- |
| | 19 | | | | | | |
| | 20 | 1720 | 1750 | 2.1 | 63 | -11.3 | -- |
| 4/27/64 | 20 | 0245 | 0315 | 2.2 | 45 | 1.8 | 40 |
| | 30 | 1300 | 1330 | 2.3 | 69 | .09 | 1.3 |
| | 13 | 1715 | 1745 | 2.0 | 60 | .58 | 9.7 |
| 4/28/64 | 28 | 1815 | 1845 | 2.0 | | | 5.9 |
| 4/29/64 | -- | 1345 | 1415 | 2.2 | 66 | 8.7 | 13 |
| 4/30/64 | -- | 0135 | 0205 | 2.2 | 66 | 17.9 | 27 |

TABLE 3A - PUREX VENTILATION

HUMIDITY DATA TAKEN AT PUREX STACK BY SLING PSYCHROMETER

| Date | Time | Wet Bulb Temp., °F | Dry Bulb Temp., °F | Dew Point °F | Relative Humidity % |
|---|---|---|---|---|---|
| 4/9/64 | 1400 | 67 | 103 | 48 | 18 |
| 4/13/64 | 1300 | 62 | 86 | 45 | 22 |
| 4/16/64 | 1045 | 63 | 90 | 44 | 20 |
| 4/20/64 | 0900 | 67 | 95 | 50 | 22 |
| | 1500 | 70 | 94 | 58 | 30 |
| | 2100 | 70 | 83 | 65 | 51 |
| | 2230 | 70 | 94 | 58 | 29 |
| | 2315 | 69 | 94 | 58 | 29 |
| 4/21/64 | 1630 | 69 | 96 | 59 | 30 |
| | 1730 | 69 | 96 | 59 | 30 |
| | 1830 | 70 | 95 | 59 | 30 |
| | 1930 | 70 | 95 | 59 | 30 |
| | 2030 | 70 | 95 | 59 | 30 |
| | 2130 | 67 | 93 | 58 | 30 |
| | 2230 | 67 | 93 | 58 | 30 |
| | 2330 | 67 | 92 | 58 | 30 |
| 4/22/64 | 1115 | 63 | 94 | 40 | 17 |
| | 1530 | 66 | 95 | 47 | 20 |
| 4/23/64 | 1030 | 66 | 93 | 49 | 22 |
| | 1325 | 67 | 95 | 50 | 21 |
| 4/24/64 | 1115 | 67 | 96 | 50 | 20 |
| 4/27/64 | 0900 | 67 | 95 | 50 | 22 |
| | 1000 | 66 | 93 | 49 | 22 |
| | 1430 | 77 | 93 | 58 | 31 |
| 4/28/64 | 1030 | 66 | 96 | 50 | 20 |
| 4/29/64 | 1530 | 68 | 97 | 46 | 19 |
| 5/6/64 | 1530 | 71 | 101 | 55 | 21 |

## TABLE 3B - PUREX VENTILATION

DEW POINT DATA - FILTER INLET/OUTLET
BY CONTINUOUS DEW POINT RECORDING APPARATUS

| Date | Time | Dew Point Filter Inlet °F | Date | Time | Dew Point Filter Inlet °F | Date | Time | Dew Point Filter Inlet °F | Dew Point Filter Exit °F |
|---|---|---|---|---|---|---|---|---|---|
| 4/21/64 | 0040 | 35 | 4/23/64 | 1930 | 40 | 4/26/64 | 2330 | 36 | |
| | 0200 | 36 | | 2130 | 41 | 4/27/64 | 0100 | 36 | |
| | 0415 | 36 | | 2330 | 40 | | 0300 | 36 | |
| | 0615 | 37 | 4/24/64 | 0030 | 40 | | 0500 | 36 | |
| | 0900 | | | 0230 | 40 | | 0700 | 35 | |
| | 1100 | | | 0430 | 40 | | 0900 | 34 | |
| | 1200 | | | 0630 | 42 | | 1100 | 36 | |
| | 1300 | | | 0845 | 39 | | 1300 | 36 | 52 |
| | 1400 | | | 1115 | 42 | | 1500 | 36 | 54 |
| | 1500 | | | 1230 | 41 | | 1730 | 36 | 54 |
| | 1530 | | | 1330 | 41 | | 1930 | 36 | 54 |
| | 1630 | | | 1500 | --* | | 2130 | 36 | 53 |
| | 1730 | | | 1530 | --* | | 2330 | 36 | 53 |
| | 1830 | | | 1730 | 48 | 4/28/64 | 0030 | 37 | 48 |
| | 1930 | | | 1930 | 50 | | 0230 | 37 | 46 |
| | 2030 | | | 2130 | 50 | | 0430 | 35 | 44 |
| | 2130 | | | 2230 | 50 | | 0630 | 35 | 42 |
| | 2230 | | 4/25/64 | 0030 | 47 | | 0830 | 35 | 40 |
| | 2330 | | | 0230 | 45 | | 1030 | 38 | 39 |
| 4/22/64 | 0130 | | | 0430 | 45 | | 1230 | 38 | 38 |
| | 0245 | | | 0625 | 45 | | 1430 | 39 | 38 |
| | 0530 | | | 0830 | 43 | | 1700 | 37 | 37 |
| | 0715 | | | 1130 | 41 | | 2100 | 37 | 35 |
| | 0915 | 35 | | 1330 | 39 | 4/29/64 | 0145 | 39 | 32 |
| | 1115 | 39 | | 1530 | 37 | | 0300 | 39 | 33 |
| | 1330 | 42 | | 1730 | 45 | | 0530 | 41 | 34 |
| | 1530 | 38 | | 1930 | 44 | | 0900 | 41 | 41 |
| | 1730 | 38 | | 2130 | 44 | | 1430 | 35 | 35 |
| | 1930 | 42 | | 2330 | 45 | | 1530 | | 46 |
| | 2130 | 42 | 4/26/64 | 0030 | 44 | | 1630 | 34 | 35 |
| | 2330 | 41 | | 0330 | 42 | | 1830 | 35 | 34 |
| 4/23/64 | 0045 | 40 | | 0530 | 41 | | 2030 | 33 | 32 |
| | 0210 | 43 | | 0730 | 41 | | 2230 | 33 | 32 |
| | 0430 | 44 | | 0930 | 42 | 4/30/64 | 0130 | 33 | 31 |
| | 0630 | 45 | | 1108 | 42 | | 0400 | 32 | 31 |
| | 0900 | 47 | | 1205 | 41 | | 0700 | 28 | 31 |
| | 1030 | 47 | | 1310 | 39 | | 1100 | 28 | 31 |
| | 1130 | 46 | | 1515 | 39 | | 1500 | 30 | 31 |
| | 1325 | 43 | | 1730 | 40 | | 1900 | 28 | 31 |
| | 1525 | 95 | | 1930 | 40 | | 2300 | 30 | 32 |
| | 1730 | 40 | | 2130 | 36 | | | | |

* Out of service.

## TABLE 3C - PUREX VENTILATION
## HUMIDITY DATA TAKEN AT PUREX AIR TUNNEL
## DETERMINED BY CLOUD CUP METHOD

| Date | Time | Dew Point °F |
|---|---|---|
| 4/18/64 | 0900 | +40 |
| | 0930 | +43 |
| 4/20/64 | 2115 | +14 |
| 4/21/64 | 0430 | +39 |
| 4/22/64 | 0115 | +46 |
| | 0515 | +45 |

## TABLE 3D - PUREX VENTILATION
## HUMIDITY DATA TAKEN AT PUREX AIR TUNNEL
## DETERMINED BY G.E. DEW POINT APPARATUS
## OPERATED ON A TRAPPED SAMPLE

| Date | Time | Dew Point °F |
|---|---|---|
| 4/18/64 | 1630 | -15 |
| | 2120 | -20 |
| 4/19/64 | 0930 | -20 |

## TABLE 3E - PUREX VENTILATION
## HUMIDITY DATA TAKEN AT PUREX AIR TUNNEL
## DETERMINED BY G.E. DEW POINT APPARATUS
## OPERATED ON A CONTINUOUS FLOW SAMPLE

| Date | Time | Dew Point °F |
|---|---|---|
| 4/19/64 | 0945 | +25 |
| | 1130 | +20 |
| | 1710 | +17 |
| | 2120 | +19 |
| 4/20/64 | 0515 | +15 |
| | 1445 | +48 |
| | 2110 | +40 |
| 4/21/64 | 0430 | +34 |
| | 2145 | +55 |
| 4/22/64 | 0120 | +49 |
| | 0515 | +41 |
| | 1000 | +54 |

TABLE 4 - PUREX VENTILATION

SPECIAL SAMPLES ANALYZED FOR AMMONIA

**Process Vessels**

| Date | Sample Ident. | Ammonia Positive | Ammonia Negative | Ammonia lbs/gal |
|---|---|---|---|---|
| 4/10/64 | F10 | x | | |
| 4/11/64 | F10 | | x | |
| | XC | | x | |
| | F13 | x | | 0.033 |
| | J1 | x | | 0.0004 |
| | F7 | | x | |
| | F15 | | x | |
| | F16 | | x | |
| | F10 | | x | |
| 4/12/64 | U1 | | x | |
| | U2 | | x | |
| | F3 | | x | |
| | F13 | | x | |
| | J21 | x | | 0.006 |
| | D5 | | x | |
| | G1 | | x | |
| | R1 | | x | |
| | J5B | | x | |
| | F10 | | x | |
| | $UO_3$ | | x | |
| | F7 | | x | |
| | J1 | x | | 0.004 |
| | F15 | | x | |
| | Tank A10 | | x | |
| | Tank 417 | x | | 0.0007 |
| | P5 | | x | |

**Dry Chemicals**

| Date | Sample Ident. | Ammonia Positive | Ammonia Negative | Ammonia lbs/gal |
|---|---|---|---|---|
| 4/13/64 | Sulfamic Acid | x | | 0.012 |
| | Potassium Permanganate | | x | |
| | Tartaric Acid | | x | |
| | Sodium Nitrate | | x | |
| | Sodium Nitrite | | x | |
| | Sodium Sulfate | | x | |
| | Oxalic Acid | | x | |
| | Sodium Carbonate | | x | |
| | Sugar | | x | |
| | Hydrazine | x | | 0.005 |
| | Ferrous Sulfamate | x | | |
| | Versenax 80 (TLA) | | x | |
| | Sweeping Compound | x | | <0.001 |
| | Sodium Hyposulfite | | x | |
| | Sodium Phosphate | | x | |
| | Citric Acid | | x | |
| | Ammonium Sulfate | x | | -- |
| | Ferrous Ammonium Sulfate | x | | -- |
| | Anhydrous Sodium Sulfate | | x | |
| | Hydroxy Acetic Acid | | x | |
| | Lead Nitrate | | x | |

TABLE 4 - (Continued)

| AMU Tanks | | | | | |
|---|---|---|---|---|---|
| Date | Sample Ident. | | Ammonia | | |
| | AMU Tank No. | Chem. Service | Positive | Negative | lbs/gal |
| 4/13/64 | 101 | Ferrous Sulfamate | | x | |
| | 103 | Potassium Permanganate | | x | |
| | 104 | Sodium Nitrate | x | | Trace |
| | 105 | Utility | | x | |
| | 106 | Sodium Nitrite | | x | |
| | 107 | Sodium Carbonate | | x | |
| | 108 | Utility | | x | |
| | 150 | XCX(Nitric) | | x | |
| | 151 | Potassium Permanganate | | x | |
| | 152 | Sodium Nitrite | | x | |
| | 153 | Sodium Hydroxide | | x | |
| | 201 | Sodium Hydroxide | | x | |
| | 202 | Sodium Hydroxide | | x | |
| | 203 | Sodium Hydroxide | | x | |
| | 204 | Sugar | | Empty | |
| | 205 | Utility | | Empty | |
| | 206 | Utility | | x | |
| | 207 | Sodium Nitrate | | x | |
| | 208 | Sodium Carbonate | | x | |
| | 209 | 1BX | | Empty | |
| | 210 | 1BX | x | | 0.0001 |
| | 211 | 2AS | | x | |
| | 212 | 2AS | | Empty | |
| | 213 | 2BX | x | | 0.001 |
| | 214 | 2BX | | Empty | |
| | 215 | Nitric Acid | | x | |
| | 216 | Ferrous Sulfamate | | x | |

| AMU Tanks | | | | | |
|---|---|---|---|---|---|
| Date | Sample Ident. | | Ammonia | | |
| | AMU Tank No. | Chem Service | Positive | Negative | lbs/gal |
| 4/13/64 | 217 | Ferrous Sulfamate | x | | 0.006 |
| | 218 | Utility | | Empty | |
| | 219 | Utility | | Empty | |
| | 220 | 3AS | x | | 0.0005 |
| | 221 | 3AS | x | | 0.0006 |
| | 222 | Nitric Acid | | x | |
| | 223 | Demineralized Water | | x | |
| | 224 | 3BX | | Empty | |
| | 22S | 3BX | | x | |
| | 324 | Utility | | Empty | |

TABLE 5A - PUREX VENTILATION

SUMMARY OF CHEMICAL COMPOSITION OF FOREIGN MATERIAL ON PUREX VENT FILTER*

| | 4" Diameter, 12" Long Core Taken 4/15/64 | | | | |
|---|---|---|---|---|---|
| | White Powder % | Grey Crust % | Middle of Core % | End of Core % | 1/2" Diameter Core Taken 4/13/64 |
| Ammonium Nitrate | 80 | 44-53 | -- | -- | 44 |
| Silicon Dioxide | -- | 7-12 | -- | -- | 8-12 |
| Water | 2-3 | 5-9 | -- | -- | 9 |
| Organic Material | -- | 3-6 | -- | -- | 9 |
| Iron (as oxide) | -- | 8-11 | -- | -- | 11 |
| HCl Insoluble Residue | -- | 1-2 | -- | -- | 10-15 |
| Water Insoluble Sub. | 11 | -- | 4 | 4 | -- |
| Water Soluble | -- | -- | 54 | 41 | -- |
| Trace Elements | 6 | 3 | -- | -- | -- |
| TOTAL | 100 | 100 | 58 | 45 | 100 |

* All numbers are percent of total weight of original.

TABLE 5B - PUREX VENTILATION

COMPOSITION OF MATERIAL ENTRAINED IN PUREX VENT FILTER
(All concentrations are expressed as percent of original material)

| | 4" Diameter, 12" Long Sample Taken 4/15/64 | | 1/2" Diameter Sample Taken 4/13/64 |
|---|---|---|---|
| | White Powder | Grey Crust | |
| Water Soluble Substance | 86.0 | 61.1 | -- |
| Water Insoluble Substance | 11.0 | 28.6 | -- |
| Water | 2.1 | 5.4 | 9 |
| TOTAL | 99.1 | 100.1 | -- |
| Water Soluble Constituent | | | HCl + $H_2O$ Soluble Constituent |
| $NH_4$+ | 18 | 12 | 10 |
| $NA_3$+ | 65 | 47 | 37 |
| Na+ | 0.2 | 0.2 | 0.4 |
| Mg+ | 0.06 | 0.1 | -- |
| Ca+ | 0.03 | 1.1 | -- |
| Fe+ | -- | 0.8 | 11 |
| $R_2O_3$ | -- | -- | 9 |
| TOTAL | 83.3 | 61.2 | 67.4 |
| $NH_4$+ calculated as $NH_4NO_3$ | 80 | 53 | 44 |
| Weight Loss @ 1000°C | 76.2 | 62 | -- |
| @ 450°C | -- | -- | 71 |
| Organic Material Extracted with $CCl_4$ | -- | 6 | 3 |
| Water Insoluble Constituent | | | |
| Total HCl Soluble Material | -- | 11.9 | -- |
| HCl Soluble Fe | -- | 5.4 | -- |
| HCl Soluble $NH_4$+ | -- | <0.1 | -- |
| HCl Soluble Ca | -- | <0.1 | -- |
| Total HCl Insoluble Material | -- | 16.7 | -- |
| HCl Insoluble Fe | -- | 2.2 | -- |
| HCl Insoluble $SiO_2$ | -- | 7.0 | 8-12 |
| HCl Insoluble Residue | -- | 1.0 | 10-12 |
| Qualitative Test - HCl and Water Soluble | | | |
| $PO_4$ | -- | -- | Negative |
| $SO_4$ | -- | -- | Negative |
| $CO_3$ | -- | -- | Negative |
| $NO_3$ | -- | -- | Positive |

TABLE 5C - PUREX VENTILATION

SOLUBILITY OF CRUST LAYER FROM INITIAL CORE SAMPLE OF PUREX VENT FILTER

(Samples taken from north bay of primary filter on 4/10/64)

| Solvent | Solubility | Remarks |
|---|---|---|
| Cold Water | Not Soluble | |
| Hot Water | Slightly Soluble | |
| Dilute $NH_4OH$(0.3M) | Slightly Soluble | |
| Dilute NaOH(0.3M) | Approximately 50% Dissolved | Black Residue |
| Dilute $HNO_3$(0.5M) | Not Soluble | |
| Conc. $HNO_3$(13M) | Slightly Soluble | |
| HCl (8M) | Slightly Soluble | |
| Ethanol (95%) | Approximately 50% Dissolved | Some Residue |
| $CCl_4$ | Slightly Soluble | |
| Acetone | Slightly Soluble | |
| Anion Test | $NO_3^-$ - Positive | $CO_3^{-2}$ - Negative |
| | $SO_4^{-2}$ - Negative | $SO_3^{-2}$ - Negative |

TABLE 6 - PUREX VENTILATION

FILTER BED DEPTH MEASUREMENTS

| Date | Time | Where Measured Hole No. | Depth From Top of Vault to Surface of Filter, inches | Change in Depth From First Measurement, inches | Remarks |
|---|---|---|---|---|---|
| 4/9/64 | 2300 | 1 | 73-3/4 | 0 | 2 supply, 3 exhaust - fans |
| 4/10/64 | 1400 | 1 | 73-3/4 | 0 | |
| | 1530 | 1 | 67 | 6-3/4 | Supply fan off, one exhaust fan |
| 4/13/64 | 1000 | 1 | 73-1/2 | 1/4 | Tunnel door test - Hi canyon D/P |
| 4/14/64 | 1630 | 1 | 62-1/2 | 11-1/4 | After power outage |
| | 1930 | 1 | 62-1/2 | | |
| | 1930 | 2 | 62-1/2 | | |
| | 1930 | 3 | 62-1/2 | | |
| 4/16/64 | 1400 | 1 | 62-1/2 | 11-1/4 | Test Basis Readings |
| | | 2 | 62-1/2 | | |
| | | 3 | 61-1/2 | 12-1/4 | |
| | 1430 | 3 | 65 | 8-3/4 | Added one exhaust fan |
| | 1445 | 3 | 64 | 9-3/4 | One supply plus one exhaust fan |
| | 1515 | 3 | 65 | 8-3/4 | 2 supply, 2 exhaust fans |
| 4/17/64 | 1125 | 3 | 67 | 6-3/4 | Test: block removal |
| 4/20/64 | 1200 | 3 | 67-1/2 | 6-1/4 | Prior to sealing hole |

TABLE 7

**EMISSION SPECTROGRAPHIC ANALYSIS OF CRUST SAMPLES AND POSSIBLE SOURCES OF CRUST LAYER OF PUREX VENT FILTER**

(S = >1%   M = 1% ± 0.01%   T = 0.01%)

| | 4" Diameter 12" long Sample Taken 4/15/64 | | | | | | 1/2" Long Sample Taken 4/13 | | Media from Driers | | | Solids From Filter on Inst. Air-C.C. | 1st Cascade Impactor | Solid Crust on Filter |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | White Powder | Water Solution | Water Insoluble Material | Grey Crust | Water Solution | Crust | Black Residue | New Glass Fiber | 4/11/64 | 4/11/64 | 4/11/64 | 4/10/64 | 4/10/64 | 4/10/64 |
| Ag | M | T | M | M | T | M | M | - | - | - | - | - | - | M |
| Al | M-S | T-M | S | S | T-M | S | S | M-S | T | T | S | S | - | S |
| B | M | - | M | M | - | - | M | M-S | - | - | - | - | - | - |
| Ca | M-S | M | M-S | M-S | M | M-S | M | M | T | M | T | T | - | M-S |
| Cu | M | T | M | M | T | M | T | T | T | T | - | - | S | M |
| Fe | M-S | T | S | S | T | S | S | M | S | T | T | S | - | S |
| Mg | M | M | M | M | M | M | M | M | M | S | T | M | S | M |
| Mn | M | M | M | M | M | M | M | T | M | - | - | M | - | M |
| Na | M-S | M | S | S | M | S | M-S | S | M | S | S | M-S | - | S |
| Ni | - | - | M | M | - | M | T-M | - | T | - | - | T | - | - |
| Pb | T-M | - | M | M | - | - | M | M | - | - | - | - | - | - |
| Si | S | T | S | S | T | S | S | S | - | M | M | S | S | S |
| Ti | M | - | S | M | - | M | S | M | - | - | - | M | - | M |
| Sn | - | - | - | M | - | T | - | - | T | - | - | T | - | - |
| U | - | - | M-S | M-S | - | - | - | - | - | - | - | - | - | - |
| Zn | - | - | - | - | - | - | - | - | - | - | - | M | - | - |
| Li | - | - | - | - | - | - | - | - | - | T | M | T | - | S |
| Cr | - | - | - | - | - | - | - | - | - | - | - | T | - | M |
| K | - | - | - | - | - | - | - | - | - | - | - | - | - | S |

TABLE 8 - VENTILATION MEASUREMENTS FOR PUREX PLANT OPERATION

| Measurement | Location | Type | Frequency | Status |
|---|---|---|---|---|
| Air Flow | Canyon Supply (inlet duct) | Recording | Continuous (2 hr)-P | New Power CR |
| | Stack (fan discharge) | Recording | Continuous (1/shift)-P | Existing - 291 |
| DP | Canyon | Recording | Continuous (2 hr)-P | Existing - Power CR |
| | Air Tunnel (in Canyon) | Recording | Continuous (2 hr)-P | Existing - Power CR |
| | Filter: Primary | Recording | Continuous (1/shift)-P | New-No. 2 Sample House |
| | Secondary | Calculated | 1/Shift - P | New-No. 2 Sample House |
| | Total | Recording | Continuous (1/shift)-P | New-No. 2 Sample House 8" alarm in C.C. |
| | Traverse | Horiz. Holes | Upon Request - P | New-S. Side of Filter |
| Temperature | Canyon Supply (inlet duct) | Recording | Continuous (1/shift)-P | New-Fan Exhaust Plenum |
| | Canyon | Recording | Continuous (2 hr)-P | Existing - Power CR |
| | Stack (fan discharge) | Recording | Continuous (1/shift)-P | New - 291 |
| | Air Tunnel | Recording | Continuous (1/shift)-P | New-No. 1 Sample House |
| Rad. Activity | Air Tunnel to Filter | Filter Paper | 1/Day - P | New-No. 1 Sample House |
| | Downstream Filter | Filter Paper | 1/Day - P | New-No. 2 Sample House |
| | Stack-50' Level-Filter | Filter Paper and Strip Sampler | Continuous - 5/week - P | Existing - 291 |
| | Stack-200' Level-Beta Filter | Millipore | Continuous - 1/day - HL | Existing - 291 |
| | Deposition Pads | 7 Filter Pads | 1/Week - P | Existing - 291 |
| Humidity | Canyon Supply Air | Wet-Dry | Upon Request - FEO | New-Purex Building |
| | Air Tunnel to Filter | Recording Dew Pt. | Continuous (1/shift)-P | New-No. 1 Sample House |
| | Downstream of Filter | Recording Dew Pt. | Continuous (1/day)-P | New - 291 |
| Particle Quantity | Air Tunnel to Filter | Millipore (Cascade Impact) | 1/Shift - P<br>On Request - P | New-No. 1 Sample House |
| | Stack | Filter Paper | 5/Week - HL | Existing - Routine |

P - Purex Personnel
FEO - Air Balance Unit
HL - Regional Monitoring Unit

## TABLE 9

### PUREX DISSOLVER OPERATIONS
### AMMONIA BALANCE - COATING REMOVAL

| Cell | $NH_4$ Recovered 216A TK-2 Pounds | Total Solids Deposited mg/1000 cu.ft. |
|---|---|---|
| A | 93 | 10.1 |
| B | 36 | 1.3 |
| A | 153 | 17.2 |
| B | 76 | 3.7 |
| C | 62 | 18.4 |
| A | 245 | 1.3 |
| C | 128 | 38.0 |
| B | 73 | 4.5 |
| A | 82 | 22.0 |
| C | 14 | 15.0 |
| B | 76 | 2.5 |
| A | 167 | 8.3 |
| C | 5 | 0.0 |
| B | 96 | 6.2 |
| A | 42 | 0.0 |
| C | 40 | 7.7 |
| A | 10 | 2.2 |
| A | 128 | 12.0 |
| C | 46 | 3.7 |
| A | 84 | 12.0 |

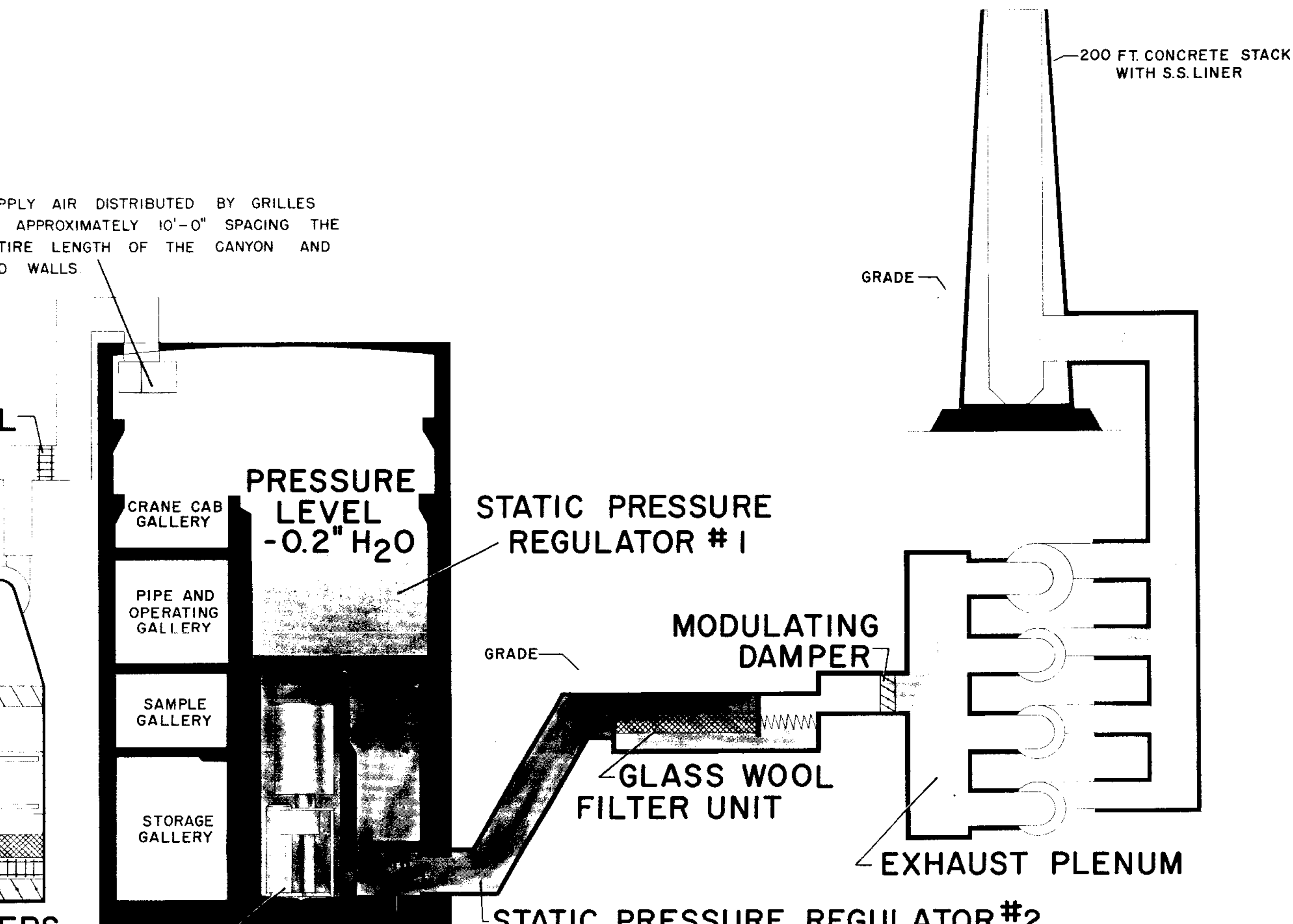
### SUMMARY

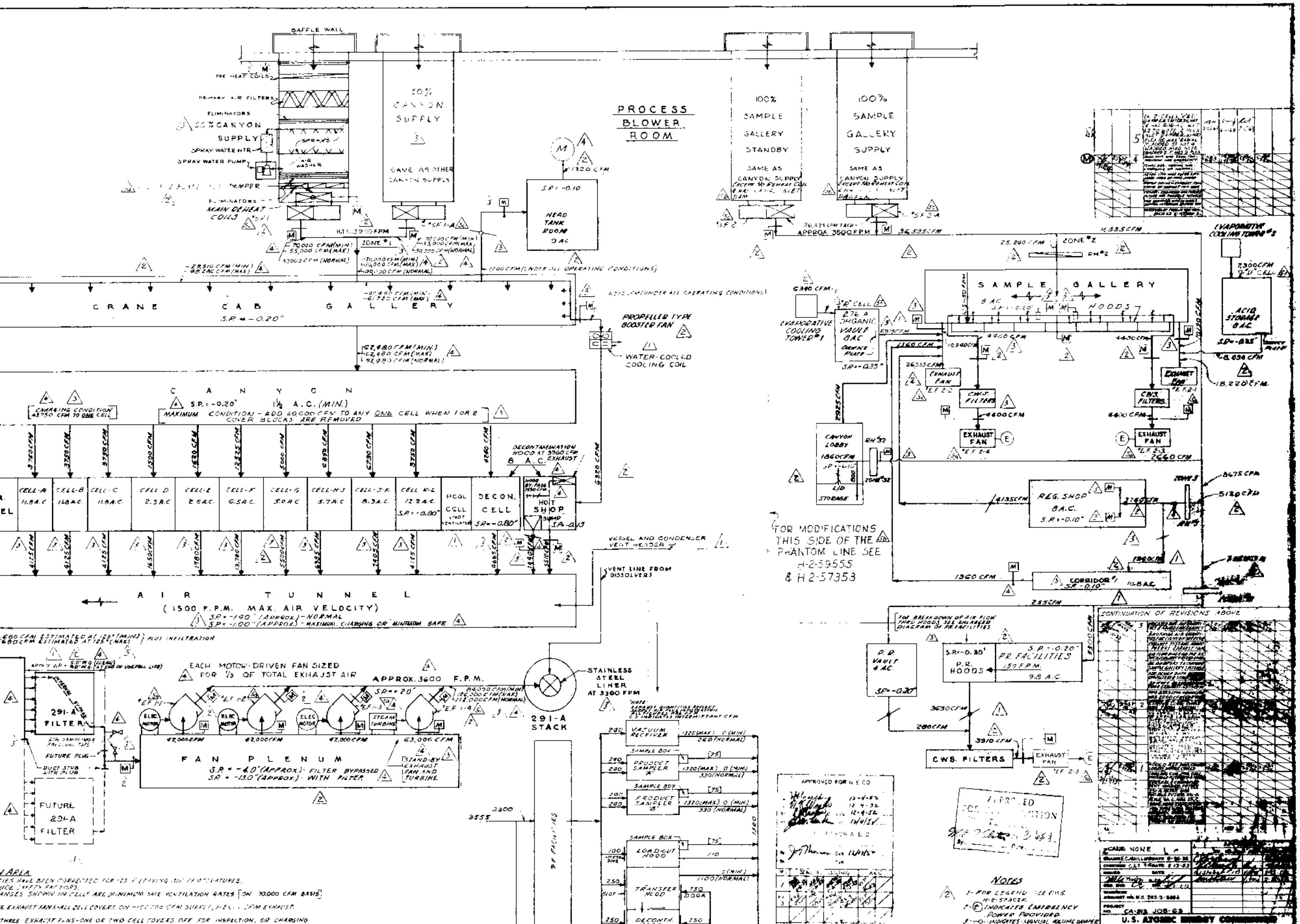
216A TK-2 AMMONIUM ION

| Cell | Freq. | Range Lo | Range High | Ave. |
|---|---|---|---|---|
| A | 9 | 10 | 245 | 111.6 |
| B | 5 | 36 | 96 | 71.4 |
| C | 6 | 5 | 128 | 49.2 |

TOTAL SOLIDS DEPOSITED

| Cell | Freq. | Range Lo | Range High | Ave. |
|---|---|---|---|---|
| A | 9 | 0.0 | 22.0 | 9.5 |
| B | 5 | 1.3 | 6.2 | 3.6 |
| C | 6 | 0.0 | 38.0 | 13.8 |


PPLY AIR DISTRIBUTED BY GRILLES
APPROXIMATELY 10'-0" SPACING THE
TIRE LENGTH OF THE CANYON AND
D WALLS
200 FT. CONCRETE STACK
WITH S.S. LINER
GRADE
PRESSURE
LEVEL
-0.2" H2O
STATIC PRESSURE
REGULATOR # 1
CRANE CAB
GALLERY
PIPE AND
OPERATING
GALLERY
SAMPLE
GALLERY
STORAGE
GALLERY
GRADE
MODULATING
DAMPER
GLASS WOOL
FILTER UNIT
EXHAUST PLENUM
STATIC PRESSURE REGULATOR #2


PROCESS BLOWER ROOM
50% CANYON SUPPLY
SAME AS OTHER CANYON SUPPLY
100% SAMPLE GALLERY STANDBY
100% SAMPLE GALLERY SUPPLY
HEAD TANK ROOM
CRANE CAB GALLERY
S.P. = -0.20"
PROPELLER TYPE BOOSTER FAN
WATER-COOLED COOLING COIL
CANYON
S.P. = -0.20"
1½ A.C. (MIN.)
MAXIMUM CONDITION - ADD 40,000 CFM TO ANY ONE CELL WHEN 1 OR 2 COVER BLOCKS ARE REMOVED
POOL CELL
DECON. CELL
HOT SHOP
AIR TUNNEL
(1500 F.P.M. MAX. AIR VELOCITY)
EACH MOTOR-DRIVEN FAN SIZED FOR 1/3 OF TOTAL EXHAUST AIR
APPROX. 3600 F.P.M.
FAN PLENUM
291-A FILTER
FUTURE 291-A FILTER
291-A STACK
STAINLESS STEEL LINER AT 3300 FPM
VESSEL AND CONDENSER VENT HEADER
VENT LINE FROM DISSOLVERS
SAMPLE GALLERY
HOODS
EVAPORATIVE COOLING TOWER #1
EVAPORATIVE COOLING TOWER #2
ACID STORAGE 8 A.C.
CANYON LOBBY
REG. SHOP 8 A.C.
CORRIDOR
EXHAUST FAN
CWS FILTERS
CWS. FILTERS
FOR MODIFICATIONS THIS SIDE OF THE PHANTOM LINE SEE H-2-59555 & H-2-57353
P.R. VAULT 4 AC.
P.R. HOODS
PR. FACILITIES
VACUUM RECEIVER
PRODUCT SAMPLER "A"
PRODUCT SAMPLER "B"
LOAD-OUT HOOD
TRANSFER HOOD
DECONTN.
PR FACILITIES
CONTINUATION OF REVISIONS ABOVE
APPROVED
NOTES
1- FOR LEGEND SEE DWG.
2-(E) INDICATES EMERGENCY POWER PROVIDED
U.S. ATOMIC ENERGY COMMISSION

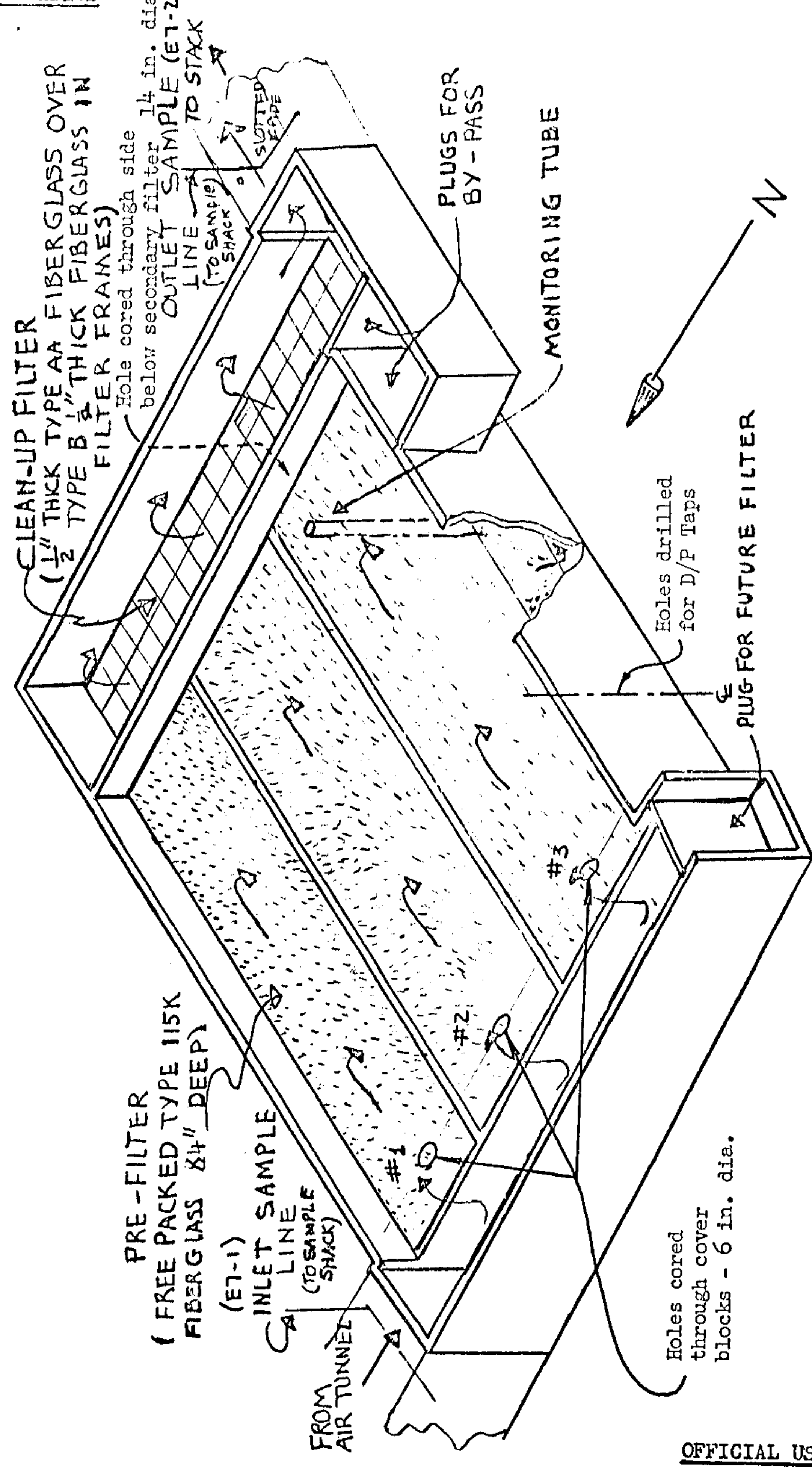
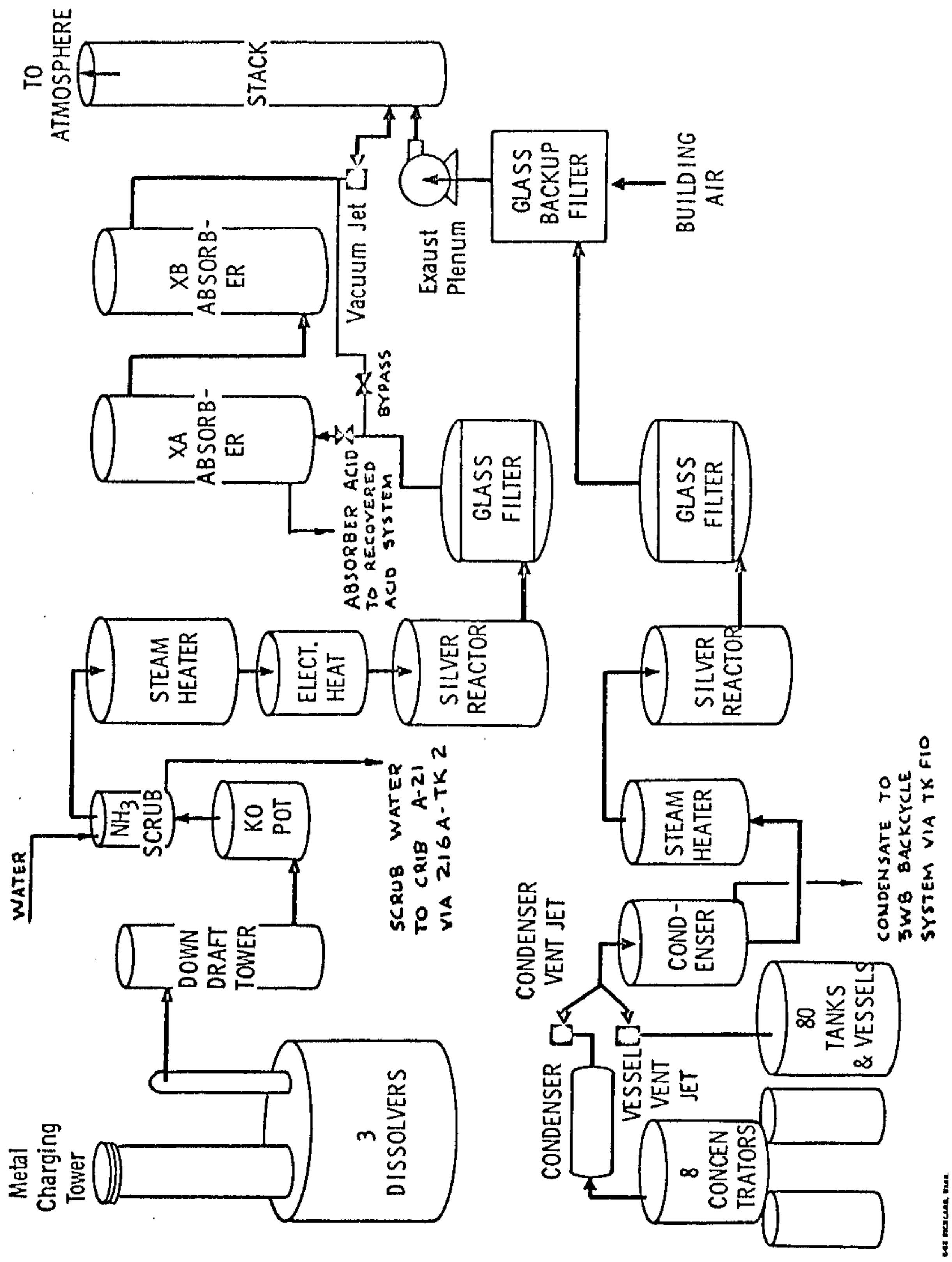



FIGURE 3

CUTAWAY OF PROCESS VENTILATION AIR FILTER

FIGURE 4

## OFF GAS TREATMENT AND IODINE CONTROL SYSTEM



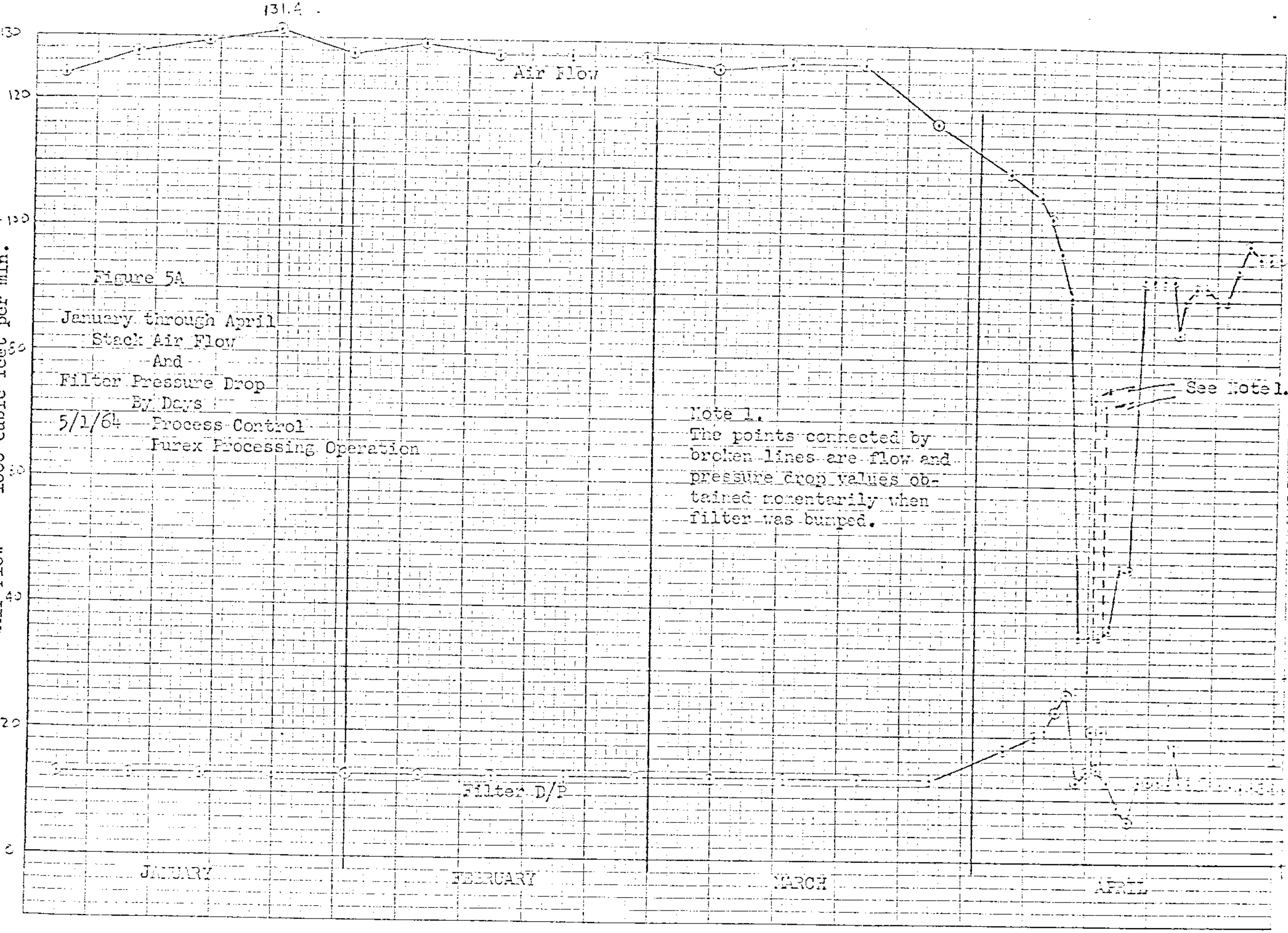
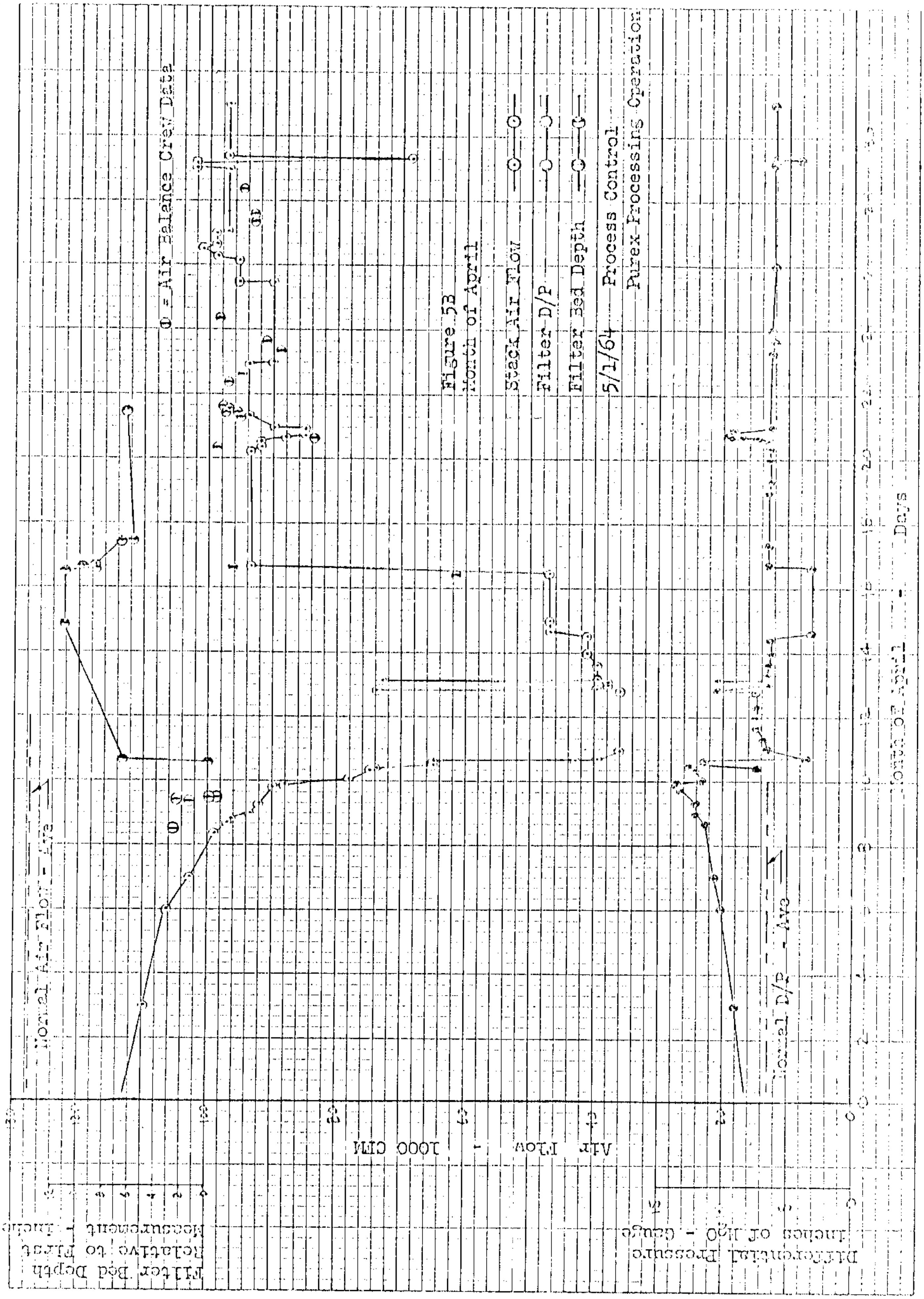



Figure 5A

January through April
Stack Air Flow
And
Filter Pressure Drop
By Days
5/1/64 Process Control
Purex Processing Operation


Φ = Air Balance Crew Data
Figure 5B
Month of April
Stack Air Flow
Filter D/P
Filter Bed Depth
5/1/64 Process Control
Purex-Processing Operation
Normal Air Flow - Avg
Normal D/P - Avg
Month of April - Days
Air Flow - 1000 CFM
Filter Bed Depth Relative to First Measurement - Inches
Differential Pressure Inches of $H_2O$ - Gauge

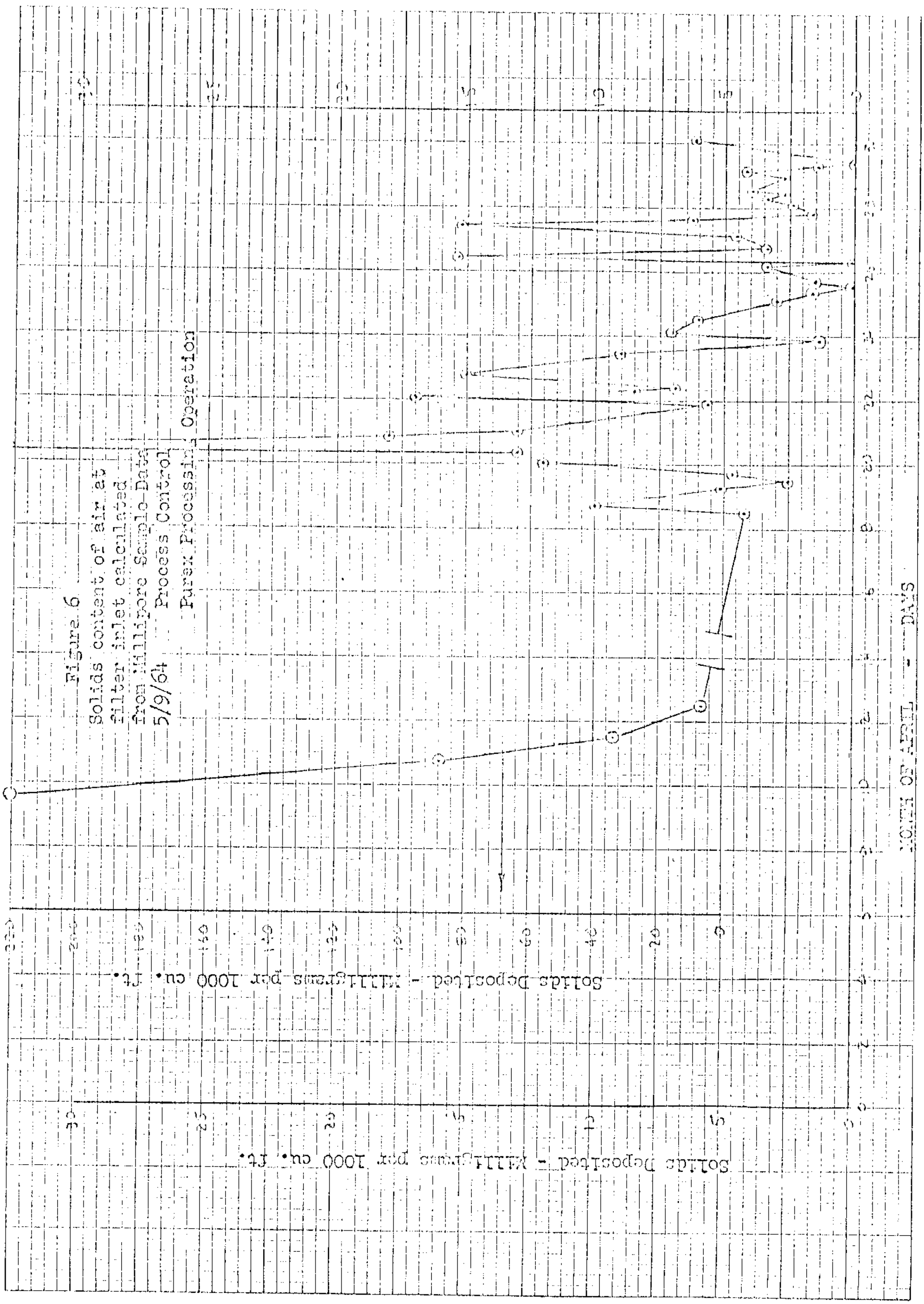



Figure 6
Solids content of air at filter inlet calculated from Millipore Sample Data
5/9/64
Process Control
Purex Processing Operation

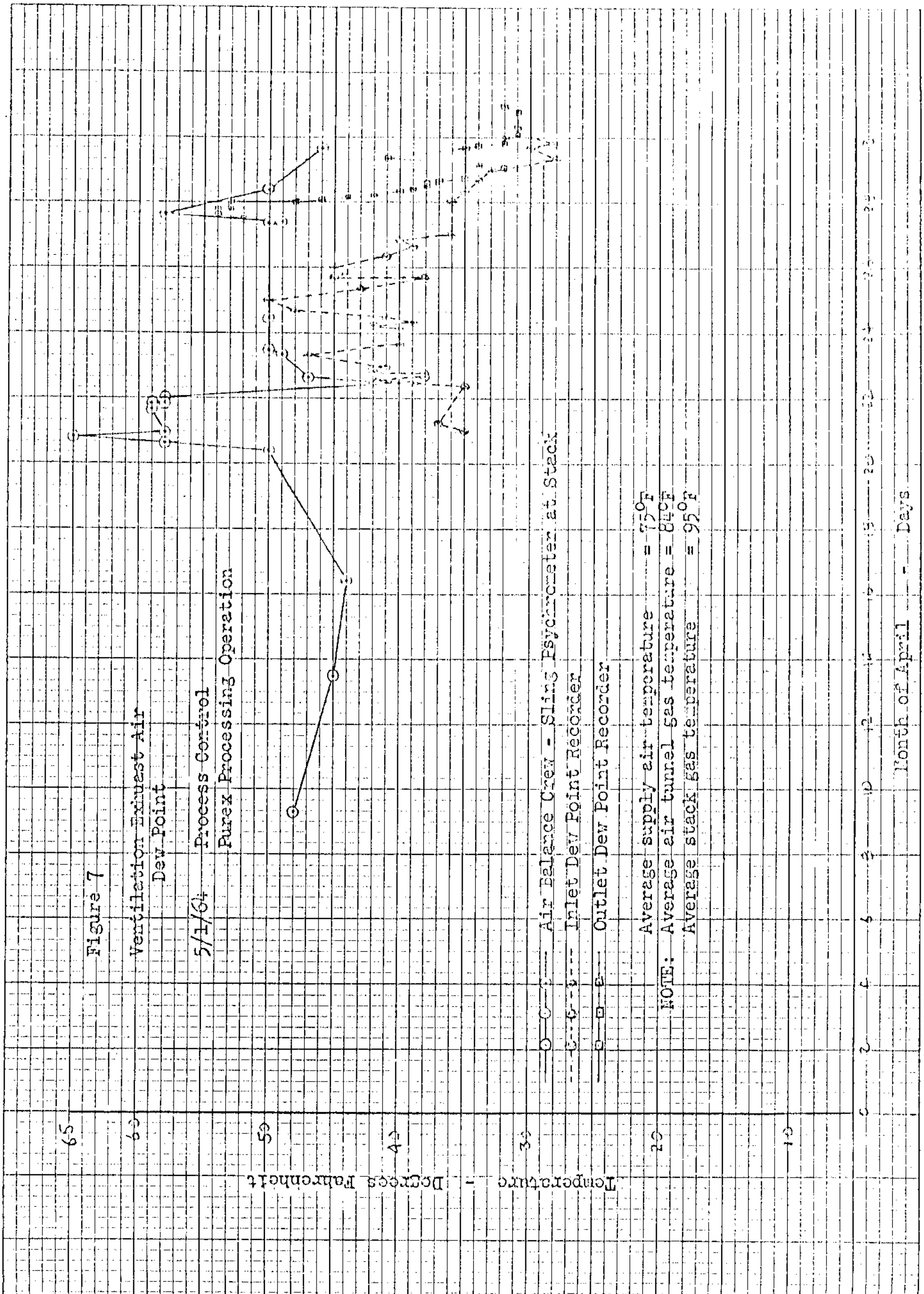
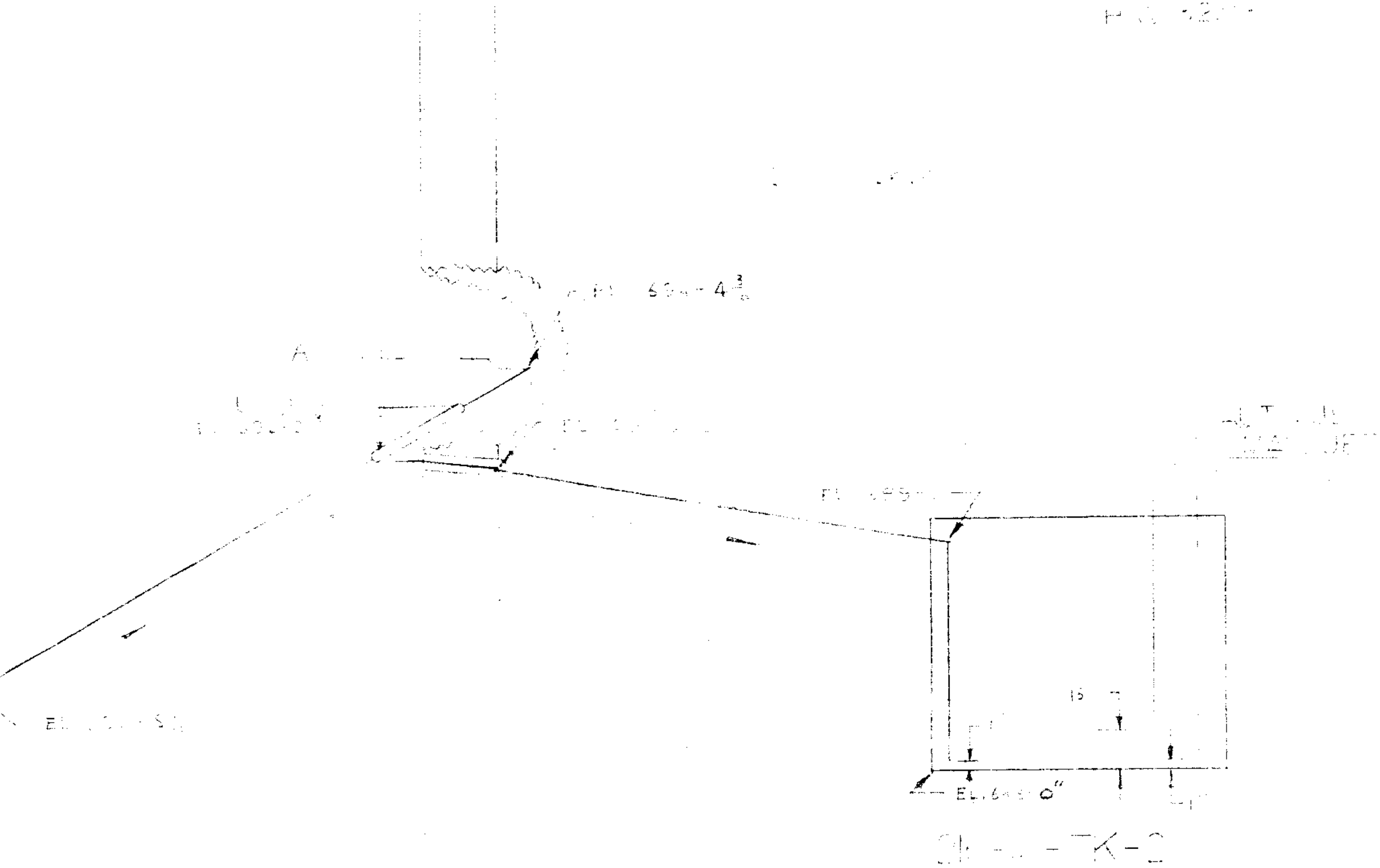
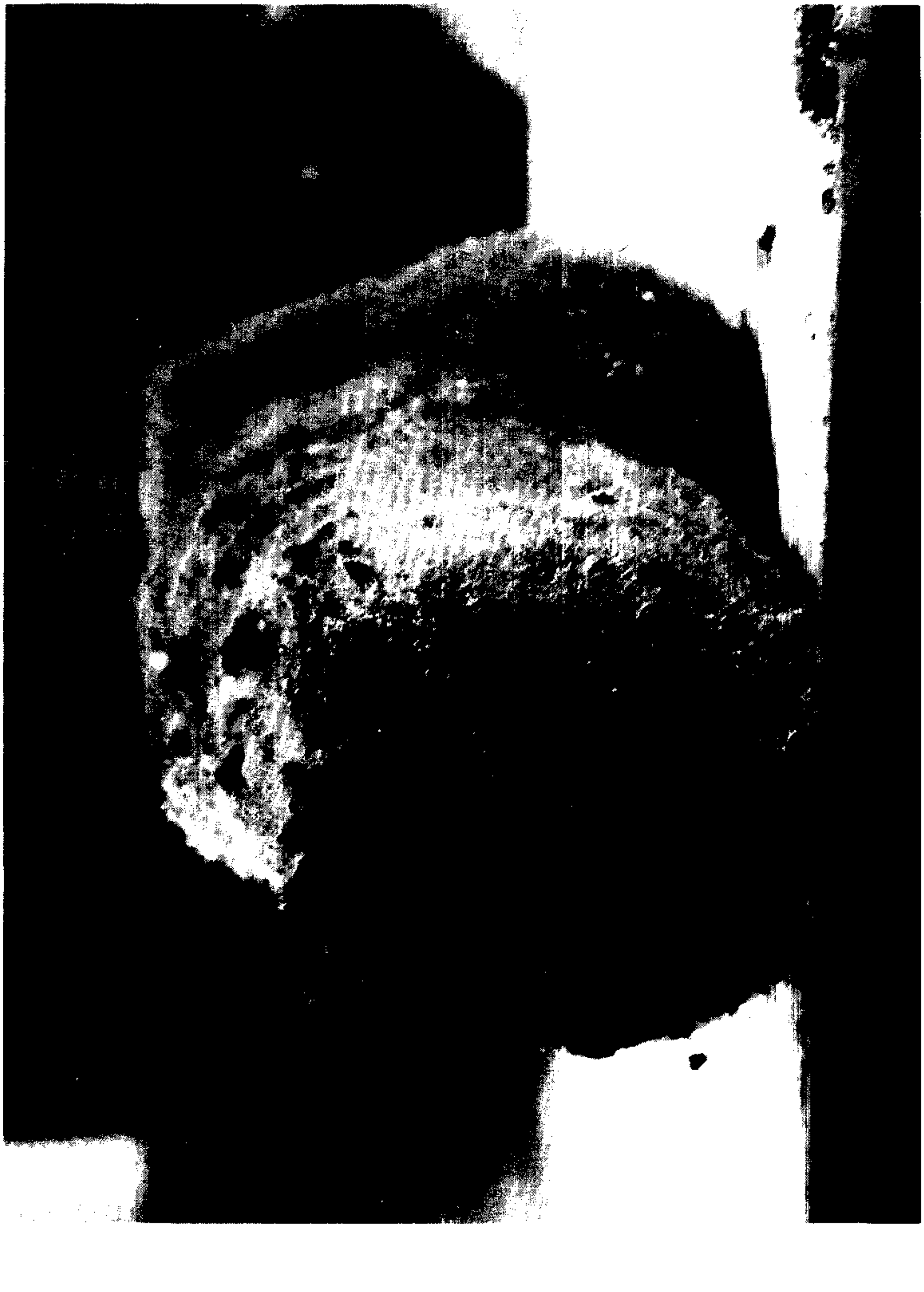
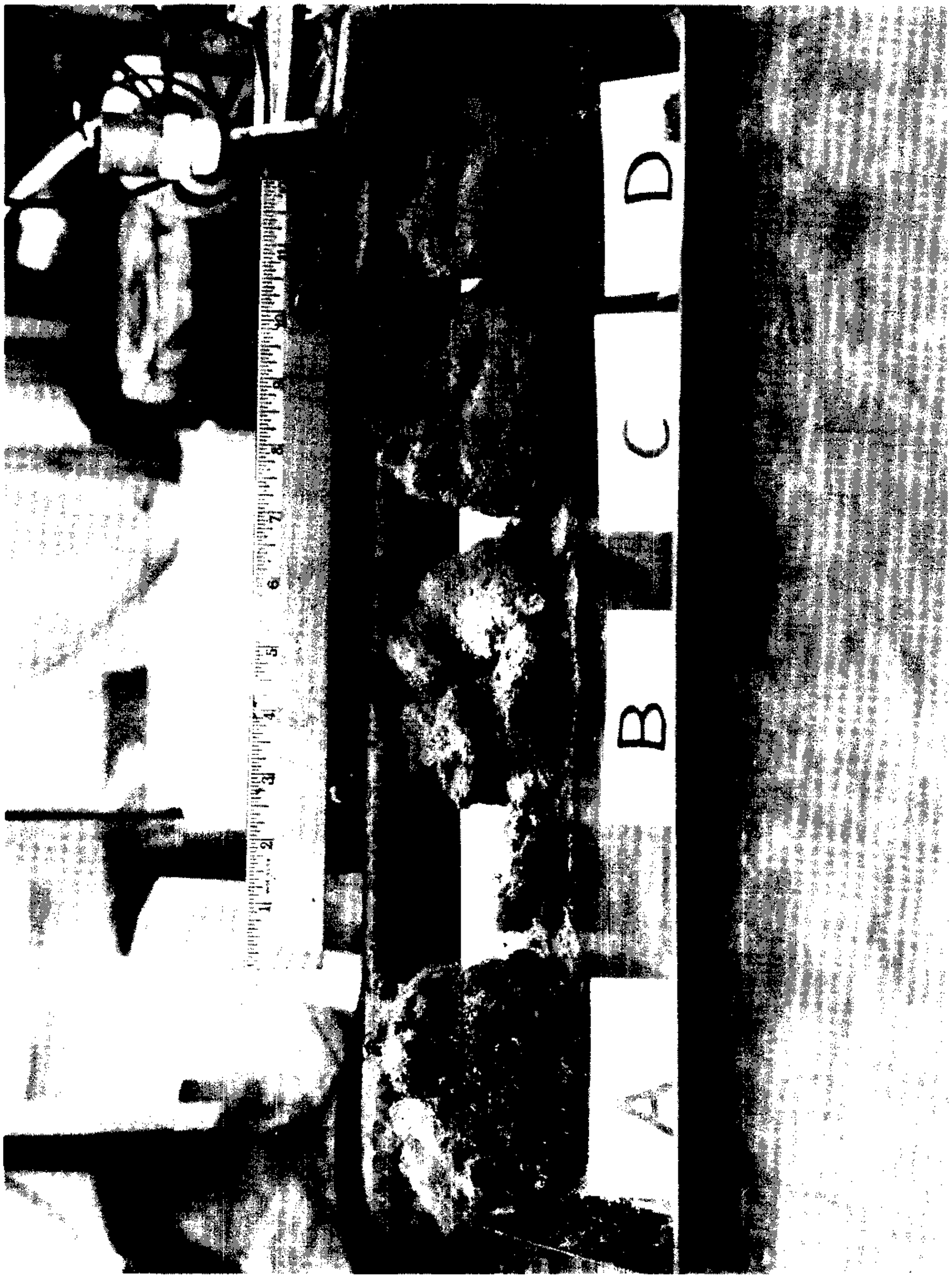


Figure 7
Ventilation Exhuast Air
Dew Point
5/1/64 Process Control
Purex Processing Operation
Air Balance Crew - Sling Psychrometer at Stack
Inlet Dew Point Recorder
Outlet Dew Point Recorder
Average supply air temperature = 75°F
NOTE: Average air tunnel gas temperature = 84°F
Average stack gas temperature = 95°F
Temperature - Degrees Fahrenheit
65
60
50
40
30
20
10
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
Month of April - Days


EL. 64'-0"
A

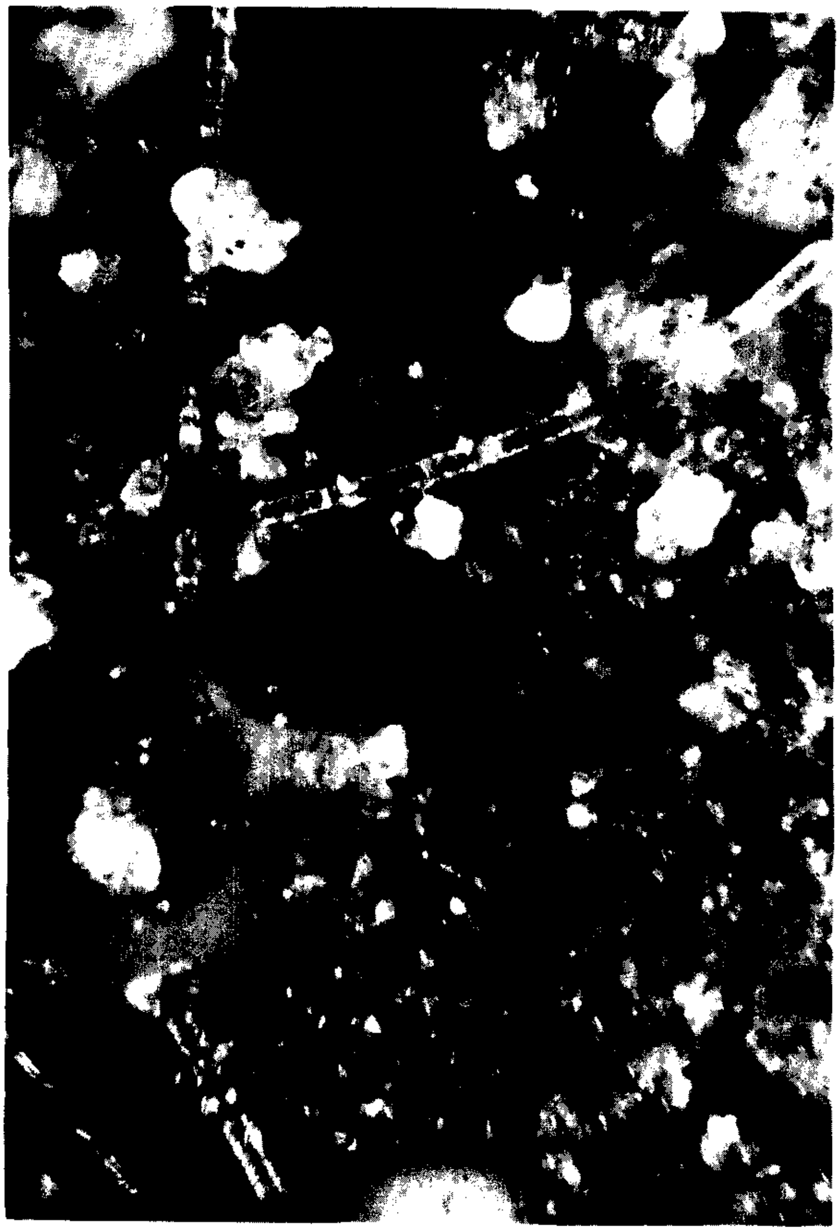


PHOTOGRAPH 2
CORE SAMPLE SHOWING SURFACE CRUST




PHOTOGRAPH 3
SECTIONS OF 4 INCH DIA. CORE SAMPLE

PHOTOGRAPH 4
75X MAGNIFICATION OF FILTER FIBERS



PHOTOGRAPH 5
100X MAGNIFICATION OF SURFACE CRUST

PHOTOGRAPH 6
100X MAGNIFICATION OF WHITE CRYSTALS

## APPENDIX A

## CHRONOLOGICAL SEQUENCE OF EVENTS AND ACTIVITIES

<u>NOTE:</u> All differential pressures reported in this summary are in inches of water. The long-term average for the Purex ventilation filter differential pressures prior to the April, 1964 problem was approximately 6.4 in. total at 119,000 c.f.m. with a drop of 4.2 in. in the primary and 2.2 in. in the secondary filter. See Table 1 for actual readings.

4-3 The power operator noted after taking weekly filter differential pressure readings that the total differential pressure was approximately 9.0 inches vs a normal 6.4 inches (long range average).

4-6 Day shift power operators took more differential pressure readings at the filter to confirm the high reading which was observed on Friday, 4-3-64. This reading was higher. The total differential pressure was 10.0 inches and the air flow was down to approximately 106,000 c.f.m.. On day shift it was decided to take daily readings. The rise in the filter differential pressure was all in the primary filter, the secondary filter differential pressure dropped slightly as the air flow dropped.

4-7 Day shift readings showed further increase in the differential pressure across the primary filter. This was thought to be due to moisture in the filter, so checks were started in search of leaking jets, etc., that were contributing $H_2O$ to the air. Swing shift sent the shift instrument man to check the manometer; the differential pressures were confirmed as high. The cover was removed from the monitor tube extending into the filter drain sump on day shift. No water was observed.

4-8 Day shift found the total filter differential pressure still increasing and the air flow decreasing and W. J. Richardson of FEO took special readings which confirmed that our differential pressure and gas flow instruments were essentially correct (see Table 1, page 7). Swing shift started taking readings every two hours on flow and differential pressure. The supply air spray pumps were shut off at 1600 hours, to eliminate a possible source of water and help dry the filter.

4-9 Graveyard shift turned the spray water back on to help balance canyon the differential pressure during the loading of a burial box. The filter differential pressure was still increasing. Day shift turned the spray pumps off again, put the vessel vent jet on air at 0930 and turned the steam off to the F Cell vent gas silver reactor and the water off to the jet condenser. FEO again confirmed our air flow and differential pressures and took humidity readings of the stack gas. The dry bulb temperature was 103° F. and the wet bulb temperature 67° F. The corresponding dew point was 48° F. and indicated that moisture was not the primary problem. A special impactor sample was pulled from the inlet air to the filter by D. E. Wisehart of RHO, which indicated extremely high particulate content in the ventilation air. (See Table 2A and Figure 6 for results of air samples.)

Swing shift brought in cold feed to prepare for shutdown. A hole was core-drilled in the concrete cover over the filter for visual inspection of the filter packing. The fiber glass was found to be compressed approximately 25 inches below the installed level (the packing originally was held in place with a 1" x 1" mesh screen) and an "off-white" crust was visible on the top of the fiber glass and on the screen.

APPENDIX A (Cont.)

4-10 Graveyard shift turned the spray pumps on again and shut off one supply fan and one exhaust fan. The air flow dropped to approximately 78,000 c.f.m. from approximately 90,000 c.f.m., but the filter differential pressure started to rise again after a short pause.

Day shift continued experimenting with the air flow and by 1500 hours, was pulling approximately 43,000 c.f.m. with no supply fans and just one exhaust fan. Two core samples of the upper 6-7 inches of the filter were taken. The samples were taken to the Purex Lab. Refer to Tables 5A, 5B, 5C and 7 for results of core samples.

The filter bed was found to have expanded approximately 6-3/4 inches from the reading taken on swing 4-9. A special monitoring routine was set up to guard against stack emission. A thermohm was installed between the exhaust fans the stack to monitor the air temperature. Shutdown of the process started at 0845 hours and was completed, with the exception of stripping of N Cell, by graveyard shift. Swing shift started taking a continuous air sample on regular filter paper. An F-10 sample was taken and a qualitative test for ammonium ion was positive (see Table 4).

4-11 A quantitative test for ammonium ion was set up and more samples were taken to determine the presence of ammonium ion in the process vessels (see Table 4). First, 2 ml samples were taken with existing Gilmonts of F-10, F-13, and J-1. Then the lab determined that 1 ml samples were sufficient for their tests, so samples of F-7, F-15, and F-16 were taken. Another 2 ml F-10 was also taken and ammonium ion was reported as nondetectable. Tanks F-7 and F-16 showed no

APPENDIX A (Cont.)

ammonium ion. The vessel vent and condenser vent jets were put back on steam at 1155 hours as a measure to reduce the amount of ammonia gas or ammonium nitrate particles being released. The filter differential pressure and air flow leveled out at about this time and held relatively constant.

A cascade impactor sample was taken by D. E. Wisehart. The sample was lost, but was estimated to be approximately 1-2 mg of solids per cubic meter of air, by comparison to previous sample.

A three-hour filter inlet air sample showed positive nitrate ion. It was not analyzed for ammonium ion. Another filter paper was placed in the sampler. An inclined manometer was installed at the stack inlet to give more accurate indication of total air flow.

4-12 A more extensive testing program for ammonium ion was launched. Tanks U1, U2, $UO_3$, F3, F-13, J-21, D5, G1, R1, J5B, F-10, F7, and J1 were sampled.

Tanks U1, U2, and $UO_3$ showed no ammonium ion. Tank J1 showed positive ammonium ion at 0.004 #/Gal.

The filter vault drain to the 216 A-2 catch tank was shown to be open by running water through the exposed pipe and noting the weight factor increase in 216 A-2. The first water added seemed to foam upon hitting the dry sump. A rotameter was hooked to the air sampler at the filter inlet (E-7-1) shack to provide a means for comparing solid deposition to air flow. The flow was 2.4 c.f.m. This was approximately what it had been running since it was installed.

A sample from this air sampler analyzed 0.012 grams of ammonium ion. This was a 16.5 hour sample.

APPENDIX A (Cont.)

Another cascade impactor sample was taken by D. E. Wisehart.

On swing shift (2045 hours), a second exhaust fan was started; the total differential pressure increased from 7.5 to 10.4 inches. The air flow essentially doubled. After readings were taken, the second exhaust fan was stopped and the differential pressure leveled out at approximately 6.6 inches, a 12 per cent improvement over previous operation. The secondary filter differential pressure was unchanged and the flow was up by 10 per cent to 39,600 c.f.m.

The scheduled readings at 2230 showed the differential pressure had increased to 6.8 inches and the flow decreased from 39,600 to 37,800 by the flow chart. There was no decrease in flow by manometer readings.

4-13 On 12-8 shift, a second exhaust fan was again started and run for approximately 10 minutes. The total differential pressure increased from 7.0 to 10.4 inches. The flow essentially doubled (factor of 1.7). After readings were taken, the second exhaust fan was stopped and the differential pressure leveled out at approximately 6.7 inches. The secondary filter differential pressure remained the same and the air flow was 39,600 c.f.m.

Sample results were all back from tank samples taken on 4-12. The only tanks showing traces of ammonium ion were F-10, J1, J-21 and F-13; in all other tanks, ammonium ion was nondetectable.

FEO took readings of stack humidity at 1300 hours, the dry bulb temperature was 86° F., the wet bulb temperature 62° F. and the dew point 45° F. Tests were run, opening the vent cover and tunnel doors to see if the canyon differential pressure could be controlled for an anticipated burial. Little change was noted in the canyon differential pressure. The differential

APPENDIX A (Cont.)

pressure decreased slightly at 1100 hours and the air increased correspondingly. A gas sample taken at the 50 foot level in the stack had solids on the filter paper and was sent to 300 Area for analysis.

Another core sample from the primary filter was taken on early swing shift and sent to the 300 Area. A crew started drilling more holes in the filter cover for visual inspection of the top of the filter and possibly more samples of the filter. Samples were taken of the solutions used in the process and analyzed for ammonium ion. No appreciable amounts were found.

4-14 The filter differential pressure continued to remain essentially constant. Samples of the essential material chemicals at Purex were analyzed for ammonium ion. A burial box was loaded with cut-up jumpers without affecting the canyon differential pressure and air flow while the horizontal tunnel door was open.

Day shift completed the scheduled burial without incident. The air flow through the filter increased approximately 13 per cent and the total differential pressure across the filters dropped from 6.3 inches to 3.2 inches, a 49 per cent decrease. These changes appear to be connected to changes in the supply system, probably caused when the position of one of the supply dampers was changed while being repaired. The third hole in the filter cover was completed and excavation started for core drilling a hole in the east side of the encasement for visual inspection of the filter supports. Excavation was also started to allow drilling of holes through the south side of the encasement to take pressure drop data throughout the filter.

The flow and differential pressure remained constant throughout swing shift.

APPENDIX A (Cont.)

Measurements were taken through the original hole at 1630 hours, which indicated the filter surface had risen approximately one foot. (Last reading taken at 1000 hours, on 4-13). Measurements taken at 1930 hours, confirmed the 1630 readings and revealed that the filter bed depth in all three bays was essentially the same. Excavation was completed on the east side and continued on the south side.

4-15 The flows and differential pressures remained relatively constant on graveyard shift.

Day shift - The air flow and total filter differential pressure remained unchanged at approximately 46,000 c.f.m. and 3.3 inches. Two 1/2-in. diameter core samples were taken. Excavation and core drilling continued.

Swing Shift - No changes in flow or differential pressure values. A 4-in. diameter by approximately one foot long core sample was taken from the west end of the fore filter and sent to 300 area. Core drilling was started on the south side of filter. The canyon differential pressure dropped almost to zero for a brief time for no apparent reason but recovered immediately.

4-16 GY Shift - There was no change in flow or differential pressure measurements. Core drilling was finished on the east and south sides of the filter. Radiation dose rate readings through the 1/2" holes on the south side were: 350, 350, 200, 150 and 50 in MR from top to bottom. The top hole is approximately 1" under the upper fiber glass surface and the holes are spaced 12" apart with the bottom hole being 3" under the lower support screen.

Day Shift - Inspection through the 14" port in the east side of the filter showed the supports of the primary filter intact and no visible damage to the

APPENDIX A (Cont.)

secondary filter. Pressure drop readings from the holes on the south side showed that the pressure drop through the upper one inch of the bed was significantly higher than the rest of the bed. Two supply fans and another exhaust fan (total of two) were started at 1600 and left on as a test. The total air flow increased to approximately 93,600 c.f.m. and the total filter differential pressure rose to 6.6 inches. The air balance crew of FEO took flow and humidity measurements.

Swing Shift - Air flow remained at approximately 93,000 c.f.m. and total filter differential pressure at 6.6 inches. Both supply fans and one exhaust fan were shut off temporarily when a false tunnel differential pressure reading was obtained but conditions remained the same when the fans were restarted.

4-17 GY Shift - No changes were noted in the ventilation readings.

Day Shift - Tests were run removing cover blocks in the canyon to see if the ventilation system would be affected, no significant changes were noted. A third exhaust fan was run for a short time as a test and 115,000 c.f.m. with a total filter differential pressure of 8.8 inches was observed.

Swing Shift - Preparations were started for resuming processing to complete the unclassified material run. The air flow remained at approximately 93,000 c.f.m. and the filter differential pressure at 6.6 inches.

4-18 GY Shift - Startup preparations continued. The ventilation status was unchanged.

Day Shift - The ventilation status remained unchanged. A special sampling and data recording program was set up to keep watch on the ventilation system.

APPENDIX A (Cont.)

Startup of the plant was in process.

Swing Shift - There was no change in the ventilation status. Completed startup but the co-decontamination cycle was in poor shape.

4-19 GY Shift - No changes were noted in the ventilation status. The co-decontamination cycle was shut down at approximately 0600 hours, in order to break a bad emulsion.

Day Shift - The ventilation status remained unchanged. The co-decontamination cycle was started up again.

Swing Shift - The ventilation system continued constant. The process was leveling off at equilibrium.

4-20 GY Shift - No change was seen in the ventilation status. The Neptunium Recovery Unit (J Cell Package) was started up.

Day Shift - The FEO air balance crew took flow and humidity readings at 0900 hours. They reported the dew point as 50° F. and the flow as 99,100 c.f.m. vs our measurement of 91,800 c.f.m. The total filter differential pressure was 4.7 inches. Between 1345 and 1545 hours, the flow dropped to 88,200 c.f.m. and the total filter differential pressure rose to 5.9 inches.

Swing Shift - The flow remained relatively constant at 84,600 c.f.m. most of swing shift but the filter differential pressure continued to rise, peaking at 9.7 inches at 1815. At 2145 the filter was "bumped" with the exhaust fans and the filter differential pressure dropped from 9.4 inches to 7.3 inches and the air flow increased from 84,700 to 90,000 c.f.m. The filter was bumped again at 2315 and the differential pressure dropped to 6.4 inches. The FEO air balance crew was taking flow and humidity readings during this period. They reported the relative humidity in the exhaust air peaked at 51% (dew point 65° F.) at 2100. (See Tables 3A and 3B for complete humidity vs time data.) A cascade impactor sample showed particle distribution similar to those found on 4/10/64. A LiCl dew point cell was installed in the air tunnel exiting the canyon and wired to record in the Power Control Room. The process vessels were sampled for $NH_4^+$ but no significant quantities were reported. Day shift was making the first coating removal (A dissolver) since the original incident. It was decided to run a special $NH_4^+$ balance during the next coating removal. The C dissolver was not started since crane work had already started on replacement of the leaking steam off-gas heater.

4-21 GY Shift - The ventilation readings remained steady. Special sampling continued.

Day Shift - Ventilation measurements remained unchanged at 92,000 c.f.m. air flow, and 6.3 inches differential pressure. Special samples were taken during the B dissolver coating removal but were inconclusive as far as an ammonium ion balance was concerned. The FEO air balance crew took data throughout day shift and swing shift. New limits were set for operating the canyon air supply units.

Swing Shift - The ventilation status remained the same. Sugar denitration of 1WW was started in the F16 tank.

4-22 GY Shift - The air flow and filter differential pressure remained the same. Activity to the filter was up slightly as seen on the E-7-1 samples. Preparations were made to recycle some cold uranium through the plant since the

APPENDIX A (Cont.)

backcycle waste system plutonium concentration was high due to heavy N cell losses.

Day Shift - There were no changes in the ventilation status. Two batches of cold uranium were recycled through the plant. A second coating removal was performed on the B3 dissolver because it appeared from the metal removed from the dissolver that some of the last charge might still be clad.

Swing Shift - The air flow and filter differential pressure remained unchanged but the "pre-filter" air tunnel dew point rose from 38° F. to 42° F., corresponding exactly with local shower activity. Cell spray nozzles in F cell were found open and were closed. The total volume of water sprayed to the sump was approximately 5200 gallons.

4-23 GY Shift - No changes in the ventilation status were observed except the dew point rose gradually to 45° F. by 0630 coinciding again with local showers. The E-7-1 millipore filters and the E-7-1 and E-7-2 sample papers were found to contain drops of a blue-green liquid. This was concluded to be a nitric acid solution of the copper sample lines caused by the condensation of the vapor in the air sample in the unheated sample shack.

Day Shift - The filter status remained unchanged. Preparations were started for a shutdown for inventory and maintenance. The FEO air balance crew took some readings. The Neptunium Recovery Unit was switched to the Decontamination Phase. Supply fan #2 was shut down from 1345 to 1525 hours, for repairs to the reheat coils. Instrumentation was installed in sample shack #2 to continuously record the primary and secondary filter differential pressures.

APPENDIX A (Cont.)

Swing Shift - Ventilation readings remained unchanged. Flow and temperature instruments were installed in the canyon supply plenum. The supply air temperature (approx. 88° F.) confirmed that the canyon air temperature element was out of calibration because the exhaust air temperature has consistently been approximately 95° F. Cold feed was started for plutonium cleanout for the shutdown.

4-24 GY Shift - There were no changes in the filter status. It was noted that with 90,000 c.f.m. exhaust flow, the supply air flow was 72,000 c.f.m. normally, but fell to 56,000 c.f.m. when the overhead tunnel door was opened, indicating an air inleakage of 16,000 c.f.m. past the vertical tunnel door. The Neptunium Recovery Unit was placed on Purge Phase rates.

Day Shift - No changes were noted in ventilation. Shutdown was started. The ammonia scrubber lines in the hot pipe trench were inspected for leaks and none were found. The Product stream was started to the Neptunium Purification Unit. Procedures were set up so that samples of the air near the ammonia scrubbers in the dissolver cells could be analyzed for solids deposition and ammonia gas. During coat removal it was also planned to again make ammonia balances using samples of the 216A-2 tank which collects the ammonia scrubber water.

Swing Shift - A thermohm was installed in the well containing the dew point cell at the air tunnel inlet to the primary filter. A dew point cell was installed in the discharge from the filter. These instruments enable us to continuously determine the relative humidity of the ventilation air. There was no change in the ventilation readings. The P&O hook-up for A, B & C cell air samples was completed.

APPENDIX A (Cont.)

4-25 GY Shift - There was no change in the ventilation readings. Shutdown was almost complete with the exception of J cell package and Q cell, which is still on Phase III, and N cell, which is stripping. Started flush of the #2 organic system batch contactor, tank G1.

Day Shift - The stack was flushed at approximately 0920 and the air flow increased from 90,000 c.f.m. at 0830 to 95,400 at 1330. This was because the stack flush procedure calls for cutting off the supply fans and going down to one exhaust fan (usually the turbine), which is equivalent to "bumping" the filter as had been done before. In this stack flush, all the exhaust fans were turned off and the stack pulled enough differential pressure on the canyon to allow flushing. The total filter differential pressure remained at 6.2 inches with the increased air flow.

Swing Shift - The status of the filter remained unchanged. All normal processing except Q cell was down and the condenser and vessel vent systems were switched from steam to air. The flush of the G1 tank was completed and the HAF pump and HSR jumper were replaced.

4-26 GY Shift - The filter differential pressure remained at 6.2 inches and the exhaust air flow rose to approximately 99,000 c.f.m. The A, B and C cell air samplers were put in service.

Day Shift - The ventilation status remained the same. The coats were removed in A3 dissolver using the new cell air samplers and special samples were taken of the 216A-2 tank for an ammonia balance. The cell air samples were scheduled on each dissolver during (1) charging and coat removal, and (2) metal dissolving along with special 216A-2 samples during coat removal until

APPENDIX A (Cont.)

further notice.

Swing Shift - The filter status remained essentially unchanged. A Neptunium Purification run started in Q cell and the second uranium cycle was started up under a special procedure to rework some oxalate contaminated UNH. Regular metal dissolving continued.

4-27 GY Shift - No changes were noted in the ventilation system. K cell uranium rework and the Q cell neptunium run continued.

Day Shift - The ventilation status remained unchanged. Continued reworking UNH and continued the Neptunium Purification run. A 4" x 24" core sample was taken through the #3 hole in the top of the primary filter. The sample was sent to 300 area for analysis.

Swing Shift - UNH rework and the Neptunium Purification run were continued.

4-28 The ventilation status was unchanged. The UNH rework and the Q cell run were finished. Preparations were underway for startup.

4-29 GY Shift - The exhaust air flow increased to 102,600 c.f.m. from 97,200 c.f.m. with the filter differential pressure remaining at 6.1 inches. The second plutonium and partition cycles were started.

Day Shift - A damper malfunction caused the shutdown of one supply fan and the two electric exhaust fans temporarily. The emergency exhaust turbine came on properly and the system was then returned to normal and the flow and differential pressure returned to 97,200 c.f.m. and 6.2 inches. Startup of solvent extraction was completed. High activity in the 2BP stream forced the diversion

APPENDIX A (Cont.)

of the second plutonium cycle product to the L cell package. When the F18 tank (containing sump wastes) was jetted to UGS, part of the tank contents backed up into the F16 tank. The number 1 supply fan and one exhaust fan were stopped temporarily for maintenance on the reheat coil on the supply fan.

Swing Shift - The exhaust air flow remained unchanged. Efforts continued on F18 and F16 jetout but apparently the line to the tank farm was plugged. The Plutonium product was diverted to N Cell.

4-30 GY Shift - The ventilation status remained unchanged. The solvent extraction process was leveling out. Crane work was underway to flush the line to UGS. The B dissolver reactor differential pressure was noted as high (14 inches).

Day Shift - The ventilation status remained the same. The J cell package was started. I-131 emission was somewhat high. The addition of mercuric nitrate was started in the head end.

Swing Shift - The only change noted in the ventilation system was that the exhaust air temperature rose 2° F. to 98° F. The line to UGS was opened and water flushed for approximately 3 hours. Tank F18 contents were then jetted to UGS.

5-1 GY Shift - No significant changes were noted in the ventilation system or the process. The uranium product continued high in gamma activity. The lines to UGS were again used successfully.

Day Shift - There were changes in ventilation readings. The use of pre-weighed 4 x 8 filter paper for deposition data at the E-7-1 (filter inlet)

APPENDIX A (Cont.)

and E-7-2 (filter exit) samplers was stopped but the E-7-1 millipore program (2 per shift) continues. A batch of partially neutralized waste was sent to the tank farm through a sampling error. Extra caustic was required to stop the fuming at the tank farm. One supply fan and both electric exhaust fans were stopped and the steam turbine exhaust fan used while maintenance worked on the preheat coil on the #1 supply fan.

Swing Shift - Air flow and filter differential pressure readings were steady. Rework of hydrolized waste from tank F8 was started.

5-2 Day Shift - Ventilation readings remained steady. It was noted that the waste rework was helping the gamma DF but increasing the waste losses.

Swing Shift - The ventilation readings were steady. The reactor differential pressure on B dissolver was getting worse.

5-3 Day Shift - The ventilation system readings and the process remained steady. Dark brown particles were found in the E-7-1 (filter inlet) sample. These are believed to be rust from the sample lines.

Swing Shift - More dark brown particles were found in the E-7-1 millipores. Trouble was experienced with the recovered acid system but it was corrected by switching the filters in the sample gallery. Tank F13 TLA and oxalic strip was moved to F18 for disposal.

5-4 GY Shift - The air flow and filter differential pressure measurements remained steady with the exhaust air temperature running at 100° F. A third cut was taken on B dissolver so that it could be shut down for flushing of the silver reactor.

APPENDIX A (Cont.)

Day Shift - Ventilation readings remained steady. Preparations were started for the B reactor flush and regeneration.

Swing Shift - Ventilation readings were steady. The laboratory reported high plutonium contamination in the uranium product so flowsheet adjustments were started to try to correct the problem.

5-5 GY Shift - Ventilation readings remained steady. The millipore filter on C cell air taken during the metal dissolving on C dissolver had a deposition of 32.7 milligrams.

Day Shift - Ventilation readings were unchanged. The old B3 dissolver tower was placed in a burial box and moved to the RR cut. The TLA and strip in F18 (originally from F13) was discarded. It was noted that the cell differential pressures in the dissolver cells were quite a bit different, making it possible to pull air from one cell to the other through the ammonia scrubber vent jumper.

Swing Shift - The ventilation system and the process remained steady.

5-6 GY Shift - The ventilation readings were unchanged. The C cell air sample millipore again showed high deposition. The deposition was later found to be 76% ammonium nitrate by weight.

Day Shift - No changes were noted in the ventilation system readings. A process test was started in the second uranium cycle to improve the plutonium contamination of the uranium product. The piping in the E-7-1 (filter inlet) sample shack was replaced with new stainless steel lines.

APPENDIX A (Cont.)

Swing Shift - Air flow and total filter differential pressure readings remain essentially constant. The F8 rework was finished and acid flushing of the tank has started.

5-7 GY Shift - Air flow and filter differential pressure readings remained steady, the exhaust air temperature was 101° F. There has been no improvement in the K6 Pu and Np problem to date.

Day Shift - The ventilation readings remained steady. The emergency water high tank was used for sanitary water for a short time while leaks were repaired in the line from the power house to the Purex plant.

Swing Shift - Ventilation system remained unchanged. A "sniffer" hose was placed in the wind tunnel at D cell to sample for deposition and ammonia. The millipore sample from A cell, taken while the A3 dissolver was dissolving showed high deposition with 51% of the deposition ammonium nitrate.

5-8 GY Shift - No significant changes were noted in the ventilation readings. Plutonium contamination of the uranium product continued to be a problem.

Day Shift - The routine sampling and data collecting to determine ammonia balances around the dissolvers during coating removal was discontinued because the results were not accurate enough to draw conclusions. However, the ammonia scrubber water flow will continue to be monitored. The metal supply was very short because of the B3 dissolver being out of service and it was decided to blend approximately 25% rework UNH into the solvent extraction feed rather than cut rates.

5-9 Day Shift - The ventilation readings remained steady. More flowsheet changes

APPENDIX A (Cont.)

were made in K cell to try to lower the Pu and Np carry over in the product. The G7 sample was found to be emulsified and a fresh solution was started to the tank.

Swing Shift - The G7 problem got worse and started putting the emulsion in the G5, recovered organic tank, which upset the solvent extraction columns. The problem was cured by adding a small quantity of caustic directly to the G7 turbomixer tank.

5-10 GY Shift - No changes were noted in the ventilation readings. The B dissolver silver reactor flush was completed and re-assembly started for regeneration.

Day Shift - The ventilation readings remained steady. An instrument malfunction oversaturated the HA column with consequent possible high product losses to the 1WW waste concentrator, F6.

APPENDIX B

ABNORMAL EVENTS OCCURRING AT THE PUREX PLANT BETWEEN 3-12 & 4-8-64

| Date | Event |
|---|---|
| 3-12-64 | The NaOH additions to the G7 turbomixer were reduced 50% as a process test. |
| 3-14-64 | An acid test was stopped and Purex recovered acid was restarted to K Cell instead of fresh or $UO_3$ acid. |
| | The condenser vent jet was switched to air while a leak in the steam to the condenser jet was repaired. |
| 3-16-64 | The F8 rework tank was found to be concentrating rather than refluxing, this was corrected. G Cell organic became emulsified and was corrected without upsetting the process. |
| | The steam heater on C dissolver off-gas train was found to be leaking. |
| | A 2AF pump failure and associated L cell upset forced plant to shut down for 6 hours. |
| 3-17-64 | Water flow to the F5 acid absorber, which had been running at a lower rate than normal due to plugged strainer, was returned to the correct rate. |
| 3-18-64 | The rupture discs were found broken in N Cell. Resin from the columns got into Tank N1. |
| | The final batch of 1WW rework from the February startup upset was processed. Mercuric nitrate was added to the metal solution tanks to supress I-131 emission. |

APPENDIX B (Cont.)

3-19-64 A G cell organic emulsion upset the HA column temporarily.

3-20-64 As a continuation of a process test, the G7 turbomixer was shut off. Between 3-17 and 3-20, F16 received more sugar than necessary for normal IWW denitration. The TLA process test was completed on 3-20-64.

3-23-64 An F18 sampler jumper was put into tank K5, contaminating K5 and K6 tanks with IWW.

3-24-64 The laboratory was found to be using an inaccurate standard for sulfamate analysis, which caused sulfamate additions in AMU to be higher than required.

3-26-64 Restarted the G7 turbomixer at standard run sheet conditions, ending the turbomixer test.

3-28-64 The purification of Neptunium from Redox was started.

3-30-64 The processing of non-rep metal was started with the final Pu cycle at 3.6 CF and the rest of the plant at 3.0 CF.

3-31-64 Water was found in process air lines. The columns in J and L cells were upset by this additional water.

4-2-64 Rework was started of the IWW from the 3-31 upset. The K cell rates were raised to 4.0 CF and rework of UNH contaminated with IWW from the 3-23-64 event was started thru K cell.

The Power Operation began adding $KMnO_4$ to the sanitary water. The J cell package was started on Phase I.

APPENDIX B (Cont.)

The B dissolver acid integrator was found to be adding excessive acid to dissolver and was corrected.

4-7-64 The 2AX CVT stuck when the IOO pump was cut off, causing the 2A column to flood. The flood was broken by stopping the 2AF flow and jetting back to J1.