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HARDY ROAD LANDFILL
AKRON, OHIO

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I. SUMMARY

In February, 1993, the National Institute for Occupational Safety and Health (NIOSH) received a management and a union request to conduct a Health Hazard Evaluation (HHE) at the City of Akron, Ohio, Hardy Road Landfill. The requests were for assistance in making a determination if employee exposures to noise and dusts created by work operations represented a health hazard. The facility accepts empty containers and packaging materials from local industries and the refuse is known to have residues of heavy metals and silica. Asbestos may also be present in construction and demolition debris which is also accepted for disposal at the landfill. The landfill does not accept liquid wastes or materials specifically classified or listed as hazardous wastes.

Personal air monitoring and noise dosimetry were conducted over the period of two days on three heavy equipment operators, three mechanics, and a laborer. The results of full-shift noise dosimetry revealed that workers were exposed to noise in excess of the Occupational Safety and Health Administration (OSHA) Time Weighted Average (TWA) Permissible Exposure Limit (PEL) of 90 decibels on an A-weighted scale [dB(A)] . Employees used hearing protection devices to guard against the hazards of occupational noise exposure. The results of full-shift personal air sampling for asbestos, respirable dust, respirable silica, and metals indicate that three equipment operators were exposed to respirable silica in excess of the NIOSH REL of 0.05 milligrams per cubic meter (mg/m^3) of air. One of these samples was in excess of an OSHA calculated TWA-PEL for respirable silica (as quartz) of 0.25 mg/m^3. Respirable silica exposures occurred in heavy equipment operators and is believed to be the result of exposure to airborne soil containing silica. Soil is excavated at the landfill and used as daily cover for compacted (buried) refuse. Excavation, transport, and compaction of soil can create considerable dust, depending on the situation. No workers were exposed in excess of the respective OSHA PELs for the metals barium, beryllium, cadmium, chromium, magnesium, manganese or lead. One mechanic, however was exposed in excess of the NIOSH REL of 0.001 mg/m^3 for chromium when expressed as hexavalent chromium [Cr(VI)]. This exposure is believed to be the result of chromium-containing residues on the equipment which the mechanic was servicing when air sampling took place. Asbestos was reported as not detected in all air samples. No exposures were determined to be in excess of the OSHA PEL of 5 mg/m^3 for respirable dust. At the time of the investigation, employee respiratory protection or hearing conservation programs were not in place at the facility; however, in addition to hearing protection, half-mask air purifying respirators were available for use by employees at their own discretion.

Results of the NIOSH HHE at the Hardy Road Landfill indicate that a health hazard existed due to exposure to respirable silica in excess of the NIOSH REL and the OSHA PEL. One personal sample of dust containing chromium was found to exceed the NIOSH REL for chromium, interpreted as hexavalent chromium (CrVI). The results of noise dosimetry indicate that exposure to noise exceeded the OSHA PEL of 90 dB(A) for an 8 hour TWA. Recommendations are included in this report to develop comprehensive hearing conservation and respiratory protection programs to reduce worker exposures to noise and particulates. Additional recommendations include suggestions for engineering controls to reduce worker exposure to noise and particulates.

II. INTRODUCTION

On February 23, 1993, the National Institute for Occupational Safety and Health (NIOSH) received requests for a Health Hazard Evaluation (HHE) at the City of Akron, Hardy Road Landfill. NIOSH was requested by management from the City of Akron, and the Akron City Employees Local 1360, due to concerns from the union and management regarding unknown employee exposures to potentially toxic dusts from empty containers and packaging materials which are landfilled at the facility. Following an initial site visit, a verbal request was made by management to evaluate employee exposures to noise as part of the HHE.

III. BACKGROUND

The Hardy Road Landfill is a 215 acre waste disposal site located in the northwest portion of Akron, Ohio. The site is owned and operated by the City of Akron. The facility has been accepting industrial and municipal wastes since 1970. Approximately 100 acres of the 215 acre site are permitted for landfill purposes. The City employs 11 people in the landfilling operation. Employee job titles and numbers of personnel include: the landfill supervisor, landfill foreman, weigh station attendant, mechanic (3), laborer (1) and equipment operator (4). Employees with work activities which may result in exposure to noise and dusts include: equipment operators compacting refuse at the working face or moving soil for cover, mechanics working on equipment used at the working face, and the laborer conducting general operations at the landfill.

According to Resource Manager for the City of Akron, all wastes entering the landfill are monitored and the landfill does not accept liquids or materials which are classified or specifically listed as hazardous wastes. However, empty containers which may contain small amounts of dry residues of hazardous materials are accepted for disposal. The four general types of solid waste which the facility accepts include: 1) wood, paper, plastic and metal from businesses and residences; 2) industrial solid waste by-products such as foundry sand, rubber scrap, and non-useable materials; 3) exempt solid wastes such as construction debris and incinerator ash waste from the Akron Recycle Energy Station (RES). This HHE involved a portion of the landfill where incinerator ash from the Akron RES was not being disposed.

On April 14-15, 1993, a site visit was made to the facility and an opening conference was conducted with management, employees, and union representatives. The purpose of the initial site visit was to conduct a walkthrough evaluation of the facility, and to observe employee work practices at the active cells (also called the working face) of the landfill. A return visit was made to the facility on June 15-16, 1993, to evaluate employee full-shift exposures to noise and to conduct full-shift personal air sampling to determine exposures to respirable dust and silica, metals, and asbestos.

Observation of the types of loads being delivered to the landfill on the days of the investigation revealed that the industrial wastes consisted largely of packaging materials. Several loads of what appeared to be scrap materials from rubber manufacturing operations and other plastic debris were delivered along with numerous loads of construction and demolition debris. Prior to the initial NIOSH site visit, a review of numerous material safety data sheets (MSDSs) was conducted. The MSDSs were sent to the City of Akron by the local industries which use the landfill to dispose of packaging materials and containers for raw materials as well as shop scrap from their production. The MSDSs indicated a number of products containing metals (including lead, chromium and chromium VI) as well as crystalline silica. Additionally, asbestos was suspected as a possibility in certain asbestos-containing building materials such as siding, roofing, and other construction debris. All of the materials appeared to create some dust when they were dumped and compacted; and therefore, particulates were judged to be a major risk factor in terms of inhalation and dermal (skin contact) exposures.

Materials arriving at the Hardy Road Landfill are generally transported by truck, although some may arrive by car. After the load is weighed and payment is collected, the load is driven off the scale and down a short road onto the working face of the landfill. The driver is directed to a specific location to dump the load, after which a diesel-powered refuse compactor is driven over the refuse to break the larger pieces and compact the refuse to the greatest degree possible. A belly scraper (pan loader) excavates soil from a nearby area of the landfill and unloads the soil which is used to cover the compacted refuse. Equipment operators are exposed to noise from heavy equipment, and to intermittent exposures from dusts created when the refuse is compacted and crushed. Clouds of dust are also generated from the action of the equipment as soils are excavated and dumped. A number of variables, including the dustiness of the refuse itself, the condition of the soil at the working face, daily weather conditions, and prevailing winds influence the amount of dust in the environment. These conditions are dynamic and personal exposures can be expected to have some attributable degree of variability. Mechanics service the equipment used on-site in the maintenance garage, an area which is a considerable distance from the working face of the landfill. The mechanics may come into contact with landfill debris that is on equipment brought into the maintenance garage for service after being used at the working face.

IV. METHODS

To characterize exposures to particulates, employees were asked to wear three personal sampling trains; one sampling train was configured to sample for respirable dust and silica, another was configured to sample for metals, and a third was configured to sample for asbestos. Sampling for metals consisted of a 0.8 micrometer (µm) mixed cellulose-ester membrane filter cassette connected to a Gilian® constant flow sampling pump calibrated to 2 liters per minute (Lpm). The cassette was clipped to the uniform lapel in the worker's breathing zone. Pre-and post-sampling calibration (including flow checks during the day) was performed using a calibrated hand-held rotameter. The samples were digested using NIOSH Method 7300[1] modified for microwave digestion and analyzed using a Thermo Jarrell Ash ICAP 61 "C" simultaneous scanning inductively coupled plasma emission spectrometer.

Respirable particulate and respirable silica samples were collected on tared 37 mm, 5-µm PVC membrane filter cassettes mounted in 10 millimeter (mm) nylon Dorr-Oliver cyclones. The cassette was connected to a personal sampling pump calibrated to a flow rate of 1.7 Lpm. The samples were analyzed gravimetrically for total weight according to NIOSH Method 0600[2] with two modifications: 1) filters were stored in an environmentally controlled room to reduce the stabilization time between tare weighings to 5-10 minutes and; 2) the filters and backup pads were not vacuum desiccated. The instrumental precision of the weighings (using an electrobalance) was reported at 0.02 milligrams (mg). After analysis for total weight, the samples were analyzed for the presence of silica (as quartz and cristobalite) using x-ray diffraction. NIOSH Method 7500[3] was used for the analysis with the following modifications: 1) filters were dissolved in tetrahydrofuran rather than ashed in a furnace; and 2) standards and samples were run concurrently and an external calibration curve was prepared from the integrated intensities rather than using the suggested normalization procedure.

Sampling for asbestos consisted of 25 mm 1.2 µm cellulose ester membrane filters housed in conductive sampling cassettes. The sampling cassette was connected to a personal sampling pump which was calibrated to a flow rate of 2 Lpm. Sample cassettes were placed in the employees breathing zone. Consistent with the other evaluations, pre-and post-sampling calibrations were performed using a calibrated rotameter. The samples were analyzed according to NIOSH method 7402[4] using transmission electron microscopy (TEM).
To continuously monitor noise exposures, Quest® Electronics Model M-27 Noise Logging Dosimeters were worn by employees during the work shift. The dosimeters were attached to the employee's belt and a small remote microphone was fastened to the work uniform (facing forward) at a mid-point between the ear and the outside of the employee's shoulder. The dosimeters were worn for the entire work day, including the employees' two breaks and the lunch period. At the end of the workshift, the dosimeters were removed and paused to stop data collection. The information was downloaded into a personal computer with Quest® Electronics Metrosoft computer software for interpretation. The dosimeters were calibrated before and after the workshift according to the manufacturer's instructions.

V. EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to ten hours a day, forty hours a week for a working lifetime without experiencing adverse health effects. However, it is important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker 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 evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

There are three primary sources of environmental evaluation criteria for the workplace: 1) NIOSH Recommended Exposure Limits (RELs)[5], 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs)[6], and 3) the U.S. Department of Labor OSHA PELs.[7] In July 1992, the 11th Circuit Court of Appeals vacated the 1989 Air Contaminants Standard. OSHA is currently enforcing the 1971 standards which are listed as transitional values in the current Code of Federal Regulations; however, some states operating their own OSHA approved job safety and health programs will continue to enforce the 1989 limits. NIOSH encourages employers to follow the 1989 limits, or the NIOSH RELs, whichever are more protective. The OSHA PELs reflect the feasibility of controlling exposures in various industries where the agents are used; whereas the NIOSH RELs are based primarily on concerns related to the prevention of occupational disease. It should be noted when reviewing this report that employers are legally required to meet those levels specified by an OSHA standard and that the OSHA PELs included in this report are the 1971 values.

ASBESTOS

NIOSH recommends as a goal the elimination of asbestos exposure in the workplace; where it cannot be eliminated, the occupational exposure to asbestos should be limited to the lowest possible concentration.[5] This recommendation is based upon the proven carcinogenicity of asbestos in humans and on the absence of a known safe threshold concentration.

NIOSH contends that there is no safe concentration for asbestos exposure. Virtually all studies of workers exposed to asbestos have demonstrated an excess of asbestos-related disease. NIOSH investigators therefore believe that any detectable concentration of asbestos in the workplace warrants further evaluation and, if necessary, the implementation of measures to reduce exposures.

The U.S. Department of Labor, OSHA PEL for asbestos limits exposure to 0.2 fiber/cc as an eight-hour TWA.[7] OSHA has also established an asbestos excursion limit for the construction industry that restricts worker exposures to 1.0 fiber/cc averaged over a 30-minute exposure period.[8] The NIOSH REL for asbestos is 0.1 fiber per cubic centimeter in a 400 liter air sample for fibers greater than 5 micrometers in length.[5]

METALS

The toxicity of metals is unique from other toxic substances in that metals are distributed naturally in the environment and are neither created nor destroyed by the human body. Metals may be the oldest toxics to have been described in historical accounts. Lead for example, was known to be in use prior to 2000 B.C. as a byproduct of the smelting of silver. Metals can produce both acute (rapid onset action) or chronic (long term) toxicity. The toxicity of metals varies with the metal itself, the valence state of the metal (i.e. relative ability to interact with biological substances), and whether the metal is in an elemental or organic state.

A. Chromium

Chromium (Cr) is a metal which exists in a variety of chemical forms. The toxicity is known to vary between the different forms. Elemental chromium, for example is relatively non-toxic.[9] Other chromium compounds may cause skin irritation, sensitization, and allergic dermatitis. In the hexavalent form [Cr(VI)], Cr compounds are corrosive to the skin and mucous membranes, and possibly carcinogenic. Until recently, the less water-soluble Cr(VI) forms were considered carcinogenic while the water-soluble forms were not considered carcinogenic. Recent epidemiological evidence indicates carcinogenicity among workers exposed to soluble Cr(VI) compounds.[10-15] Based on this new evidence, NIOSH recommends that all Cr(VI) compounds be considered as potential carcinogens.[16] The NIOSH REL for Cr(VI) compounds is 1 $\mu g/m^3$ for a 10 hour TWA.[16] The current OSHA PEL does not address Cr specifically as Cr(VI) and lists the PEL-TWA for chromium metal and insoluble salts as 100 µg/m.[17]

B. Respirable Silica and Cristobalite

Crystalline silica (quartz) and cristobalite have been associated with silicosis, a fibrotic disease of the lung caused by the deposition of fine particles of crystalline silica in the lungs. Symptoms usually develop insidiously, with cough, shortness of breath, chest pain, weakness, wheezing, and non-specific chest illnesses. Silicosis usually occurs after years of exposure, but may appear in a shorter period of time if exposure concentrations are very high.[18] The NIOSH RELs for respirable quartz and cristobalite, published in 1974, are 50 $\mu g/m^3$, as TWAs, for up to 10 hours per day during a 40-hour work week.[19] These RELs are intended to prevent silicosis. However, evidence indicates that crystalline silica is a potential occupational carcinogen and NIOSH is currently reviewing the data on carcinogenicity.[20-22] OSHA requires that the 1971 PEL for respirable silica be dependent upon the percent silica in the sample, and that the respirable dust exposure for an 8-hour TWA not exceed the value obtained from the formula:

$$\frac{10 mg/m^3}{\% SiO_2 + 2}$$

The ACGIH TLVs for respirable quartz and cristobalite are 100 and 50 µg/m^3, as 8-hour TWAs, respectively.[6]

C. Noise

Occupational deafness was first documented among metalworkers in the sixteenth century.[23] Since then, it has been shown that workers have experienced excessive hearing loss in many occupations associated with noise. Noise-induced loss of hearing is an irreversible, sensorineural condition that progresses with exposure. Although hearing ability declines with age (presbycusis) in all populations, exposure to noise produces hearing loss greater than that resulting from the natural aging process. This noise-induced loss is caused by damage to nerve cells of the inner ear (cochlea) and, unlike some conductive hearing disorders, cannot be treated medically.[24]

While loss of hearing may result from a single exposure to a very brief impulse noise or explosion, such traumatic losses are rare. In most cases, noise-induced hearing loss is insidious. Typically, it begins to develop at 4000 or 6000 Hz (the range of human hearing is approximately 20 Hz to 20000 Hz) and spreads to lower and higher frequencies. Often, material impairment has occurred before the condition is clearly recognized. Such impairment is usually severe enough to permanently affect a person's ability to hear and understand speech under everyday conditions. Although the primary frequencies of human speech range from 200 Hz to 2000 Hz, research has shown that the consonant sounds, which enable people to distinguish words such as "fish" from "fist", have still higher frequency components.[25]

The OSHA standard for occupational exposure to noise (29 CFR 1910.95)[26] specifies a maximum permissible exposure limit (PEL) of 90 dB(A)-slow response for a duration of eight hours per day. The regulation, in calculating the PEL, uses a 5 dB time/intensity trading relationship. This means that in order for a person to be exposed to noise levels of 95 dB(A), the amount of time allowed at this exposure level must be cut in half in order to be within OSHA's PEL. Conversely, a person exposed to 85 dB(A) is allowed twice as much time at this level (16 hours) and is within their daily PEL. Both NIOSH, in its Criteria for a Recommended Standard,[27] and the ACGIH, in their TLVs,[6] propose an exposure limit of 85 dB(A) for eight hours, 5 dB less than the OSHA standard. Both of these latter two criteria also use a 5 dB time/intensity trading relationship in calculating exposure limits.

Time-weighted average (TWA) noise limits as a function of exposure duration are shown as follows:

Duration of Exposure (hrs/day)	Sound Level (dB(A)) NIOSH/ACGIH	OSHA
16	80	85
8	85	90
4	90	95
2	95	100
1	100	105
1/2	105	110
1/4	110	115 *
1/8	115 *	- **

* No exposure to continuous or intermittent noise in excess of 115 dB(A).

** Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

The OSHA regulation has an additional action level (AL) of 85 dB(A) which stipulates that an employer shall administer a continuing, effective hearing conservation program when the TWA value exceeds the AL. The program must include monitoring, employee notification, observation, an audiometric testing program, hearing protectors, training programs, and recordkeeping requirements. All of these stipulations are included in 29 CFR 1910.95, paragraphs (c) through (o).

The OSHA noise standard also states that when workers are exposed to noise levels in excess of the OSHA PEL of 90 dB(A), feasible engineering or administrative controls shall be implemented to reduce the workers' exposure levels. Also, a continuing, effective hearing conservation program shall be implemented.

VI. RESULTS AND DISCUSSION

The purpose of the HHE was to evaluate working conditions at the Hardy Road Landfill and determine if employee exposures to noise and dusts generated during working conditions represented a health hazard to employees. Noise exposures occurred when heavy equipment was operated and when maintenance activities were performed on the equipment. Exposure to particulates occurred when dusts were created by dumping and compacting refuse at the working face of the landfill and when heavy equipment was used to move soil at the site.

A. Asbestos

The presence of asbestos was not detected on any of the samples including field blanks and media blanks. Four samples were not analyzed due to filter overloading, a condition which may have been caused by an accumulation of soil on the face of the filter. While this condition was anticipated, and the sampling cassettes filters were regularly inspected and changed at the first sign of discoloration, this condition could not be entirely controlled.

B. Respirable Dust

Full-shift sampling results for respirable dust ranged from 0.03 mg/m^3 to 1.05 mg/m^3. The highest concentration of respirable dust (1.05 mg/m^3) was measured on the pan scraper operator as he transported soil from to the working face of the landfill. For the same job however, on the second day of evaluation, exposures to respirable dust were much lower (0.05 mg/m^3). The next highest, and the most consistent exposure to respirable dust, was to the bulldozer operator, where 0.37 mg/m^3 and 0.38 mg/m^3 was measured on the days of sampling. The bulldozer was often observed pushing the pan scraper as the scraper excavated soil. This operation was observed to generate a large cloud of airborne soil. The lowest respirable dust exposure was to mechanics (average concentration 0.035 mg/m^3). The OSHA PEL for respirable dust is 5 mg/m^3. However, the criteria for respirable dust, is based on the premise that the dust is not toxic and therefore may not be appropriate for dusts generated at this landfill due to the possible presence of toxic compounds. There is no NIOSH criteria for nuisance dust.

C. Respirable Silica

Concentrations of respirable silica (as respirable quartz) were reported on five of the nineteen samples which were submitted for analysis. Cristobalite was not detected on any samples. Respirable quartz was reported only on the samples taken on the equipment operators (using the pan scraper, the compactor, and the bulldozer). Using the OSHA formula for TWA concentrations of respirable quartz, exposures ranged from 0.18 mg/m^3 to 0.78 mg/m^3. The OSHA PEL formula for respirable quartz is:

$$\frac{10 mg/m^3}{\% SiO_2 + 2}$$

The NIOSH REL for silica (as crystalline quartz) is 0.05 mg/m^3 as a TWA for up to 10 hours/day. Using the NIOSH exposure criteria for respirable silica, TWA exposures ranged from 0.03 mg/m^3 to 0.42 mg/m^3. Both of the samples collected on the bulldozer operator were in excess of the NIOSH REL, one of these samples exceeded an OSHA calculated PEL of 0.25 mg/m^3, based on a sample containing 38% free silica. The air samples on which silica was reported ranged from 14% to 40% quartz. One sample taken on the pan loader operator was in excess of the NIOSH REL and another sample taken on the compactor operator

was equal to the NIOSH REL. These exposures are likely to be the result of silica-containing soil which becomes an airborne dust when it is disturbed during the excavation process. The minimum detectable concentration (MDC) of silica was
0.02 mg/m^3 based on average sample volumes of 607 liters (L). The reported analytical limit of detection (LOD) for the sample set was reported as 0.01 mg/sample.

D. <u>Metals</u>

Based upon an extensive review of MSDSs supplied to NIOSH by the Resource Manager, the metals determined to be of primary toxicological concern included: arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr), manganese (Mn) and lead (Pb). Air sampling results revealed metals of toxicological concern to be present in concentrations below OSHA PELs or NIOSH RELs with the exception of one sample in excess of the NIOSH REL for chromium as expressed as Cr(VI).

Full-shift sampling results indicate that on the days of the investigation no personal exposures (with the exception of the sample for chromium) to any of the previously mentioned metals were found to exceed the current OSHA PELs based on 8-hour TWAs. However, one personal sample for chromium taken on a mechanic was calculated as 0.002 mg/m^3. This is above the NIOSH REL of 0.001 mg/m^3 for Cr(VI). The MDC for this sample was 0.0006 mg/m^3 based on an average sample volume of 783 L. NIOSH method 7300 does not distinguish between chromium compounds in differing valences (oxidation states). The analytical report only indicates quantitative amounts of chromium and a reportable LOD. The chromium which is reported could exist as elemental chromium (Cr), Cr (II), Cr(III) or Cr(VI). Since the NIOSH REL for chromium metal, Cr(II) and Cr(III) is 0.5 milligrams per cubic meter[16], (compared to the REL of 0.001 mg/m^3 for Cr(VI)) this result can be interpreted as representing a conservative, worst-case situation for occupational exposure to hexavalent chromium or Cr(VI).

E. <u>Noise Monitoring</u>

Noise dosimetry was conducted on three heavy equipment operators working at various locations, and on the two mechanics working near the equipment maintenance garage. For the equipment operators, the mean 8-hour TWA for both days was 92.9 dB(A) [range: 91.4 - 94.4 dB(A)]. The maximum dB(A) - slow noise level had a mean value of 110.8 dB(A) (range: 108.0 - 112.9). The averages for the equipment operators were based on a mean sample period of seven hours, one minute. The mechanics had a mean eight-hour TWA of 79.2 dB(A) (range: 73.8 - 86.0), and mean maximum noise level of 117.4 dB(A) (range: 109.1 - 133.9). The average sample period for the two mechanics on the two days of the survey was six hours, two minutes.

The patterns of noise exposure to the employees were consistent with their job requirements. The heavy equipment operator who operated the pan loader had long periods of time where he was exposed to approximately 98 dB(A) of noise (Figure 1). This pattern is most likely the result of the operator constantly circling the working face of the landfill, excavating soil from a remote area, and delivering the soil above the working face. The noise in this case, originates from the engine of the vehicle operating at a fairly constant speed. The variations in Figure 1 are the result of breaks, lunch periods, and other situations when the equipment was stationary with the engine idling. The compactor operator, on the other hand, has a work schedule dependant on loads of refuse arriving at the working face. When a load is dumped, the compactor compresses the refuse into the working face of the landfill and then may have a period when the vehicle idles awaiting a new load or for a vehicle to clear the area. The noise profile is characterized with higher noise levels corresponding to the time when the compactor drives over the working face and is crushing the refuse, and lower noise levels that are associated with the vehicle idling (Figure 2). The higher levels of noise are very similar in intensity to the pan loader, exhibiting approximately 98 dB(A) of noise when the vehicle is moving. Finally, the noise profiles of the mechanics are extremely variable with few definable or task-specific peaks or valleys in the noise exposures (Figures 3 and 4). This is an expected result in part due to the nature of the work assignment which is given to the mechanic and whether or not noisy tools or work practices are a part of his assigned task.

Hearing protection devices (HPDs) were available to the employees at the Hardy Road Landfill. Most employees were observed to be wearing HPDs whenever they were engaged in noisy tasks or operations. Inspection of some of the ear muffs worn by employees revealed that the plastic seals or cushions on the edge of the muffs were brittle or torn. When this occurs, the cushions need to be replaced for optimum protection from noise. Employees reported that no other components of a hearing conservation program, such as audiometric testing, training, or HPD fitting, were offered to them at their job.

VII. RECOMMENDATIONS

The following recommendations are provided to improve health and safety conditions for employees at the City of Akron, Hardy Road Landfill.

1. Based on observations and the results of noise measurements and noise dosimetry the following recommendations are offered to better protect the Hardy Road Landfill employees from potentially harmful noise exposures.

   A. The results of the two-day noise survey reveal that heavy equipment operators are exposed to noise levels exceeding the OSHA PEL of 90 dB(A) for an 8-hour TWA. Thus, a complete hearing conservation program that meets the requirements set forth in the OSHA regulation[26] needs to be implemented at the Hardy Road Landfill.

NIOSH has published a guide to assist employers in setting up and operating an effective hearing conservation program.[28] A copy of the guide will be sent with the HHE final report.

B. Engine noise from the heavy equipment operated at and near the working face of the landfill contributes the major portion of the employees' noise exposure. Engineering controls to reduce engine noise should be pursued. New heavy equipment purchased by the City of Akron for use at the landfill should have low noise specifications written into the contracts that the suppliers will have to meet or exceed. Noise exposures from existing equipment can also be reduced. A rigorous preventive maintenance program that repairs and replaces mufflers, broken doors and windows, and loose parts on the vehicles as soon as they are reported will help to reduce noise exposures to the operators. The addition of air conditioning to the cabs of the vehicles can help reduce noise that travels to the operator through open doors and windows. Finally, there are retrofit noise control programs that have been used in the surface mining industry that may be appropriate at this facility. Two reports have been published from researchers at the Mine Safety and Health Administration (MSHA) regarding cab retrofits for noise control.[29,30]

C. A routine inspection program for the HPDs given to employees needs to be implemented. Specifically, ear muffs need regular inspection to detect early wear, broken parts, or tears in the ear cushions, which should be changed every six months, or earlier if they begin to become brittle or hard to the touch.

2. Based on observation of work practices and the results of personal air monitoring, the following recommendations are offered to reduce worker exposure to dusts.

A. Observations of work practices and dusty conditions at the working face of the landfill suggest that considerable variability is present depending on the types of loads delivered, meteorological conditions, and prevailing winds. When refuse is compacted and loads of soil are being delivered and moved about, conditions can be quite dusty; at other times, conditions can be relatively dust free. The wastestream is known to vary considerably; however, it is clear that residues containing heavy metals and other toxic materials can become airborne when disposed of at this facility. Construction debris may also have asbestos-containing materials in certain loads of waste. Because it is difficult to ascertain which loads of refuse or what specific conditions may result in increased risk of exposure to employees, respiratory protection consisting of high efficiency particulate air (HEPA) filters should be provided and worn by all employees exposed to the dusts from materials intended for landfill disposal. This includes silica-containing soil used for cover at the working face. Mechanics servicing equipment contaminated with hazardous residues should also use respiratory protection. A complete employee respiratory protection program should be developed. The minimum standards for such a program are described in the Occupational Safety and Health Administration (OSHA) General Industry Standards, 29 CFR 1910.134.

B. Where it is possible, workers should stay upwind of dusty operations or dusty site conditions to reduce exposures. On windy days, consideration should be given to organize work operations to minimize generation of dust at the working face.

C. Engineering control modifications to the compactors, loaders, and bulldozers in the form of cab retrofits with HEPA filtration and positive pressurization, should be investigated as a possibility for future implementation at the landfill. It may be possible to incorporate controls with cab air conditioning.

D. All employees should be reminded of the importance of showering before leaving the facility each day and not leaving the site with any soiled work uniforms. Tyvek suits, to be worn over the work uniform should be available for situations when extremely dusty conditions are present. The use of a Tyvek suit can, however, increase the possibility of heat stress in the warmer summer months. A heat stress monitoring program may need to be implemented.

E. Eating, drinking, and smoking should occur only in break areas and employees should be informed of the importance of handwashing to reduce the risk of dermal exposure and the ingestion hazards related to toxic materials.

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