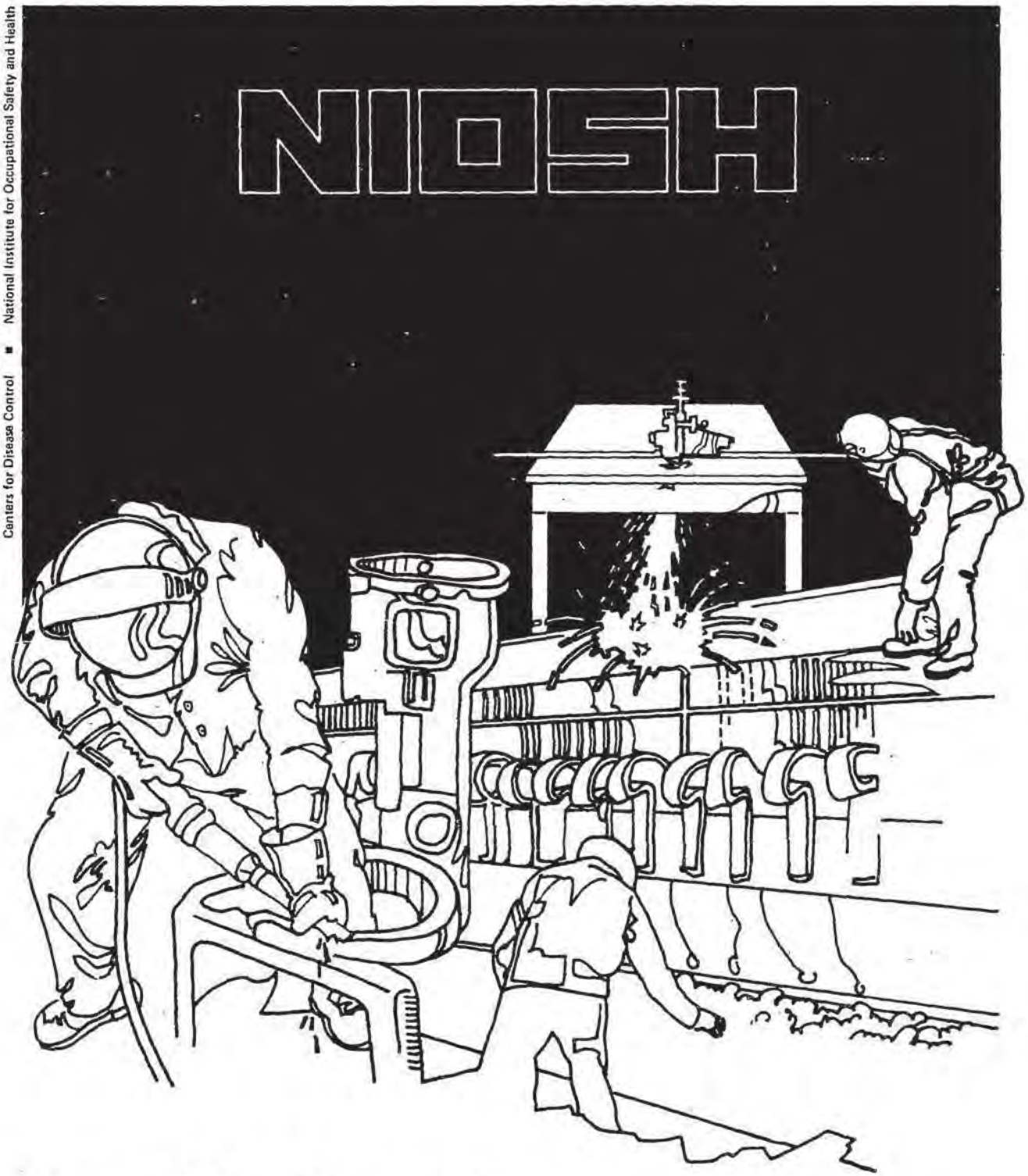
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Se.
Centers for Disease Control ■ National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

HETA 79-119-1068
THE EVENING NEWS
SOUTHBRIDGE, MASSACHUSETTS

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 79-119-1068
MARCH 1982
THE EVENING NEWS
SOUTHBRIDGE, MASSACHUSETTS

NIOSH INVESTIGATOR:
BRUCE A. HOLLETT, IH

SUMMARY

In June 1979, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation from the management of The Evening News, Southbridge, Massachusetts. This company has operated from the same facility for 50 years and was making plans to relocate portions of their plant to a new facility. The purpose of this request was to identify any potential health hazards that might require controls in their new facility or that should be controlled in the existing facility for those activities that were not moving.

On January 28-31, 1980, NIOSH conducted an initial visit at the facility. Personal and area air samples were taken where appropriate for para-hydroquinone, quinone, N-methyl-para-aminophenolphosphate, acetic acid, hydrocarbons, and ink mist in six departments during parts of four shifts. Direct readings for hydrogen cyanide, formaldehyde with Drager tubes, and sound level measurements were taken. Employees were given confidential interviews.

Analysis of environmental data indicated no exposures above recommended limits for quinone, hydroquinone, hydrocarbons, hydrogen cyanide, formaldehyde, and acetic acid.

Noise levels of 88 to 95 dBA were measured in the pressroom during press runs. The Inserter machine operator was exposed to 90 dBA and the Address machine operator was exposed to 86 dBA. Compugraphic Tape punch operators were exposed to 81 to 82 dBA with brief excursions to 90 dBA.

Attempts to measure ink/oil mist were unsuccessful, since the laboratory reported that the fluoresence spectra of the inks on the filter samples did not correspond to the spectra of bulk black ink samples submitted. The bulk black ink samples were analyzed for the benzene soluble fraction and for five of the PNA's, which are known or suspect carciongens. The findings were negative for Benzo(a)pyrene, Chrysene, and Benzo(a)anthracene. Fluoranthene ranged from 0.03 to 0.05 mg/g and Pyrene was found at 0.20 to 0.21 mg/g. The total benzene soluble fraction ranged from 866 mg/g to 915 mg/g. NIOSH is conducting an Industrial Hygiene and Mortality study of Printing trades. Measurements were taken in the New York Times, where the PNA levels in the black inks were less than these. Airborne PNA's were present in the four area samples. NIOSH has evaluated two other printing inks and has found there is a wide variation in PNA content. Therefore, it is recommended that airborne PNA exposures be evaluated and controlled to the lowest feasible limit. Control by substitution of a PNA-free ink would be most effective and engineering controls would be second best. There was considerable direct contact with hands and forearms by pressroom workers. It would be prudent to minimize this exposure by use of protective equipment and emphasis on personal hygiene.

Based on these results, NIOSH concludes that there was not a health hazard from overexposure to airborne contaminants that were measured during the survey, however further evaluation of PNA exposure should be performed. Improved ventilation and handling procedures were recommended for the long-term plate developing and photo lab, and printing inks respectively. The potential did exist for hazardous noise exposures. Hearing conservation program improvements were recommended.

KEYWORDS: (SIC 2710 News Paper printing), presses, offset printing, plates, photographic processing, mailroom, compositing, ink mist, polynuclear aeromatic hydrocarbons (PNA), fluoranthene, pyrene, quinone hydroquinone, hydrogen cyanide, formaldehyde, acetic acid, noise.

II. INTRODUCTION

In June 1979, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation from the management of The Evening News Southbridge, Massachusetts. They were planning to relocate the camera photo lab, plate processing, presses, and mailroom portions of their plant to a new facility. The purpose of the request was to identify any potential problems that might require controls in their new facility or that should be controlled in the existing facility for those activities that were not moving. Special interest was expressed in ink mist and photo process chemical exposures. The request enumerated 22 trade name products used in the photo offset and printing process. The direct reading findings and observations were reported and a list of recommendations were provided in a March 1980 Interim Report.

III. BACKGROUND

This company has operated for 50 years in it's present location. The process was converted to photo offset printing 8 years ago. Sixty five production workers are employed at the Southbridge facility, excluding reporters, administrators, and administration support personnel. They run a small daily paper and 9 weeklies plus other customers.

The editorial darkroom is used by the staff photographer to develop negatives, make contact prints for editing, and then negatives or prints for composition. This room was relocated less than 1 year ago to improve working conditions.

News or ad copy are processed in the composition department, which has a staff of four full-time and eight part-time employees. Copy is marked for type size, style, column size, etc., and then typed onto paper punch tape with a compugraphic type punch. The tapes are then placed in a compugraph computer typesetter, which transfers type to film paper. Paper film developing completes the process.

The camera/plate department is staffed by four men who work two or three per shift. The prints and type are shot in the cameraroom, then processed in the darkroom. Full newspaper pages consist of two shots, which are married two to a plate. The plateroom is where the coated aluminum plates are burned with high-intensity lights and developed. Darkroom developing is done by a Photo Mechanical Transfer (PMT) processor, however, half tones still require hand developing. Most of the plates are processed through an automatic developer. The exception is long-lasting plates, which must be hand developed.

The pressroom is operated by five pressmen working two shifts per day. There are six Goss Community Press (SC 672) units with a suburban folder. The annual usage of black ink is approximately 75,000 pounds and about 1/3 as much colored inks. Colored inks are distributed by

hand using a knife. Within the previous year, a compressor driven ink pump was added so that black ink is now distributed to the presses from drums through pipes. Presses typically run from 12 to 18 hours per day. The maximum impressions per-hour rate is 17,000, however, the average use rate is 10,000 to 12,000 per hour. Paper is dispensed from rolls. The web of paper passes through the six units. Four pages can be offset printed by each unit. The papers are cut and folded automatically. A row of wall air-conditioning units were installed at ceiling height above the pressline. Hard hats are worn and ear defenders are provided for use in this area.

There are 13 pressroom/mailroom helpers with flying and tying duties. Papers are manually stacked and jogged straight. They are either picked up from a conveyor to be tied and skided or passed into the mailroom for inserting or mailing. The mailroom is adjacent to the pressroom and contains inserting and addressing machines.

IV. DESIGN AND METHODS

A. DESIGN

Prior to initiating the field survey, information was sought on the trade name products listed in the request. The NIOSH trade name products file was searched and letters were sent to manufacturers requesting information on the products listed in the request.

Air samples were taken and work practices observed during parts of four shifts. The activity in each department is cyclic. Therefore, the air samples were taken during activity periods when possible. Personal breathing zone (PBZ) samples were taken in the editorial darkroom, in the camera darkroom, and in the plate developing area for acetic acid, quinone, hydroquinone, and N-methyl-para-aminophenol sulfate. Also PBZ samples were taken in the plate developing area and the pressroom for total hydrocarbons. In addition, PBZ oil mist samples were collected in the pressroom. PBZ acetic acid samples were collected in the composite room and colormetric measurments for hydrogen cyanide and formaldehyde were made in the composite room and both photographic darkrooms.

Noise levels were measured at several positions in the pressroom, composite room, and mailroom.

Ventilation conditions were assessed by discussions with employees in the pressroom and darkrooms, since none of the systems were in operation at the time of the survey.

Nine employees were administered confidential medical questionaires by the NIOSH investigator.

Bulk samples were taken of 12 products used in the facility.

B. ANALYTICAL METHOD

Personal breathing zone samples were taken with MSA Model G and Sipin battery-operated pumps.

Para-hydyoquinone and ink mist samples were collected on 37mm AA mixed cellulose ester filters in closed-face cassettes at an airflow rate of 1.5 liters per minute with the Model G pumps. The para-hydroquinone filter cassette was followed by a XAD-2 solid sorbent porous polymer tube to collect quinone. It was requested that N-methyl-para-aminophenol sulfate be analyzed on the same para-hydroquinone filter.

There are no analytical methods for "ink mist" that is specifically quantifiable. Therefore, an attempt was made to measure the amount of oil mist which is characteristically present as a component of the ink. This was done using NIOSH Method Nos. 159 and S-272, which were developed for analysis of pure mineral oil. The more complex samples of ink mist contain additional fluorescent substances. The "ink mist analysis" attempts to use a sample of ink as a standard to quantify the ink mist, by comparison with the fluoresence spectrum of the filter sample.

Three bulk black ink samples were analyzed for total benzene solubles and for five polynuclear aromatics. The total benzene solubles were determined using sonicated extraction. The limits of detection for this method is 0.02 mg per sample. The PNA's were analyzed by high pressure liquid chromatography with UV detection at 280 nm. The limits of detection in mg per gm were; fluoranthene 0.03, pyrene 0.03, chrysene 0.03, benzo(a)pyrene 0.01, and benzo(a)anthracene 0.01, for sequence 2252-T.

In conjunction with an industrywide study of the color industry, the NIOSH laboratory was developing a method for polynuclear aromatic hydrocarbons (PNA"s) analysis of ink samples, therefore, it was requested that the bulk black ink samples be analyzed for the benzene soluble fraction and for five of the PNA's, which are known or suspect carcinogens.

Analytical method for para-hydroquinone filter samples is P&CAM S-57 by high-pressure liquid chromatography (modified). The samples were submitted in 10 ml of 1% acetic acid solution. The limit of detection for this analysis is 2 micrograms per sample, for sequence 2252-R and-S.

The analytical method for the hydroquinone and quinone on the porous polymer tubes was by high-pressure liquid chromatography. Samples were desorbed in absolute ethanol and analyzed within 1

hour after desorption. The limits of detection for this method is 1.6 micrograms per sample for each analyte, for sequence 2252-T.

Acetic acid and hydrocarbons were collected on charcoal tubes at one liter per minute and 0.2 liters per minute, respectively.

Acetic acid samples were extracted with 0.1% H_2O_2 and analyzed on a Dionex Model 10 ion chromatograph. The limit of detection is estimated to be 10 micrograms per charcoal tube, for sequence 2252-L.

Hydrocarbons were extracted with carbon disulfide and analyzed following a modified NIOSH Method P&CAM 127 on a Hewlett-Packard gas chromatograph with a flame ionization detector. The limit of detection was 0.03 milligrams total hydrocarbons per sample, for sequence 2252-O.

The limits of detection for the Drager colormetric detector tube used are 2 ppm for hydrogen cyanide and 0.5 ppm for formaldehyde.

V. EVALUATION CRITERIA

There are a number of criteria for limiting occupational exposures to toxic chemicals and physical agents. In addition to the legal standards of Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH) recommended standards, there is one commonly recognized guide, the American Conference of Governmental Industrial Hygienists Threshold Limit Values^R. These criteria are presented for the substances evaluated in this report in Appendix I, along with the primary health effects.

The criteria for benzene solubles is based on experience with coal tar pitch volatiles, which contain a number of carcinogens, cocarcinogens, and potentiators.[1] The five PNA's analyzed for are known or suspect carcinogens, which are frequently among the benzene extracts of coal tar. While there are no criteria directly applicable to the printing inks tested, it is known that skin contact with coal tar products can lead to skin cancer. Airborne exposure is limited to 0.1 mg/m^3 coal tar pitch volatiles. NIOSH also recommended that carbon black dust containing greater than 0.1% benzene extractables be handled as a carcinogen and airborne exposures be limited to less than 0.1 mg/m^3 of benzene extractables.[2]

The NIOSH criteria for hydroquinone is based on its irritant properties, however, there is a need for further research regarding other toxicological effects.[3]

There is no generally applicable criteria for the total hydrocarbons analysis. The toxicity of the various components of a mixture of

hydrocarbons determines the combined exposure criteria. In the case of the exposures to Powerklene-X in the pressroom, the material safety data sheet supplied by the manufacturer provided the chemical categories of its components and their TLV's, which ranged from 200 to 500 ppm. In the case of the Imperial Black Developer used in the plate developing process, the material safety data sheet TLV data ranged from 10 to 100 ppm.

The OSHA hazardous noise criteria is 90 dBA for an 8-hour time-weighted average exposure. NIOSH recommended criteria for new construction is 85 dBA, 8-hour TWA. The damage risk associated with exposures above 85 dBA is significant and therefore, the newly implemented OSHA hearing conservation program guidelines require all exposed to 85 dBA TWA be given ear defenders and annual audiograms as well as training.

VI. RESULTS AND DISCUSSION

The findings of the January 28-31, 1980, survey which were previously stated in the March 1980 Interim Report are as follows:

Drager colormetric tube measurements for hydrogen cyanide, a decomposition product of Stabilizer CG-40, were negative. Measurements for formaldehyde, which is sometimes found in photo processing, were negative. The lower limits of detection were 2.0 and 0.5 ppm, respectively.

Ventilation was already recognized to be a problem in the newsroom photo lab. It had been relocated from a small room downstairs to an upstairs room where a window air conditioner had been placed. Reportedly, the prior location had caused the operator some problems due to excess heat and chemical odors; however, the new location was much improved. The impracticality of using air conditioning in cold weather and the need for a closed door for darkroom activities leads to a need for improved ventilation.

The cameraroom photo lab had provisions for an air inlet and an exhaust fan in addition to an air-conditioner unit. The fans were not operational at the time of this survey. A makeshift fan was placed in the exhaust port during the last shift observed. In plate developing, most concern was expressed about the possible effects of exposure to a subtractive plate developer used on long-term plates, which were not being processed at the time. This substance reportedly can produce the effect of lightheadedness when hand developing these plates.

Noise levels of 88 to 95 dBA were measured intermittently in the pressroom during press runs. The pressmen were provided ear defenders. However, they were not used as diligently as they should have been. Workers did not always wear them when they were working in the pressroom while the presses are running.

In the mailroom, noise exposures from an inserter and labeler had not been previously measured. It is likely, based on short-term measurements, that the inserting machine operators would be exposed to 90 dBA. This machine reportedly is normally operated less than 3 hours per shift. The address machine operator should wear ear defenders because of the routine 8- to 10-hour exposure period to 86 dBA noise levels, determined by short-term measurments. Other mailroom workers who stand within arms' reach of the inserting machine should be encouraged to use ear defenders if the inserting activities exceed a total of 4 hours per day, or when the work shift is extended beyond 8 hours.

Short-term noise measurements taken at the compugraphic tape punch operator's ear were 81 to 82 dBA. There were occasional brief excursions above 90 dBA when one machine was run to delete an error.

Pressroom workers were concerned about oil mist and paper dust. Unfortunately, a direct-reading GCA dust measuring instrument was damaged in transit and inoperative. While dust levels were not very noticeable at the time of the survey, dust deposits were evident and workers pointed out that they sometimes make much longer sustained runs than were observed.

Confidential interviews with employees did not indicate a high level of concern over health problems. There was, however, evidence that the photographic chemicals in both laboratories are potential problems. The mention of mucous in the throat and throat soreness was common.

The additional findings in this report are results of the analysis of environmental samples taken, which were not in excess of exposure criteria for toxic substances observed on the days of this survey. See Table 1 for quinone, hydroquinone, acetic acid, and total hydrocarbons findings. No findings were made for ink mist, or N-methyl-para-aminophenol sulfate. The ink mist analysis was not possible, since the original bulk ink samples were broken in shipment and the replacement samples did not have a similar spectrum to the filter samples. The laboratory was unable to perform the analysis of both p-methylamino phenol sulfate on the same samples analyzed for hydroquinones.

The findings of benzene solubles and PNA's in the bulk black ink samples is of concern, since the black offset printing inks reportedly have a coal tar component. The findings were negative for benzo(a)pyrene, chrysene, and benz(a)anthracene. Fluoranthene ranged from 0.03 to 0.05 mg/g and pyrene was found at 0.20 to 0.21 mg/g. The total benzene soluble fraction ranged from 866 to 915 mg/g. Since no airborne samples were taken for PNA's, there is no airborne exposure data.

NIOSH is conducting a Mortality and Industrial Hygiene study of Printing Trades.[4] Ink mist and PNA measurements were made in the New York Times. It is recognized that the work environment is not directly equateable due to differences in equipment, materials, and operating conditions. However, these findings are significant in that this potential hazard has not been generally recognized in the industry to date. The bulk black ink samples in that case were of lower PNA content than the above. The highest reported for benzo(a)pyrene was 0.0088 mg/g, for pyrene was 0.0261 mg/g, for benzo(a)anthracene was 0.019 mg/g, for fluoranthracene was 0.0396 mg/g; chrysene was not detected. The presence of airborne PNA's was measured in all four area samples. Highest measured levels were for benzo(a)pyrene 0.03 ug/m^3, for pyrene 0.07 ug/m^3, for benzo(a)anthracene 19.0 ug/m^3, and for fluoranthracene 39.6 ug/m^3. In addition, NIOSH has analyzed two other printing inks for PNA content. They were found to have a wide variability in PNA content.[4]

Therefore, it is prudent to minimize ink exposure and to place emphasis on personal hygiene. The accomplishment of reducing handling of black ink by use of the pressurized distribution system is certainly desirable. However, there are instances (such as the one observed during the survey when a ink drum leaked) that require manual transfer of the ink by putty knife. The procedure observed did not minimize the workers skin exposure. Good work practice would require the use of gloves with long cuffs and an apron or equivalent protective equipment for this activity; i.e. reaching down into the drum to scoop out the ink. The literature does not speak to the potential hazards of benzene soluble ink components in the printing industry. NIOSH is presently conducting studies of the potential health hazards of dyes in the color and printing industry. The results of this study have been made available to these NIOSH researchers.

The pressroom total hydrocarbon results were well below the TLV provided. This is based on the known range of molecular weights in the classes of chemicals used in the Powerklene-X.

The laboratory report of total hydrocarbons for the plateroom workers did not represent exposures to the Imperial Black Developer but to some other unidentified hydrocarbons. The quantitation of results given for these samples was based on a internal laboratory standard, therefore, are uninterpretable in terms of the unknown exposure.

VII. RECOMMENDATIONS

The recommendations which were previously stated in the March 1980 Interim Report are as follows:

The ventilation design of the new facilities should make provisions for local exhaust of the hand plate developing operations in addition to

the minimum four air changes per hour recommended for photo processing laboratories.[3]

The newsroom photo lab should be provided general exhaust and replacement air inlet at the opposite end of the room to ensure good air circulation at a minimum of four air changes per hour.

Noise exposures for full 8-hour work shifts at the addressing machine require use of ear defenders by operators. They should be included in the hearing conservation program.

Workers in the press area should be given training in the nature of neurosensory hearing loss and motivated to wear the ear defenders when the presses are running.

The mailroom inserting machine operators and others working within arms' reach of this machine should be encouraged to use ear defenders when they work over 8 hours or when the inserter is operated more than a total of 4 hours on any shift.

Compositors who work with the tape punches were not exposed to hazardous levels of noise when measurements were taken. The levels were 81 to 82 dBA at the operators ear. This is, however, a level high enough to be annoying and distracting. The use of ear defenders might make some individuals more comfortable and could reduce error rates and job annoyance.

Compositors who change chemicals in the Compugraghic paper processor should be instructed in proper handling and disposal procedures as specified by the manufacturer.

The new expanded press lines to be installed in another facility may be operated for longer periods and/or at higher speeds than were observed. An experienced manufacturer's representative should be consulted regarding recommendations for ink mist and paper dust controls. This recommendation is given greater emphasis based on the recent findings of airborne PNA's in a printing press room by NIOSH.[4]

When relocating the press and mailroom equipment, consideration should be given to noise exposure controls. Proper spacing of work areas could reduce exposures to other workers. In many cases, proper engineering of mountings and installation of sound suppressors can greatly reduce or eliminate high noise exposure environments. If new equipment is added, noise emissions should be a criteria in selection and installation.

As anticipated, the findings of the environmental sample analysis presented in this report do not alter the recommendations provided in the Interim Report of March 1980. The material safety data sheets previously provided give an overview of the potential toxic hazards in

many of the products used in the newspaper industry. Since recommended criteria are not always protective of the more susceptible individual and since the chronic effects of long-term, low-level exposures to a combination of contaminants is generally uncertain, the control of chemical exposures to the extent feasible is generally recognized to be the best practice.

The findings of benzene solubles and PNA's in the ink, in use here and at other newspapers, is another reason for emphasizing good work practices and personal hygiene in the pressroom. These work practices should be adhered to when handling the colored inks as well. The substitution of ink which is PNA free would most effectively eliminate the potential for health effects from this contaminant. The evaluation of airborne ink and PNA exposures should be accomplished in the new facility. This could be done through the submittal of another request to this agency.

VIII. REFERENCES

1. National Institute for Occupational Safety and Health. Criteria for a recommended standard--Occupational Exposure to Coal Tar. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1977 (DHHS Publication No. (NIOSH) 78-107).

2. National Institute for Occupational Safety and Health. Criteria for a recommended standard--Occupational Exposure to Carbon Black. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1978 (DHHS Publication No. (NIOSH) 78-204).

3. National Institute for Occupational Safety and Health. Criteria for a recommended standard--Occupational Exposure to Hydroquinones. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1978 (DHHS Publication No. (NIOSH) 78-155).

4. National Institute for Occupational Safety and Health, Industrywide Studies Branch. Mortality and Industrial Hygiene Study of Printing Trades, Unpublished data.

IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared by:

Bruce A. Hollett, C.I.H., P.E.
Senior Engineer
(Senior Industrial Hygienist)
Industrial Hygiene Section

Originating Office:

Hazard Evaluations and Technical Assistance Branch
Division of Surveillance, Hazard Evaluations and Field Studies
Cincinnati, Ohio

Report Typed By: Debra A. McDonald
Clerk-Typist
Industrial Hygiene Section

X. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technical Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. 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. Editor and Publisher of The Evening News
2. NIOSH, Region V
3. OSHA, Region V

For the purpose of informing the 65 affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

APPENDIX I

EXPOSURE CRITERIA AND HEALTH EFFECTS

HETA 79-119

JANUARY 1982

This appendix is a brief overview of the principles and practices used by Industrial Hygienists and other qualified Occupational Health Professionals in applying exposure criteria. For a full understanding of any criteria, it is necessary to refer to the documentation used in making the criteria recommendation.

There are thousands of chemical and physical hazards in the workplace for which there are little or no information upon which to base a health effects exposure limit. There are a few hundred that have been sufficiently documented to be published by one or more professional groups or government agencies. Two of the most widely recognized are the American Conference of Governmental Industrial Hygienists list of Threshold Limit Values (TLVs^{R}) and the National Institute for Occupational Safety and Health (NIOSH) Recommended Standards for Occupational Exposure. The Occupational Safety and Health Administration has promulgated a number of Permissible Exposure Limits (PELs) which, for the most part, were adopted from the 1968 TLV professional guides and are now standards. When available, all three of the above have been provided in these tables. The particular guide of choice depends on its intended use and limitations.

There are several general statments that can be made regarding the origin, limitations, and application of most of the exposure limit criteria:

Exposure criteria for chemical contaminants are given in units of airborne concentrations, which is primarily related to toxic inhalation hazards. However, they may also be annotated as toxic by entry through the skin. This annotation warns of the need for precautions to avoid skin absorption, which would invalidate the airborne exposure limit. Similarly in general, there is a need to ensure that toxic exposures through ingestion are controlled by good personal hygiene, food handling, and contamination control.

These criteria are based on the best available information from industrial experience, from experimental human and animal studies, and when possible from a combination of all three. The basis on which the values are established may differ from substance to substance; protection against immediate impairment of health may be a guiding factor for some, whereas reasonable freedom from irritation, narcosis, nuisance or other forms of stress, which could result in health effects, may form the basis for others.

The amount and nature of the information available varies from substance to substance. Consequently, the precision of the estimated criteria is also subject to variation and the latest documentation should be consulted in order to assess the extent of the data available for a given substance.

The criteria represent exposure conditions under which it is believed that nearly all workers may be repeatedly exposed for five 8-hour days a week for a working lifetime without adverse effect. Because of a wide variation in individual susceptibility, a small percentage of workers may experience discomfort from some substances at concentrations at or below the exposure limit; a smaller percentage may be effected more seriously by aggravation of a pre-existing condition or by development of an occupational illness. In spite of the fact that serious injury is not believed likely as a result of exposures to the exposure limit concentrations, the best practice is to manitain concentrations of all atmospheric contaminants as low as is practical.

These criteria are for single-substance exposures and specified work schedules. Exposures to a combination of chemicals under a variety of physical conditions and work schedules requires adjustment of these criteria based on sound knowledge and profesional judgment. This adjustment is more difficult when some of the exposures are to chemicals of unknown or poorly documented toxicity. These uncertainties add to the need to minimize exposure to atmospheric contaminants.

Threshold Limit Values for mixtures are addressed by the ACGIH as follows; "When two or more hazardous substances are present, their combined effect rather than that of either individually, would be given primary consideration. In the absence of information to the contrary, the effects of the different hazards should be considered as additive..." It is also possible to have other effects from combined exposures, such as synergistic action or potentiation. A synergistic effect is a combined toxicity greater than that expected from the two single toxicities added together. A Potentiation effect is one which increases the toxic effect of a toxic hazard; potentiative and synergistic agents are not necessarily harmful by themselves. Potentiation effects are often caused by exposures other than inhalation, e.g. imbibed alcohol and inhaled narcotic (trichloroethylene).

Carcinogens, teratogens, and mutagens must be treated cautiously, since unlike other toxicicants the effect is a potentially serious disease irrespective of the exposure which caused it. However, the exposure level does appear to have a direct relationship on the likelihood of having these effects. Therefore to minimize the risk, it is prudent to minimize the exposure.

There are three catagories of airborne exposure limits: the Time Weighted Average (TWA), the Short-Term Exposure Limit (STEL), and the Ceiling Limit (C).

The TWA is a calculated average exposure level for a specified period, typically 8 to 10 hours per day and 40 hours per week. TWA's permit exposures above the limit, provided they are compensated by equivalent excursions below the limit during the work period. There is a limit to the excursions that are permissible above the listed values. This limit is based on guidelines which take into account such factors as acute toxicity at higher concentrations, whether the effects are cumulative, the frequency of occurance of peaks, and their duration. All factors must be considered in making a judgment as to whether a hazardous condition exists.

The STEL is the maximal concentration to which a worker can be exposed for a period up to 15 minutes without suffering from 1) irritation, 2) chronic or irreversible tissue change, 3) narcosis of sufficient degree to increase accident proneness, impair self-rescue, or materially reduce work efficiency, provided that no more than four excursions per day are permitted, with at least 60 minutes between exposure periods, and provided that the TWA-TLV is also not exceeded. The STEL should not be used as a design criteria.

The Ceiling Limit (C) is the concentration that should not be exceeded even instantaneously. The STEL is also to be considered a ceiling limit.

OSHA's Accepted Maximal Peak above the 8-hour TWA specifies the applicable maximum duration for each substance so treated.

NIOSH Ceiling limits specify the short-term sampling period required for commonly available monitoring methods to detect the ceiling limit. This does not represent acceptance of a TWA excursion above the ceiling/peak exposure limit.

TABLE 1

RESULTS OF PERSONAL AIR SAMPLES FOR QUINONE,
HYDROQUINONE, ACETIC ACID, AND TOTAL HYDROCARBONS

THE EVENING NEWS
SOUTHBRIDGE, MASSACHUSETTS
HETA 79-119

JANUARY 29-30, 1980

DEPT.	JOB CLASSIFICATION	SAMPLE DATE	SAMPLE PERIOD	VOL. (L)	QUIN[1] (mg/m^3)	HYQU[2] (mg/m^3)	ACI (mg/
Camera	Photo Developer #1	29	1545-1645	90.0	<0.02	0.17	--
Camera	Photo Developer #1	29	1545-1645	90.0	----	<0.02	--
Camera	Photo Developer #1	29	1650-1810	120.0	<0.01	0.06	--
Camera	Photo Developer #1	29	1650-1810	120.0	----	<0.02	--
Camera	Photo Developer #1	29	1635-1650	22.0	<0.07	<0.07	--
Camera	Photo Developer #1	29	1635-1650	22.0	----	0.09	--
Camera	Photo Developer #1	29	1545-1850	185.0	----	----	0.
Camera	Photo Developer #1	29	1810-1920	60.0	<0.03	<0.03	--
Camera	Photo Developer #1	29	1810-1920	60.0	----	<0.03	--
Camera	Plate Developer #2	29	1545-1920	34.0	----	----	--
Newsroom	Photo Developer	30	0750-0850	90.0	<0.02	<0.02	--
Newsroom	Photo Developer	30	0750-0850	90.0	----	<0.02	--
Newsroom	Photo Developer	30	0850-0950	90.0	<0.02	<0.02	--
Newsroom	Photo Developer	30	0850-0950	90.0	----	<0.02	--
Newsroom	Photo Developer	30	0750-0950	120.0	----	----	1.
Camera	Photo Developer #3	30	0955-1055	90.0	<0.02	<0.02	--
Camera	Photo Developer #3	30	0955-1055	90.0	----	<0.02	--
Camera	Photo Developer #3	30	1155-1305	105.0	<0.02	<0.02	--

(CONTINUED)

TABLE 1 (CONTINUED)

DEPT.	JOB CLASSIFICATION	SAMPLE DATE	SAMPLE PERIOD	VOL. (L)	QUIN[1] (mg/m^3)	HYQU[2] (mg/m^3)	A (r
Camera	Photo Developer #3	30	1155-1305	105.0	----	<0.02	
Camera	Photo Developer #3	30	0955-1325	105.0	----	----	
Camera	Photo Developer #4	30	1000-1100	90.0	<0.02	<0.02	
Camera	Photo Developer #4	30	1000-1000	90.0	----	<0.02	
Camera	Photo Developer #4	30	1100-1305	188.0	<0.01	<0.01	
Camera	Photo Developer #4	30	1100-1305	188.0	----	<0.01	
Camera	Photo Developer #4	30	1000-1500	61.0	----	----	
Camera	Photo Developer #4	30	1100-1305	188.0	----	----	
Camera	Photo Developer #5	30	1305-1430	128.0	<0.01	<0.01	
Camera	Photo Developer #5	30	1305-1430	128.0	----	<0.01	
Camera	Photo Developer #5	30	1325-1430	65.0	----	----	
Camera	Photo Developer #6	30	1000-1100	143.0	<0.01	<0.01	
Camera	Photo Developer #6	30	1000-1000	143.0	----	<0.01	
Camera	Photo Developer #6	30	1100-1305	38.0	<0.04	<0.04	
Camera	Photo Developer #6	30	1100-1305	38.0	----	<0.04	
Camera	Photo Developer #6	30	1000-1500	120.0	----	----	
Camera	Photo Developer #7	30	1530-2030	56.0	----	----	
Camera	Photo Developer #8	30	1550-1725	143.0	<0.01	<0.01	
Camera	Photo Developer #8	30	1550-1725	143.0	----	<0.01	
Camera	Photo Developer #8	30	1725-2030	278.0	<0.01	<0.01	
Camera	Photo Developer #8	30	1725-2030	278.0	----	<0.01	

(CONTINUED)

TABLE 1 (CONTINUED)

DEPT.	JOB CLASSIFICATION	SAMPLE DATE	SAMPLE PERIOD	VOL. (L)	QUIN[1] (mg/m^3)	HYQU[2] (mg/m^3)	A (m
Press	Pressman #1	29	1320-1420	59.0	----	----	
Press	Pressman #1	30	1015-1810	95.0	----	----	
Press	Pressman #2 Foreman	30	1015-1810	95.0	----	----	
Lower limits of detection: (units per sample)					1.6 ug/spl	1.6 ug/spl	1 ug
Evaluation Criteria:	NIOSH = TWA				N/A	N/A	
	= Ceiling				N/A	2.0	
	(ceiling sample period)				N/A	(15 min.)	
	ACGIH = TLV				0.4	2.0	2
	= STEL-TLV				1.2	N/A	3
	OSHA = PEL-TWA				0.4	2.0	2

NOTES:

mg = milligrams (1.0 mg = 0.001 g).
ug = micrograms (1.0 ug = 0.001 mg).
N/A = Not Applicable/None Published.
< = These samples were below the detection limit, therefore, the airborne exposure, if any, the value indicated.
1 = QUIN - Quinone.
2 = HYQU - Hydroquinone.
3 = ACID - Acetic Acid.
4 = HCAR - Total Hydrocarbons.
a = Unknown composition compared to internal standard. Limit of detection 50.0 ug/spl.
b = Compared to standards made from the pressroom "Powerkleen X." Limit of detection 30.0 levels are well below the range of component TLV's provided on the material safety da

When referring to the following tables of criteria and effects, it is necessary to keep th
practices discussed above in mind. To interpret or apply these numbers to any particular
environmental conditions, the advice the council of a qualified occupational health profes
necessary.

TABLE I OF APPENDIX I

ENVIRONMENTAL CRITERIA AND PRINCIPAL HEALTH EFFECTS FOR AIRBORNE CONTAMINAN
(Please note: this table is not to be duplicated without Appendix I text.

January 1982

UNITS ARE GIVEN IN BOTH: PARTS PER MILLION PARTS OF AIR BY VOLUME (ppm)/AND THE EQUIVALEN
CUBIC METER OF AIR (mg/m^3)

	ACGIH (TLV)		OSHA (PEL)			NIOSH		
COMPOUNDS AND (SYNONYMS)	TWA (ppm) mg/m^3	STEL (ppm) mg/m^3	TWA (ppm) mg/m^3	CEILING (ppm) mg/m^3	PEAK (ppm) mg/m^3	TWA (ppm) mg/m^3	CEILING (ppm) mg/m^3	PRINCIPAL HE EFFECTS, TA ORGANS AN (REFERENCE
Acetic acid (SYN: Ethanoic acid)	(10.0) 25.0	(15.0) 37.0	(10.0) 25.0	------- -------	-------- --------	----- -----	--------- ---------	Causes eye, no throat, respir and skin irrit chronic bronch dental errosio
Carbon black-benzene solubles (PNA contamina ted)	-------- --------	------ ------	------- -------	------- -------	-------- --------	(0.1) -----	--------- ---------	POTENTIAL CARC (NIOSH Criteri the benzene so fraction of bu GTh. 0.01%)

(CONTINUED)

TABLE I OF APPENDIX I (CONTINUED)

COMPOUNDS AND (SYNONYMS)	ACGIH (TLV) TWA (ppm) mg/m³	ACGIH (TLV) STEL (ppm) mg/m³	OSHA (PEL) TWA (ppm) mg/m³	OSHA (PEL) CEILING (ppm) mg/m³	OSHA (PEL) PEAK (ppm) mg/m³	NIOSH TWA (ppm) mg/m³	NIOSH CEILING (ppm) mg/m³	PRINCIPAL HE EFFECTS, TA ORGANS AN (REFERENCE
Carbon black (PNA-free) dust not contaminated with PNAs	3.5	------	3.5	-------	--------	3.5	---------	NONE-(NIOSH CR Carbon is PNA- if the benzene ble fraction o is LTh. 0.01%)
Coal tar pitch volatiles (benzene soluble fraction)	A1a 0.2	------	0.2	-------	--------	0.1	FILTER plus TUBE	CARCINOGENIC (recommends a p backup tube fo glass fiber/Ag brane)
Formaldehyde (SYN: Formalin)	# A2 # A2	------ ------	(3.0) 3.6	(5.0) 6.0	(10.0)** 12.0**	LFL LFL	--------- ---------	SUSPECT CARCIN CURRENT INTELL BULLETIN No. 3 eye, skin, and respiratory ir
Hydrogen Cyanide (SYN: Prussic acid)	(10.0)C* 11.0 C*	------ ------	(10.0)* 11.0*	------- -------	-------- --------	----- -----	(0.5)** 5.0**	Asphyxia & dea (IDLH 50 ppm); tral nervous s cardiovascular tem; weak; con

(CONTINUED)

TABLE I OF APPENDIX I (CONTINUED)

COMPOUNDS AND (SYNONYMS)	ACGIH (TLV) TWA (ppm) mg/m³	ACGIH (TLV) STEL (ppm) mg/m³	OSHA (PEL) TWA (ppm) mg/m³	OSHA (PEL) CEILING (ppm) mg/m³	OSHA (PEL) PEAK (ppm) mg/m³	NIOSH TWA (ppm) mg/m³	NIOSH CEILING (ppm) mg/m³	PRINCIPAL HEALT EFFECTS, TARGE ORGANS AND (REFERENCES)
Hydroquinone (SYN: Quinol)	-------- 2.0	------ ------	------- 2.0	------- -------	-------- --------	----- -----	--------- 2.0 C**	Eye, respiratory system, skin irri tation; central nervous system; excitement; dizzi
Quinone (SYN: p-benzo-quinone)	0.1 0.4	0.3 1.2	0.1 0.4	------- -------	-------- --------	----- -----	--------- ---------	Eye and skin irri tion; skin ulcera tion and conjunct itis keratitis

*,** = Notes in right column for each entry.
# = Indicates that the following value is a proposed revision to the TLVs.
C = Designates a ceiling value not to be exceeded at any time.
A1a = Human carcinogens with an assigned TLV.
A2 = Industrial substance suspect of carcinogenic potential for man.
ACGIH = American Conference of Governmental Industrial Hygienists.
TLV^{R} = Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Env with Intended Changes.
STEL = Short-term Exposure Limit - the maximal concentration to which workers can be exposed up to 15 minutes continuously, provided that no more than four excursions per day are with at least 60 minutes between exposures.

(CONTINUED)

TABLE I OF APPENDIX I (CONTINUED)

TWA = For ACGIH and OSHA - The time-weighted average concentration for a normal 8-hour work
40-hour workweek to which nearly all workers may be repeatedly e
after day, without adverse effect.

For NIOSH - The time-weighted average concentration for a normal work period up to 10
and a 40-hour workweek to which nearly all workers may be repeatedly expo
day, without adverse effects.

CEILING = For ACGIH - The concentration that should not be exceeded even instantaneously.

For OSHA - The permissible ceiling for an 8-hour day.

For NIOSH - The concentration that should not be exceeded at any time and that sh
over a specified short-term sampling period.

PEAK = OSHA acceptable maximum peak above the ceiling for a specified maximum duration.

LFL = For NIOSH the Lowest Feasible Limit is recommended since a safe level of exposure to
carcinogens has not been demonstrated, but the probability of developing cancer shoul
decreasing exposure.

DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTERS FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
ROBERT A. TAFT LABORATORIES
4676 COLUMBIA PARKWAY, CINCINNATI, OHIO 45226

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

Third Class Mail

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF HHS
HHS 396