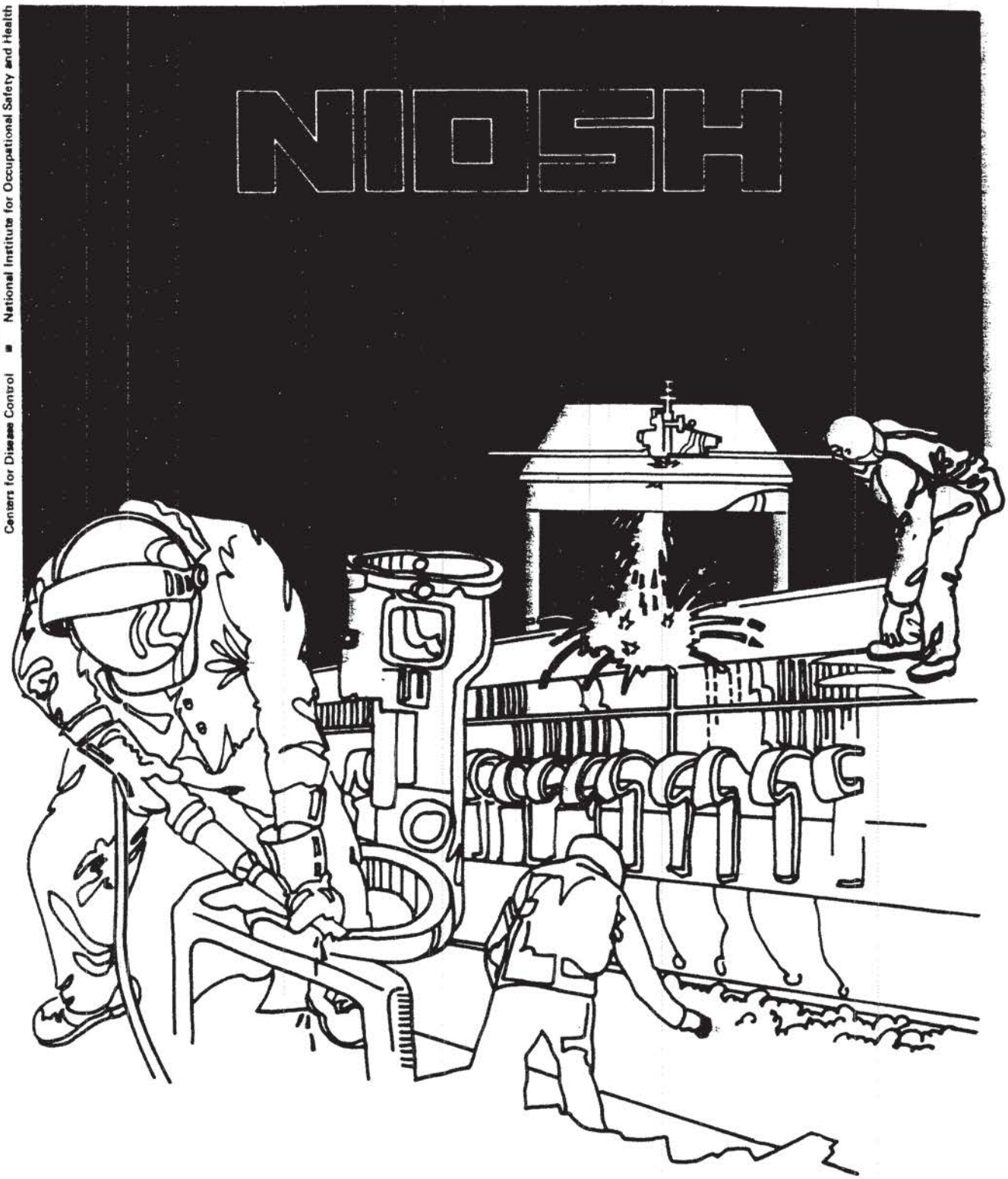
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

HETA 81-090-997
PUBLISHERS PAPER COMPANY
NEWBERG, OREGON

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 81-090-997
November 1981
Publishers Paper Company
Newberg, Oregon

NIOSH Investigator
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I SUMMARY

In December 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Association of Western Pulp and Paper Workers Local 60 to determine if vocal cord nodules experienced by 2 of 4 paper machine tenders are caused by their exposure to a combination of chemicals and high noise at Publishers Paper Company, Newberg, Oregon.

Environmental air samples were collected on April 14-16, 1981 to determine the workers' exposure to sulfuric acid, sulfur dioxide and phosphates. The workers' eight-hour noise exposures were also measured.

The back tenders' average exposure to sulfur dioxide was 0.02 ppm while the machine tenders' exposure was significantly higher at 0.11 ppm. All breathing zone samples were less than the sulfur dioxide criteria of 0.5 ppm. However, area samples ranged up to 0.95 ppm. The machine tenders' exposure to sulfuric acid was 0.01 to 0.02 mg/cu m which is only 1 to 2 % of the criteria of 1 mg/cu m. Area samples ranged up to 6% of the criteria. All workers on the paper machine had 8 hour equivalent potential noise exposure that ranged from 94 to 101 dBA, levels which exceed the NIOSH recommended criteria of 85 dBA and the Oregon State Standard of 90 dBA.

NIOSH postulates that there may be a relationship between development of vocal cord and nodule cord exposure to high noise levels and to chemicals that can cause upper respiratory irritations. This is based on: 1. Two of the four machine tenders have had vocal cord nodules surgically removed; 2. At various times the machine tenders experience sore throats, eye, nose and throat irritation, burning eyes, irritation of the skin and headaches; 3. The workers at the dry end of the paper machine did not develop vocal cord nodules while exposed to the same noise levels as the machine tender but not to the upper respiratory irritants; and 4. A literature review that showed that upper respiratory infection and high noise have resulted in the development of vocal cord nodules.

Recommendations to reduce the exposure to the airborne chemical irritants and to reduce the strain on the vocal cords are included in this report.

Keywords: SIC 2621 (Paper Mills) noise, respiratory irritants, sulfur dioxide, sulfuric acid, vocal cord nodules (singers nodes, chorditis tubosa, teachers nodes).

II INTRODUCTION

In December 1980, NIOSH received a request from the Association of Western Pulp and Paper Workers to determine if vocal cord nodules (singers nodes) experienced by 2 of 4 paper machine tenders are caused by their exposure to a combination of chemicals and high noise. An initial survey was conducted on January 8, 1981 and an environmental survey on April 14-16, 1981. An interim report including the environmental and questionnaire results and recommendations was submitted to the company and the requestor on August 10, 1981.

III BACKGROUND

Publishers Paper Company is a pulp and paper mill that produces paper for newsprint. This evaluation involves only the paper machine. Paper is made from the pulp. During the pulp production a variety of chemical compounds are added. Some of these are still present when the pulp reaches the paper machine. Several additional chemicals are added just before the pulp passes through the paper machine, such as slime control agents, brightners, pH control chemicals and others. Some of the chemicals used are sulfuric acid, sulfur dioxide, trisodium phosphate, aluminum sulfate, sodium mercaptobenzothiazole, triphenylmethane dye, dithiocarbamates, pentachlorophenols, pentachlorophenates, n-alkyl dimethylbenzyl ammonium chloride and others.

The pulp solution (approximately 3% pulp) enters the headbox of the paper machine and is flowed on a high speed moving screen. In this section (the fourdriner) the water is removed by suction. Mists, vapors and aerosols are released due to the high speed of the moving screen. There is also some mist sprayed out the sides in several places. There is no local exhaust ventilation on this section; however, there are ceiling fans about 30 ft above the fourdriner. The flattened and felted pulp then passes over a heavy woolen blanket between press rollers where additional water is removed. From there it proceeds to the dryer section where the paper is dried by passing it over a series of steam heated cylinders. The dryer section is enclosed with a ventilating hood where the moist air is removed. After drying the paper receives its finish between the rollers of the calander and is wound up on a reel. The time for the paper to pass through this process is 10 seconds or less. The headbox, fourdriner and press section comprise the wet end and the remainder the dry end of the process.

On each shift there are six workers on each machine. They are the utility man, 5th hand, 4th hand, 3rd hand, back tender and machine tender. The machine tender works at the wet end and the other 5 work

at the dry end. The machine tender is the top job with progression through the jobs on a seniority basis. There are four crews that rotate shifts to cover the 24 hour, 7 day a week operation.

At the wet end of the paper machine, there is a series of control consoles and a control shack. The machine tenders work at the control panels, make periodic inspections of the entire wet section, make repairs during breakdowns and spend the extra time in the control shack. He is exposed to the mists, vapors and gases that are released and to high noise. The dry end is operated by five workers whose exposure consists mainly of high noise.

There are two paper machines at this plant. The first machine was installed in 1968, and the second machine was installed and became operational in the Fall of 1980. Prior to the installation of the second machine, there were 4 machine tenders. One machine tender had been on the job 3 years, two for 6 years and one for 8 years. Prior to this they worked on the dry end. All have worked on the paper machine for 13 years. Two of these four workers have had nodules removed from their vocal cords while working on the wet end.

IV EVALUATION DESIGN AND METHODS

A Environmental

Breathing zone and area samples were collected for sulfuric acid, sulfates, and phosphates on cellulose membrane filters followed by KOH treated filters for the collection of sulfur dioxide at a flow rate of 1.5 lpm. The sulfur ions were analyzed by NIOSH methods P&CAM #268 and the phosphate by P&CAM #216. Noise exposures were made using personal noise dosimeters. Bulk pulp liquid samples were collected and analyzed for sulfates, phosphates, and pentachlorophenates.

B Medical

The machine tenders were interviewed during which time they stated the adverse health effects they experienced. A questionnaire was provided to 300 employees at that facility which included questions about their work environment (chemicals used, noise levels, amount of communication required, etc.) whether they had any adverse health effects and if they ever had vocal cord nodules.

V EVALUATION CRITERIA

A Environmental

Substance	NIOSH Recommended TWA	Oregon State Standards TWA
noise	85 dBA 8 hr.	90 dBA 8 hr.
pentachlorophenol	---	0.5 mg/cu m
sulfur dioxide	0.5 ppm	5 ppm
sulfuric acid	1 mg/cu m	1 mg/cu m
phosphate and trisodium phosphate	---	none

B Toxicity

1. Fungicides [1]- Various fungicides are added in small quantities. They include disodium ethylene bisdithiocarbamate, other dithiocarbamates and sodium pentachlorophenol. The adverse effects produced by these compounds are irritation of the skin, eyes and upper respiratory tract.

2. Noise [2]- Daily noise exposures above 85 dBA over a period of years is capable of producing noise induced hearing loss. Noise levels of 94 dBA and above make communication difficult. With this noise exposure a person will use his voice excessively in trying to communicate with his fellow workers and thus can strain his vocal cords.

3. Sulfur dioxide and sulfuric acid [3,4] - Sulfur dioxide is a chemical gas which combines rapidly with moisture on moist surfaces, such as mucous membranes, to form sulfurous acid. Sulfurous and sulfuric acid can cause an irritation of the nose and throat, sneezing and coughing. At levels below those detectable by the foregoing subjective effects, sulfuric acid can cause a reflex increase in the rate, and diminution of the depth of respiration, with reflex bronchoconstriction resulting in pulmonary air flow resistance. Over the course of many years, exposure to sulfuric acid may also result in conjunctivitis and frequent respiratory infections.

VI RESULTS AND DISCUSSION

A. Environmental Results

The breathing zone and general sample results are shown in Table I. The back tenders' average exposure to sulfur dioxide was 0.02 ppm while the machine tenders' exposure was significantly

higher at 0.11 ppm. All breathing zone samples were less than the sulfur dioxide criteria of 0.5 ppm. The machine tender's exposure will vary depending on the amount of time spent at different locations around the wet end of the machine. As seen in the results the area sample concentrations went up to 0.95 ppm.

The machine tenders on the number 2 machine had sulfuric acid exposures of 0.01 to 0.02 mg/cu m. This is 1 to 2% of the current standard. The highest area sample, which was collected in the mist on the north side walkway along the fourdriner of the #1 machine, was 0.06 mg/cu m. The back tender's breathing zone sulfuric acid samples were all less than 0.01 mg/cu m.

All breathing zone and area samples for phosphates were less than 0.01 mg/cu m, except the area samples collected in the mist on the north side walkway along the fourdriner of the #1 machine which were 0.02 and 0.16 mg/cu m. There currently is no standard for phosphate or trisodium phosphate.

None of the other chemicals added to the pulp were sampled as they are added in small quantities and would not be detectable. This is shown by the bulk liquid samples taken at the side silo, which contained 360 mg of sulfates/liter while the majority of the airborne sulfate sample results were less than detectable limits. The bulk samples also contained 10 to 20 mg of phosphates per liter and less than 0.001 mg of pentachlorophenates per liter.

B. Noise Results

All workers in the paper machine area are potentially exposed to high noise. The results are listed in Table I. The machine tenders average 8 hour equivalent potential noise exposure ranged from 94 to 101 dBA with an average of 96.7, while the back tender ranged from 94.5 to 98 with an average of 96.4. All levels exceeded the Oregon State Standard of 90 dBA and the NIOSH recommended standard of 85 dBA. All workers were observed wearing hearing protection (ear plugs or ear muffs) so measured levels may not be actual levels reaching the inner ear.

C. Medical Results

The machine tenders stated that at various times they may experience sore throat, irritation of the eyes, nose and throat, burning eyes, irritation of the skin and headaches which are not present or clear up when off the job for extended periods such as vacations. These symptoms can be caused by many of the chemicals added to the pulp. Although the airborne

concentrations are low, they often come in physical contact with mist. They stated that the symptoms are more prevalent when the pH of the liquid is below 4-5.

A questionnaire was submitted to the 300 workers at Publishers. Only 87 were returned. None of those responding (except the 2 machine tenders) had vocal cord nodules. These two machine tenders have had surgery for the vocal cord nodules.

D. Discussion

A search of the occupational medical literature produced several studies involving vocal cord nodules. A Swedish study drew attention to the presence of vocal cord nodules as a consequence of speech communication difficulties in a high noise environment. Infections of the upper airways was often a trigger factor.[5] Another study looked at 283 patients with noise induced hearing loss. Twenty-one of the patients had vocal cord nodules. A second group of 26 industrial workers with vocal cord nodules was examined. All but three of these worked in high noise areas.[6] This study looked only at high noise and did not consider any other simultaneous chemical exposure. A health hazard evaluation at a plastic injection molding plant found 4 cases of vocal cord nodules among 100 workers. Noise level measurements were not made, however, it was recommended that they conduct a noise survey.[7] This information indicates that persons who have upper airways infections and/or who are exposed to high noise and who must communicate while in the high noise may abuse their vocal cords causing the production of nodules on the vocal cords. This is similar to singers who develop "singers nodes" (vocal cord nodules) by putting excessive strain on their vocal cords.

At Publishers Paper the machine tenders are potentially exposed to 8-hour equivalent noise exposures that ranged from 94 to 101 dBA and are also exposed to airborne concentrations of chemicals that cause upper respiratory irritation. The machine tenders stated that at various times they experience sore throat and irritation of the throat. The workers on the dry end of the machines do not appear to develop vocal cord nodules although the noise exposure is the same as the machine tenders, but they lack the irritating chemical exposures. It is also interesting to note that the machine tenders all worked on the dry end of the paper machine for 6 or more years before becoming machine tenders, but they did not develop the vocal cord nodules until after they became machine tenders.

VII CONCLUSIONS

Two of the four machine tenders have had surgery for vocal cord nodules. They are potentially exposed to 8-hour equivalent noise exposure levels of 94-101 dBA, during which time they frequently must communicate by voice, and airborne concentrations of sulfuric acid mist, sulfur dioxide and other potential chemical irritants that were below the applicable standards. The machine tenders stated that at various times they may experience sore throat, irritation of the eyes, nose and throat, burning eyes, irritations of the skin and headaches. NIOSH postulates that there may be a relationship between the development of vocal cord nodules and exposure to high noise levels and to irritant chemicals. This is based on a literature review that showed that upper respiratory infection and high noise exposure resulted in the production of vocal cord nodules and the fact that the workers on the dry end of the paper machines did not develop the nodules while exposed to the same noise levels but not the upper respiratory irritants.

VIII RECOMMENDATIONS

1. Adverse health effects of eye, nose and throat irritation appear to be more prevalent when the pH of the pulp liquor is less than 4-5. Raising the pH above this level may be helpful.

2. Use of an air supplied respirator or air cap that provides filtered air past the face could reduce the machine tenders' eye, nose and throat contact with the chemical irritants.

3. Since it appears that voice strain occurs during communication in high noise areas, the use of a communication system involving a collar or throat microphone, a transmitter and a receiver built into ear muffs would permit the machine tender to talk in a normal voice and thus reduce the voice strain.

4. Any worker experiencing persistent hoarseness should have their vocal cords examined for nodules or other vocal cord abnormalities.

IX REFERENCES

1. Occupational Diseases. A Guide To Their Recognition. DHEW (NIOSH Publication No. 77-181.

2. Criteria for A Recommended Standard, Occupational Exposure to Noise. HEW Pub. No. HSM 73-11001.

3. Criteria for A Recommended Standard, Occupational Exposure to Sulfur Dioxide. HEW Pub. No. (NIOSH) 74-111.

4. Criteria for A Recommended Standard, Occupational Exposure to Sulfuric Acid. HEW Pub. No. (NIOSH) 74-128.

5. "Vocal and Throat Disorders Due to Noise"; National Workers' Protection Board Stockholm, Sweden. Feb. 5, 1973.

6. Rontalje et al "Vocal Cord Dysfunction - An Industrial Health Hazard", The Annals of Otology, Rhinology and Laryngology. Vol. 88, December 1979.

7. NIOSH Health Hazard Evaluation Determination Report No. 76-60-398.

X DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this complete Determination Report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After ninety (90) days, the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address.

Copies of this report have been sent to:

1. Publishers Paper Company Newberg, Oregon

2. Association of Western Pulp and Paper Workers Local 60, Newberg, Oregon

3. U.S. Department of Labor, Occupational Safety and Health Administration, Region X Seattle, Washington

4. Oregon State Accident Prevention Division Salem, Oregon

For the purpose of informing the 8 affected employees, the employer shall promptly post this Determination Report in a prominent place(s) near the work area of the affected employees for a period of thirty (30) calendar days.

XI ACKNOWLEDGMENTS

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Originating Office:

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Assistance Branch
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TABLE I

PAPER MACHINE DEPARTMENT
SULFUR DIOXIDE, SULFURIC ACID AND PHOSPHATE
AIR CONCENTRATIONS

PUBLISHERS PAPER COMPANY
Newberg, Oregon
HHE 81-090

JOB OR AREA	DATE	SHIFT	SAMPLE #	SAMPLE TIME min.	SAMPLE VOLUME liters	SULFUR DIOXIDE ppm	SULFATES as SULFURIC ACID mg/cu m	PHOSPHATES mg/cu m	Potential noise exposure, 8-hr TWA dBA
Machine Tender #1 Machine (BZ)	4-14-81	2	1	420	630	0.02	<0.01	<0.01	96
"	4-15-81	1	11	443	664	0.15	0.01	<0.01	97
	4-16-81	3	21	455	682	0.14	<0.01	<0.01	95.5
Machine Tender #2 Machine (BZ)	4-14-81	2	2	446	669	0.09	0.02	<0.01	101
"	4-15-81	1	12	430	645	0.12	0.01	<0.01	94
"	4-15-81	3	22	455	682	0.14	0.01	<0.01	96.5
Back Tender #1 Machine (BZ)	4-14-81	2	4	444	666	0.03	<0.01	<0.01	96.5
"	4-15-81	1	13	437	655	0.04	<0.01	<0.01	95.5
"	4-16-81	3	23	448	672	0.02	<0.01	<0.01	95.5
Back Tender #2 Machine (BZ)	4-14-81	2	3	448	627	0.03	<0.01	<0.01	98
"	4-15-81	1	14	443	664	<0.01	<0.01	<0.01	98.5
"	4-16-81	3	24	450	675	<0.01	<0.01	<0.01	94.5
So. Side of Wringer Roller #1 Machine (GA)	4-14-81	2	5	427	640	0.54	0.01	<0.01	--
"	4-15-81	1	17	428	642	0.51	0.01	<0.01	--
"	4-16-81	3	28	428	642	0.95	0.01	<0.01	--
North Side # 1 Paper Machine By Wire in the mist (GA)	4-14-81	2	6	430	645	0.34	0.01	0.02	--
"	4-15-81	1	15,20	435	652	0.33	0.06	0.16	--
"	4-16-81	3	30	300	450	0.68	0.04	0.02	--
So. Side by Rail-Side Silo & Wire (GA)	4-14-81	2	8	420	630	0.08	<0.01	<0.01	--
	4-15-81	1	16	432	648	0.12	0.02	<0.01	--
"	4-16-81	3	27	430	645	0.15	0.01	<0.01	--
Stock Prep Control Room (GA)	4-14-81	2	9	460	690	<0.01	<0.01	<0.01	--
Inside Control Shack by Control Panels (GA)	4-14-81	2	-	-	-	-	-	-	73
Control Panel Area	4-14-81	2	10	460	690	0.16	0.01	<0.01	97
"	4-15-81	1	18	440	660	0.13	0.01	<0.01	96.5
"	4-16-81	3	29	420	630	0.12	0.01	<0.01	--
So. Side #2 Machine Inside Hood 1st Deck, in the Mist (GA)	4-15-81	1	19	443	619	0.09	0.03	<0.01	--
"	4-16-81	3	25	393	584	0.05	0.02	<0.01	--

BZ - Breathing Zone Sample
GA - General Area Sample