WALK THROUGH REPORT: OBSERVATIONS AND RECOMMENDATIONS FOR REDUCING EXPOSURE TO CHLORAMINES

AT

Bil-Mar Foods, Sara Lee, Inc.
Storm lake, Iowa

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Background

On November 11-12, 2003, the National Institute for Occupational Safety and Health (NIOSH) conducted a site visit at the Bil-Mar Foods, Sara Lee Inc., Storm Lake, Iowa turkey processing plant in response to a Health Hazard Evaluation (HHE) request received from the Occupational Safety and Health Bureau of the Iowa Division of Labor. This request for technical assistance concerned symptoms of respiratory irritation among evisceration workers, and noted the workers were concerned about psittacosis and chlorine exposure. Our recent visit follows the June 2002 NIOSH Health Hazard Evaluation (HHE Report #2002-0257) conducted at this facility. The HHE report indicated that the suspected etiological agents for the respiratory problems and eye irritation were exposure to soluble chlorine compounds and trichloramine. The HHE report recommended that engineering controls be implemented. As we discussed, the purpose of our visit was to look at the processes and make preliminary recommendations related to controlling worker exposures to air contaminants.

Process Description

Approximately 17,000 turkeys are processed on each shift at this facility. Turkeys are initially unloaded by hand and hung by their feet on a shackle conveyor, after which they are electrically stunned and killed by a mechanical throat slitter. An employee in this area will manually slit throats if the machine fails. The turkeys then pass through a "bleed-out" room into a hot-water scald tank. The temperature of the water in these tanks is 138 to 140 degrees Fahrenheit (°F), which allows for easier removal of the feathers due to the opening of the pores in the turkey's skin. Following the scald tank, the turkeys are mechanically de-feathered in the picking room. After the picking room, an employee in the pinning room inspects the birds for any remaining feathers, and removes them as necessary. Additionally, hock cutters remove the legs and feet from the body of the turkeys, which are then re-hung on the evisceration line.

Activities which employees perform in the evisceration line area include removal of the turkeys' entrails, head, neck, and lungs, as well as trimming off defective parts of the birds. U.S. Department of Agriculture (USDA) inspection of the birds for visible contamination also occurs on the evisceration line. Substantial amounts of super-chlorinated water (through the addition of sodium hypochlorite) are used at a number of stations on the evisceration line for disinfection of the birds. These stations include a bird-scrubber located at the start of the line, reprocessing stations where birds with potential fecal contamination are sent, and the high-pressure inside/outside bird wash. An open trough running throughout the evisceration line area catches the used super-chlorinated water along with discarded or dropped turkey parts. At the end of the evisceration line, the turkeys are split into a hind (dark meat) and front (white meat) half, which are then dropped into tanks of super-chlorinated water, and chilled to temperatures of 32 to 36°F through ammonia refrigeration.

Following a period of up to three hours in the chill tanks, the white and dark meat portions of the turkeys are sent to separate white meat and dark meat departments for further processing and

packaging for shipment. Little, if any, super-chlorinated water is used in these processing and packaging departments.

Compounds and Exposures

There have been numerous reports of eye and upper respiratory tract irritation among poultry processing workers and USDA inspectors during processing steps involving the use of super-chlorinated water, and this is considered to be a widespread problem in this industry.[1,2,3,4] Reported symptoms generally are intermittent in nature, vary in severity, and may be accompanied by reports of a "chlorine-like" odor. Whether sodium hypochlorite or chlorine is used as the source of super-chlorination does not appear to account for any differences in the reporting of irritation.

Investigations to identify the cause of irritation and determine appropriate remedial action have been conducted by the USDA, NIOSH, and others at several different poultry processing plants. Efforts to identify obvious contaminants such as chlorine or ammonia in air as the cause of irritation have generally been inconclusive. Chloramines, specifically trichloramine (NCl_3), are suspected as a primary cause of the reported symptoms because of the interaction between the chlorinated water and the nitrogenous material from the turkeys.

Chloramines are formed by the reaction between chlorine disinfectants and nitrogenous compounds such as ammonia, amines, or organic nitrogen-containing material. The species and concentrations of chloramine are influenced by the concentration of residual chlorine, ammonia (or other nitrogen sources), pH, and temperature. In general, the lower the pH and the greater the chlorine:ammonia ratio the higher the likelihood of producing chloramines.

Trichloramine, or nitrogen trichloride (NCl_3), is a brownish-yellow gas, has a pungent chlorine odor (sometimes described as rotting grapefruit or geraniums) and is a strong irritant and lacrimator.[5] NCl_3 has low solubility, aerates easily, and decomposes rapidly in sunlight. Eye and respiratory tract irritation appear to be the primary effects of exposure, although asthma has been documented in lifeguards and swimming instructors.[6] The irritant characteristics of NCl_3 seem to be similar to that of chlorine.[7] Occupational exposure criteria for NCl_3 have not been established.

The following section describes some of the general observations that we made during our November site visit.

General Observations

During our walk-through of the Evisceration Department we focused on the operations contributing to chloramine aerosolization. These processes and associated observations are discussed below:

Bird Washers:
There are two bird washers in the Evisceration room. There is a bird-scrubber at the start of the processing line and a high-pressure inside/ outside bird washer at the end of the line (just prior to separation of the white and dark meat). Substantial quantities of super-chlorinated water (related to the addition of sodium hypochlorite) are used in these washers to disinfect the birds. The scrubbing of the birds in these washers generates airborne contaminants. As each bird that has been saturated with chlorinated water exits the washer, these compounds are aerosolized into the work environment through drag-out of aerosol-laden air.

High-pressure Cleaning:
High pressure bird washing occurs in all of the reprocessing and salvage stations. Splashing and spraying of the birds with both city and chlorinated water provides ample opportunity for aerosolization of chloramines and soluble chlorine compounds. Chlorinated water is sprayed with enough force so that the enclosures used for salvage and reprocessing are ineffective. Some of the spray is hitting the operator. The high-pressure cleaning that occurs on breaks and during the cleaning shift can also potentially aerosolize chloramine and soluble chlorine products from on the floor. General dripping of these compounds can also exacerbate the problem.

Trough :
An open trough runs through the evisceration line area. This trough catches the super-chlorinated water along with discarded or dropped turkey parts. During our visit, the turkey parts in the trough frequently clogged the drain and required periodic cleaning to ensure the trough was fully operational. Frequent clogging can cause the contaminated water to backup inside of the evisceration room and allow more contaminants to become airborne.

As turkeys exited the washers, the chlorinated water used to clean them, continued to drain. There was no catch pan to contain the contaminated water. Chlorinated water falling from large distances is a significant source of potential aerosolization.

Chiller:
The chiller used to hold turkey necks is not covered or exhausted from the work environment. This large open trough contains chlorinated water near the center of the evisceration room. It represents a potential source of exposure.

Reprocessing/Salvage Work-Stations:
Our qualitative evaluation of the reprocessing and salvage work stations showed that there was little to no ventilation. Smoke tubes indicated that there was essentially zero capture.

Ventilation:
Proper ventilation is critical for removal of harmful contaminants from the work environment. Ventilation systems need to provide a sufficient air flow and uniform distribution. Tests previously conducted by NIOSH using a fog machine demonstrated that ventilation in the evisceration area was non-uniform and turbulent. Part of the evisceration room where the most problems have been reported may be related to the location of the exhaust fans. They appear to be drawing contaminated air past the workers. The ventilation design data sheets provided to us during our site visit indicated that the total ventilation of the evisceration facility was low and needed to be upgraded. The overall airflow pattern also need to be improved to ensure adequate, uniform laminar air flow in this area.

Discussion and Recommendations

Exposure to soluble chlorine compounds and trichloroamine in your facility can be reduced through a combination of approaches. However, it is paramount that the concentration of chlorine in the chlorinated water is constantly maintained at the USDA recommended level. Higher levels of chlorine in chlorinated water can potentially result in increase generation of soluble chlorine compounds and trichloroamine in the evisceration room. Specifically, measures should be taken to minimize aerosolization and to collect airborne emissions using ventilation. The recommendations involving ventilation were largely based on information in the following manual: American Conference of Governmental Industrial Hygienists (1998): **Industrial Ventilation-A Manual of Recommended Practice**, 24th edition, Cincinnati Ohio.

The following recommendations fall into three groups. Group I recommendations are associated with improving the local exhaust ventilation of the washers, work stations and chillers. Group I will capture contaminants at the source and prevent their release into the work environment. Group II recommendations are associated with optimizing the general ventilation in the Evisceration Facility to ensure adequate, uniform ventilation. Group III involves minimizing the aerosolization of contaminants to reduce the overall contamination of the work environment.

Group I Local Exhaust Ventilation
Work Stations:
These work stations are currently grouped into pairs and exhausted with a single blower. During our site visit, the work stations had inadequate capture velocity. The poor work station ventilation is related to the undersized exhaust ducts, and improper connection to the work station. The primary goal of these stations is to capture contaminants released during reprocessing and salvage tasks. We recommend that the exhaust system for these hoods be

redesigned to provide improved capture velocities. These stations can either be individually exhausted or incorporated into the central system.

Bird Washers:
These devices are not currently exhausted and permit aerosol laden air to enter the work environment. We recommend that the central exhaust system for the evisceration room be modified to include exhaust pick-ups for both washers. This arrangement would minimize cross-contamination and improve containment of the contaminants in the overall evisceration facility.

Chiller:
We recommend the chiller in the evisceration facility be exhausted to prevent the escape airborne contaminants resulting from the interactions of chlorinated water in the tanks and organic matter from the turkeys.

Group II General Ventilation
According to the design specifications provided by the plant, general ventilation for the evisceration facility appears to be inadequate. The engineering consultant hired by Sara Lee, estimated that the current number of air changes should be increased by two to three fold. We agree that air changes in this part of the facility need to be increased. Based on the design airflow and the overall dimensions of the evisceration room, the air changes were calculated to be around 7-10 air changes per hour which is much lower than what is required for proper ventilation of the evisceration facility. In order to improve air changes, the fan motors may need to be upgraded, the drip pans currently installed on the supply and exhaust ducts entering and exiting the evisceration room should also be replaced with low resistance pans. The current pans are creating airflow restrictions and limiting the airflow. New U-shape traps should be installed to allow for smooth condensate drainage.

Air flow to this area should also be uniformly dispersed. The distribution of air in any ventilated room depends on the size and location of ventilation intakes. The current supply and exhaust locations are detrimental to uniform ventilation in the evisceration room. It promotes short-circuiting and creates dead spaces and turbulence. To ensure uniform air changes in the evisceration room, the supply and exhaust ductwork should be re-designed and relocated.

Group III Minimize Aerosolization
High-pressure Cleaning:
High pressure chlorinated water used to clean the birds is believed to help to contaminate the air. Other low pressure cleaning methods should be explored that involve lower water pressure and nozzle velocity. Different nozzle designs should be explored to find a suitable design that minimizes aerosolization and splashing onto the operator and the floor. The current centralized high pressure chlorinated water system should be modified to reduce pressure and prevent contamination of the air. This area should be explored in consultation with the manufacturer/designer of the chlorinated water system.

Trough:

The existing troughs were frequently clogged with turkey parts. This caused the trough to overflow releasing contaminated water into the room. To minimize this problem we recommend covering these troughs with a screen. In other areas, there were no troughs to capture the contaminated water (For example, where the bird exits the washers saturated with chlorinated water). This causes chlorinated water to drain onto the floor. Splattering of drops onto the floor (from four feet in the air) increases the airborne concentration of chloramines and soluble compounds. Sloped collection pans should be utilized to catch the drips before they fall large distances.

References

1. Sanderson W, Weber A, Echt A [1995]. Case reports: epidemic eye and upper respiratory irritation in poultry processing plants. Appl Occup Environ Hyg 10(1): 43-49.

2. NIOSH [1994]. Hazard evaluation and technical assistance report: Tyson Foods, Monett, Missouri. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, NIOSH HETA Report No. 93-230-2405.

3. NIOSH [1989]. Hazard evaluation and technical assistance report: Columbia Farms Poultry Plant, Columbia, South Carolina. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, NIOSH HETA Report No. 87-110-1943.

4. Segna L [1988]. Nitrogen trichloride summary. Reston, VA: Applied Environmental Health and Safety Inc. USDA Contract No. 53-3A84-7-09 Draft Report.

5. Barbee SJ, Thackara JW, Rinehart WE [1983]. Acute inhalation toxicology of nitrogen trichloride. Am Ind Hyg Assoc J 44(2): 145-146.

6. Thickett KM, McCOach JS, Gerber JM, Sadhra S, Burge PS [2002]. Occupational asthma caused by chloramines in indoor swimming-pool air. Eur Respir J. 19:827-832.

7. Gagnaire F, Axim S, Bonnet P, Hecht G, Hery M [1994]. Comparison of the sensory irritation response in mice to chlorine and nitrogen trichloride. J Appl Toxicol 14:405-409.