HEALTH HAZARD EVALUATION REPORT

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DONNELLY PRINTING COMPANY
ST. LOUIS, MISSOURI

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Donnelly Printing Company
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I. SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) conducted a health hazard evaluation (HHE) at Donnelly Printing Company in St. Louis, Missouri, at the request of the Graphic Communications International Union (GCIU), Local 505. Workers were concerned about their potential solvent exposures and had been experiencing dizziness, headaches, and nausea. In April 1994, NIOSH investigators conducted a survey of the facility which included a walk-through of the plant, informal employee interviews, review of records and programs, and air sampling. Employee interviews revealed symptoms of nausea, dizziness, and skin irritation. There was also a documented case of an allergic reaction. The health and safety program is minimal, especially the Hazard Communication Program. Several bulk samples of blanket wash, a compound used throughout the facility to clean press parts, tools, and other equipment, and thirteen air samples were collected for analysis of volatile organic compounds. Air samples were also collected for ethylene glycol and glycol ethers. The glycol ether air samples were not analyzed since the bulk sample analysis the blanket wash did not detect any glycol ethers. All of the remaining air concentrations were well below their respective occupational exposure limits, but there appeared to be an extensive amount of skin contact with the solvents.

Although workers are exposed to low airborne concentrations of toluene and other hydrocarbons, dermal exposure could potentially result in significant exposure to the workers. Recommendations are made to improve ventilation, personal protective equipment use, and the health and safety program.

KEYWORDS: SIC 2711 (newspapers: publishing and printing), printing, off-set printing, newspapers, toluene, ethylene glycol, total hydrocarbons

II. INTRODUCTION

In April 1994, the National Institute for Occupational Safety and Health (NIOSH) conducted a health hazard evaluation (HHE) at Donnelly Printing Company in St. Louis, Missouri. The Graphic Communications International Union (GCIU), Local 505, submitted the HHE request because workers were concerned about their potential solvent exposures and had been experiencing dizziness, headaches, and nausea. NIOSH investigators visited the facility on April 5, 1994, and conducted a general walk-through survey, informal employee interviews, a review of records and programs, and industrial hygiene sampling.

III. BACKGROUND

Donnelly Printing Company shares a building with two other companies, one that is a completely separate business, and one that is under the same umbrella of management as Donnelly. The building was built in 1970 by Donnelly for off-set printing. The company has expanded its printing capacity from the original eight printing units to 22. Donnelly Printing was bought by Ingersol in 1984, and it is under the management of Suburban Journals. Presently, Donnelly prints 14 different weekly newspapers.

The facility consists mainly of one large, open room that contains two off-set printing-press lines. The lines are side-by-side with the area between them being called the gear side of each press and the outside of each press being called the operator side. On the operator side of both Press 1 and Press 2 there are two blanket wash stations. The operator side of Press 2 also has a third larger blanket wash station. The blanket wash stations, called dip tanks by the employees, are sinks with flexible nozzles for faucets which supply the blanket wash used throughout the facility to clean rollers, blankets, and other press parts, as well as tools and equipment. Some employees also wash their hands with it.

The blanket wash, contained in a small drum below the sink, is pumped through the nozzles to rinse materials placed in the sinks. The used blanket wash then drains back into the drum and is reused. Periodically the drum is emptied and refilled with new blanket wash solution. Workers also fill buckets or jars at these stations and carry blanket wash to the press lines to clean the rollers and blankets whenever a line is changed over to run a new print. This cleaning typically requires a worker to place his head and upper body into one of the units and wipe the rollers and blankets with a rag soaked in blanket wash. (For future reference, this area where employees place their head and upper body will be referred to as the roller area.) When not in use the blanket wash stations have covers that can be closed.

Until recently, RYK-6 Blanket Wash, manufactured by Chemisphere Corporation, was used at Donnelly Printing. The Material Safety Data Sheet (MSDS) indicated that this chemical contains cumene, ethylbenzene, toluene, xylene, 1,2,4-trimethylbenzene, ethyl benzene, and other hydrocarbons. Currently RYK-7 Blanket Wash is used, a solution which contains 2-methoxymethylethoxy propanol (a glycol ether), refined petroleum distillates, and aromatic hydrocarbons. The percentage of each component and exact petroleum distillates and aromatic hydrocarbons are not reported on the MSDS.

In the floor below the two press lines is a depression or trough that is several inches deep and drains into sewer traps. This trough is usually filled with a few inches of solvents and inks that have leaked down from the presses, as it was on the day of the survey. The two sewer traps connected to this drain used to empty directly into the city sewer system, but now the contents of the traps are routinely pumped into an open drum which is disposed of as hazardous waste. Workers reported that the traps are usually full to the level where they can still slightly overflow into the sewer system.

There are four large ink storage tanks along the south wall of the facility. There is also a small water room near the ink tanks where the water solution is mixed for the off-set printing process. The water is in a closed-loop system, cycling between the press lines and the water room. When it returns from the press lines, the water is filtered through nylon stockings to remove particulate matter. These stocking filters are changed as needed by employees.

Varying numbers of employees work each day. On the two heaviest days, Tuesdays and Saturdays, 12 to 15 pressmen are working each shift. Monday is a set-up day with very few pressmen, and the other days are moderately busy and staffed. The employees are expected to eat along the presslines. There is no cafeteria, but there is a small break area with vending machines.

Personal protective equipment, such as gloves, is provided to employees, but use is not enforced. Workers reported that only recently have they been advised to only put clean hands in their gloves to avoid contaminating the insides. Several choices of hearing protection are also provided to employees and their use is required when either press line is operating. Most of the workers use the small ear plugs that must be rolled between two fingers before inserting into the ear. Often workers remove their ear plugs several times during the day, and then replace them with dirty hands. At the end of the day, the plugs themselves are often as dirty as the workers' hands, and these dirty plugs could cause ear infections.

A no smoking policy exists within the building; workers are expected to smoke only outside the building. Unfortunately, this policy is not strictly enforced.

Donnelly Printing has a written health and safety policy, but several of the programs in the policy do not exist or are not practiced. There was no evidence that the hazard identification inspections occur or that the suggestion/complaint program operates. Also, the hazard communication program appears to be insufficient; the workers reported that they do not receive adequate education about the specific materials that they handle. According to the written plan, there is supposed to be a MSDS Interpretation Guide, but neither management nor the employees were aware of it. Workers also reported that they routinely enter the other company in the building which is managed by Donnelly Printing but do not have access to any information about the chemicals used in that area. Communication in general is poor between the management and the employees.

The original ventilation system provides heating, cooling, and dilution ventilation to the printing area, but there are only supplies and returns in one half of the room. Fans have been added to the other side of the room because heat was a complaint during the summer; and

heating lamps were suspended from the ceiling in this area because cold was a complaint in the winter. The heat lamps, however, are no longer used.

IV. EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ evaluation criteria for the assessment of a number of chemical (and physical) agents. The primary sources of environmental evaluation criteria for the workplace are the following: (1) NIOSH Criteria Documents and Recommended Exposure Limits (RELs), (2) the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs), and (3) the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs).[1,2,3] The objective of these criteria for chemical agents is to establish levels of exposure to which the vast majority of workers may be exposed without experiencing adverse health effects.

Full-shift and shorter duration criteria are available depending on the specific physiologic properties of the agent. Full-shift limits are based on the time-weighted average (TWA) airborne concentration of a substance that workers may be repeatedly exposed to during an eight or 10 hour workday, up to 40 hours a week for a working lifetime, without adverse health effects. Some substances have short-term exposure limits (STELs) or ceiling limits (CLs) which are intended to supplement the full-shift criteria where there are recognized irritative or toxic effects from brief exposures to high airborne concentrations. STELs are based on 15 minute TWA concentrations, whereas CL concentrations should not be exceeded even momentarily.

Occupational health criteria are established based on the available scientific information provided by industrial experience, animal or human experimental data, or epidemiologic studies. Differences between the NIOSH RELs, OSHA PELs, and ACGIH TLVs may exist because of different philosophies, different interpretations of technical information, and the different research data that was available at the time that the standard was written. OSHA PELs take into account the technical and economical feasibility of controlling exposures in various industries where the agents are present. The NIOSH RELs are primarily based upon the prevention of occupational disease without assessing the economic feasibility of the affected industries and, as such, tend to more stringent. ACGIH is not a government agency, it is a professional organization whose members are industrial hygienists or other professionals in related disciplines and are employed in the public or academic sector. TLVs are developed by consensus agreement of the ACGIH TLV committee and are published annually. The documentation supporting the TLVs (and proposed changes) is periodically reviewed and updated if believed necessary by the committee.

Not all workers will be protected from adverse health effects if their exposures are maintained below these occupational health exposure criteria. A small percentage may experience adverse effects due to individual susceptibility, a pre-existing medical condition, previous exposures, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, or with medications or personal habits of the worker (such as smoking) to produce health effects even if the

occupational exposures are controlled to the limit set by the evaluation criterion. These combined effects are often not considered by the chemical specific evaluation criteria. Furthermore, many substances are appreciably absorbed by direct contact with the skin and thus potentially increase the overall exposure and biologic response beyond that expected from inhalation alone. Finally, evaluation criteria may change over time as new information on the toxic effects of an agent become available. Because of these reasons, it is prudent for an employer to maintain worker exposures well below established occupational health criteria.

Exposure Criteria for Aromatic Hydrocarbons

Exposure to aromatic hydrocarbons can occur through inhalation of the vapors and absorption through the skin. Exposure symptoms include dizziness, headache, fatigue, lightheadedness, weakness, poor concentration, mucous membrane irritation; and, at higher concentrations, impaired motor function, respiratory depression, central nervous system (CNS) depression, unconsciousness, and death.[4,5] Chronic effects that have been reported among some workers exposed to organic solvents include peripheral neuropathies (impaired nerves), organic affective syndrome, and mild chronic toxic encephalopathy. Organic affective syndrome is characterized by fatigue, memory impairment, irritability, difficulty in concentration, and mild mood disturbance. Mild chronic toxic encephalopathy is manifested by sustained personality or mood changes such as emotional instability, diminished impulse control and motivation, and learning capacity. The extent to which chronic neurotoxicity is reversible remains to be established.[4]

Two specific hydrocarbons that were evaluated in this survey were toluene and ethylene glycol. The NIOSH REL for toluene is 100 parts per million (ppm), with a STEL of 150 ppm.[5] The OSHA PEL for toluene is 200 ppm,[2] and the ACGIH TLV is 50 ppm.[3] The TLV also carries a "skin" notation indicating that skin absorption can contribute to the overall dose.[3] The CNS, liver, kidneys, and skin can all be affected by toluene exposure at or above the recommended exposure limits. Symptoms of exposure to lower concentrations include fatigue, weakness, confusion, dizziness, headache, and dermatitis.[5]

NIOSH and OSHA do not have exposure limits for ethylene glycol. The ACGIH TLV is a ceiling limit of 50 ppm. Inhalation exposure is often not a problem because of the low vapor pressure of ethylene glycol. Ethylene glycol aerosol can cause upper respiratory irritation and headaches at levels of 12 ppm.[6] At exposures of 56 ppm, the irritation is more pronounced, and at 80 ppm of aerosol, the irritation and cough are unbearable.[6] Ingestion of ethylene glycol can cause CNS depression, severe metabolic acidosis, liver and kidney damage, and pulmonary edema.[6]

Total hydrocarbon concentrations are not regulated by specific exposure standards or guidelines. However, exposure to a combination of low level hydrocarbon concentrations could have a cumulative exposure effect. For this reason, air concentrations of total hydrocarbons should be evaluated when an exposure to a mixture of hydrocarbons exists.

V. EVALUATION METHODS

Environmental

The environmental evaluation consisted of a walk-through of the facility; conversations with employees; air sampling; and review of the MSDSs, the written health and safety policy, and a previous OSHA site visit report. Several general area (GA) air samples, as well as one personal breathing zone (PBZ) sample, were collected for volatile organic compounds (VOCs) using charcoal tubes and Gillian low-flow pumps at a flow rate of 200 milliliters per minute (ml/min). These VOC samples were analyzed according to NIOSH Method 1501. GA air samples for glycol ethers were collected using charcoal tubes and Gillian low-flow pumps at a flow rate of 50 ml/min. These samples would have been anaylzed using a method similar to NIOSH Method 1403. Finally, two GA air samples for ethylene glycol were collected using SKC #226-57 tubes and Gillian high-flow pumps at a flow rate of 1 l/min.

Medical

The medical evaluation consisted primarily of informal interviews with ten of the employees present on the day of the site visit. Each person was questioned about dizziness, headaches, nausea, skin irritation, and any other prevailing health problems. The OSHA 200 Injury and Illness logs were also reviewed.

VI. RESULTS AND DISCUSSION

Environmental

Three GA air samples were collected along the press lines and analyzed qualitatively for the presence of hydrocarbons. The samples that were collected could represent a typical exposure while working along the side of the presslines; they would not represent a worse case exposure, such as placing the head and upper body into the roller to clean with blanket wash. Based on these results, the other air samples collected were quantitatively analyzed for toluene and for total hydrocarbons. The total hydrocarbon analysis was based on a bulk sample of the blanket wash solution for which the bulk analysis revealed a composition similar to stoddard solvent -- one of the components listed on the blanket wash MSDS.

The ten GA and two PBZ samples were analyzed for toluene and total hydrocarbon concentrations. The toluene concentrations ranged from trace levels (0.06 to 0.20 ppm) to 0.35 ppm for the GA samples, and were 0.22 ppm and 0.27 ppm for the two PBZ samples. The PBZ samples were consecutive samples collected on a pressman feeder. The accurary of the second PBZ sample (0.27 ppm) may be questionable because of a laboratory error during the analysis which might have resulted in an overestimate. However, 0.27 ppm appears to be reasonable based on the other samples. These toluene concentrations are well below the REL and PEL of 100 ppm and the TLV of 50 ppm.

The concentrations of total hydrocarbon from the GA samples ranged from 19 mg/m^3 to 210 mg/m^3. The two PBZ samples were 36 mg/m^3 and 115 mg/m^3, but again, the second

concentration (115 mg/m^3) could be an overestimate due to the same laboratory error as mentioned above. Since the bulk analysis of the blanket wash identified the solution as similar to stoddard solvent, the exposure criteria for stoddard solvent was used for comparison. The NIOSH REL is 350 mg/m^3, and the OSHA PEL and ACGIH TLV are both 525 mg/m^3. Again, the air concentrations detected during the site visit are well below the exposure limits.

Since the bulk samples of the blanket wash solution did not reveal significant amounts of glycol ethers, the area samples for glycol ethers were not analyzed. Without a source of exposure, measurable air concentrations were not expected.

The two ethylene glycol samples collected when the rollers were being wiped down with the copper plating solution had a concentration of 0.35 ppm on one and no detectable amount on the other. These results suggest that the exposures would be well below the ACGIH TLV of 50 ppm.

Medical

Of the ten employees interviewed, three reported experiencing dizziness during work hours, and all ten reported nausea when working in the roller area of the presslines. Employees estimated a work time of one to five hours before experiencing any effects. All reported dry or cracking skin, which was often worse during the winter months. Two of the workers had noticeably cracked skin, especially in the web space between their fingers; and most had minor cuts and abrasions on their hands. Workers could not recall their last tetanus booster. Workers expressed no reservations about exposing their skin to the blanket wash; some reported that they washed their hands in it because it removes ink better than the soap provided by the company.

Four of the ten employees interviewed stated that the blanket wash caused reddening of their skin above the cuffs of their gloves or underneath any clothing that had blanket washed spilled on it. The reddened areas would generally fade within a day.

Review of the OSHA 200 Injury and Illness log revealed one entry of allergic reaction. One employee, while cleaning the drain below the presses, felt constriction in his throat, became flushed, and developed hives, all of which resolved with an antihistamine. The same employee subsequently experienced another allergic reaction but of quicker onset and less severity than the former.

VII. RECOMMENDATIONS

1. Since workers are experiencing symptoms that are consistent with low levels of solvent exposure, consideration should be given to increasing the ventilation in the work area. A second general dilution ventilation system with a more even distribution of supplies and returns throughout the workplace, some local exhaust ventilation (LEV) systems, could be added. Suggested LEV designs include slot hoods located at each dip tank that would operate when the dip tanks are open, and a ventilation system that exhausts air from below the press lines. Since thermal discomfort was a common complaint, the first option

should be a second dilution ventilation system that provides conditioning of the air. If the headache, and dizziness symptoms persist, then the LEV systems should be considered. A ventilation engineer should be consulted prior to making any ventilation changes to ensure that the systems are properly installed and balanced.

2. Since organic solvents can be absorbed through the skin, proper gloves should be worn for every activity where their use would not create a safety hazard. Nitrile rubber and Viton® gloves are two that offer good protection from a variety of solvents. Proper use of the gloves should be taught and enforced. For example, once the inside of a glove is contaminated, such as from putting a hand with solvent on it into the glove, the glove may actually do more harm than good. The glove holds the solvent against the skin and does not allow for any evaporation. It is also important for workers to understand that most materials are not completely impermeable to solvents; there will eventually be breakthrough. Therefore, the glove's manufacturer should be consulted to determine how often new gloves should be issued. New gloves should be easily accessible to the workers.

   Workers should be discouraged from washing their hands with the blanket wash solution. Since washing with detergents or soaps frequently can also dry and damage skin, lubricating skin lotion should be provided for workers by each wash station.

   Finally, safety goggles should be worn when working on the presslines, and face shields should be used at the dip tanks. The goggles should be provided to each worker, and face shields could be stored by each dip tank.

3. Many workers had spilled solvents on their uniforms on the day of the site visit, and several reported skin redness at the cuff of their gloves or where solvent had spilled on their clothing. Since skin contact can be a significant route of solvent exposure, uniforms should be provided and laundered at the workplace and workers should be allowed to change work clothes after a spill or splash. The locker rooms and shower already exist in the work area, and this uniform laundry service was provided in the past at Donnelly Printing. Also, the shower should be cleaned and maintained routinely so that workers can use it.

4. Since the solvents and inks used in the press room are flammable liquids, there should be no lit cigarettes, matches, or lighters in the area. The no smoking policy needs to be strictly enforced to avoid a fire or explosion. Also, the drains and traps under the presslines should be cleaned routinely. This will also reduce the likelihood of fire or explosion by reducing the amount of uncontained solvents in the room.

5. When emptying the sewer traps, the waste should be pumped into covered 55-gallon drums through the screw cap, instead of pumping into uncovered drums. Covering the drums will prevent the employee from working over an open container of mixed volatile organics and lessen the exposure to their vapors.

6. Eating and drinking should not be permitted in the press room since the food could possibility become contaminated. This can result in exposure to workplace chemicals

through ingestion. A separate area, such as the break room, should be designated for eating and drinking.

7. The written health and safety policy for Donnelly Printing included some programs that are not currently set up or practiced.

   First, the routine hazard identification inspections that are supposed to occur routinely do not. This program should be implemented so that management and employees can maintain a safe workplace. Inspections could be conducted routinely by health and safety representatives from management and union. As needed, more complicated problems could be evaluated by a contracted industrial hygienist.

   Second, the suggestion/complaint program has been ineffective because of an apparent lack of trust between management and the union. If properly implemented, this program could provide a line for better communication between the employees and management. This communication is important -- employees should be able to offer suggestions or point out issues of concern without any negative repercussions. Management should try to address each issue in routine health and safety meetings. If action is to be taken, management should inform employees what is being done and why. Likewise, if action is not to be taken, management should inform employees that the issue was considered and why no action is being taken.

   Third, the written Hazard Communication Program refers to an MSDS Interpretation Guide to help the workers understand the MSDSs, but workers interviewed by NIOSH investigators have never heard of it. Copies of this guide should be kept at the workers' right-to-know center in the press room as well as in the health and safety office.

   The Hazard Communication Program also should involve more detailed employee training and education. A better understanding of the potential hazards of the workplace should reduce worker exposure and also any anxiety about unknown exposures. Also, if employees are required to go into other work areas throughout their work shift (such as the other company in the building which is under the same umbrella of management as Donnelly), they should have access to the MSDSs for this other work area as well. Since both work areas are required to have a Hazard Communication Program, it should not be difficult to allow the workers access to the health and safety information for both. If part of their job is to enter other work areas, workers have the right to know the potential hazards of the other work areas.

8. The Hearing Protection Program at Donnelly Printing requires workers to use hearing protection (HP) in the press room whenever at least one press is running. This program should involve noise level monitoring to establish the need for HP, and it also needs to provide better training in HP use. Not only do the plugs need to be placed in the ear correctly, but they should be inserted with clean hands. If HP is required after measuring the noise levels in this area, two possible solutions are to provide ear plugs that do not require rolling between fingers (but they do not protect as well) or to provide ear muffs. A better solution would be to reduce the noise levels to below 85 decibels (dB) through engineering controls so that hearing protection is not necessary.

VIII. REFERENCES

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IX. INVESTIGATORS AND ACKNOWLEDGEMENTS

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X. DISTRIBUTION AND POSTING

Copies of this report have been sent to:

1. Graphic Communications International Union, Local 505
2. Production Director, Suburban Journals
3. OSHA, Region VII

For the purpose of informing 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.