

Evaluation of Exposures in a Steel Coil Pickling Plant

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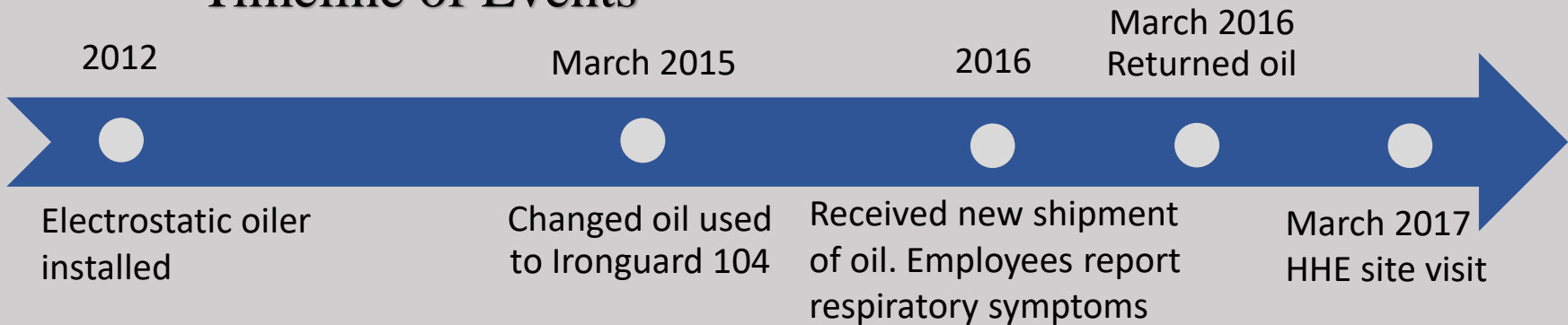
Description

Steel pickling is a metal surface treatment in which oxide (rust) and scale are removed from the surface of the steel using acid. Pickling occurs after steel production and before the steel can be used for further manufacturing. A Health Hazard Evaluation (HHE) request was submitted by a management representative at a steel coil pickling plant after concerns of respiratory symptoms in the plant that were thought to be associated with a change in the oil used to coat and protect the steel following the pickling process.

Situation

Employees at a steel coil pickling plant were experiencing respiratory symptoms following a change in the oil that was electrostatically applied to steel coils to prevent them from rust after the pickling process. Before the HHE site visit, the oil was changed back to the original oil that was not associated with respiratory symptoms, but concerns persisted. This led management at the plant to request an HHE to help evaluate employee exposures and health effects; the main exposures of concern were the oil, diesel exhaust from trucks, and environmental dust.

Timeline of Events



Steel coil after pickling process. The rust has been removed and additional oil is rolled on the outside to protect the steel. Photo by NIOSH.



Exit operator at station controlling electrostatic oiler. Photo by NIOSH.

Methods

Air sampling

We collected personal air samples from three employees in the exit area of the pickling line (employees closest to the oil application)

- Oil mist (NIOSH 5026)
- Hydrochloric acid (HCl, NIOSH 1403): acid used for pickling and potential respiratory irritant
- Diethylene glycol monobutyl ether (DGME, NIOSH 7907): a solvent and dispersant in the oil that was increased in the new oil formulation).

We collected area air samples for oil mist near the quality control station (n=1, adjacent to exit area), HCl on the pickling line (n=3) and in crane cabs (n=2), and elemental carbon (NIOSH 5040, surrogate for diesel exhaust) in crane cabs (n=2) and outdoors (n=1).

Noise sampling

We also collected personal noise sampling on three employees in the exit area and area noise sampling in the exit area of the pickling line and in crane cabs (n=2). We conducted short-duration sound level checks during processes in the plant and determined the main source of noise.

Medical interviews and other observations

We interviewed all 50 employees across all 3 shifts about work history, work practices, relevant medical history, and work-related health symptoms in the previous 3 months. We compared the prevalence of work-related irritant symptoms (symptoms that improved away from work and included nasal congestion, sore throat, cough, and/or eye irritation) between production and office employees, entry and exit employees on the pickling line, and crane operators and all other production employees.

We made workplace observations, visually evaluated the ventilation, and reviewed relevant documents including audiometric records.

Data – Air sampling

Personal air sampling results

Job title	DGME (ppm)	Oil mist (mg/m ³)	HCl (ppm)
Exit operator*	0.092	0.053	0.021
Exit laborer 1	0.036	0.081	Not detected
Exit laborer 2	0.071	0.075	Not detected
NIOSH REL	None	5	None
ACGIH TLV	10	5	None
OSHA PEL	None	5	None

*This result is from a shift split between two employees

Elemental carbon area air sampling results

Location	Result (mg/m ³)
North crane cab	0.037
Center crane cab	0.023
Outdoors	0.0091

Results/Discussion

Air sampling

Full-shift personal air sampling results for DGME and oil mist were several orders of magnitude below the lowest occupational exposure limits. Personal air sampling results are displayed in the table above. Full-shift area air sampling results for oil mist was 0.088 mg/m³ for the quality control area. Full-shift area air samples for HCl were not detected in the quality control area and in both crane cabs. Full-shift area air sampling results for elemental carbon were 2 to 4 times higher than outdoors. Diesel exhaust is considered to be a carcinogen and should therefore be kept at the lowest feasible levels. Although these results were not personal samples, we collected area air samples in the crane cabs to estimate the worst-case scenario exposures for crane cab employees if they were to spend the entire shift in the crane cabs.

Noise sampling

One exit laborer and the exit operator had overexposures to noise using NIOSH REL criterion and OSHA AL criterion. Area noise measurements in the entry area of the pickling line indicate that employees in that area may also be overexposed to noise, and personal noise sampling should be conducted for entry area employees. Sources of noise on the pickling line included the steel coil passing through line entry (104.2-115.4 dBA), threading a new steel coil through the line (82.6-91.5 dBA), cutting a new coil (108.4 dBA), and in the tank farm area (95 dBA).

Medical interviews and other observations

The most commonly reported symptoms included nasal congestion, sore throat, cough, and headache. 31 (62%) of employees reported work-related irritant symptoms. Production area employees had higher prevalence of work-related irritant symptoms than office employees. The prevalence of work-related irritant symptoms were similar among different production area employees.

Other

Hearing protection use was voluntary. 1 employee had an OSHA-recordable standard threshold shift.

Conclusions

We found high prevalence of work-related irritant symptoms among production employees. Industrial hygiene sampling measured low levels of oil mist, HCl, and DGME in the air. Area elemental carbon levels were high. It is possible that the combination of these exposures, and exposures to environmental allergens such as dust could have contributed to employees’ symptoms. Employees with the title of exit laborer and exit operator had noise exposures above the NIOSH REL and OSHA AL. One employees’ audiograms showed a standard threshold shift.

Selected Recommendations

- Reduce diesel exhaust concentrations by replacing diesel-powered equipment and enclosing crane cabs.
- Consult with electrostatic oiler manufacturer to reduce the amount of oil that escapes from the oiler.
- Buy quiet when purchasing or replacing equipment.
- Use NIOSH criteria significant threshold shifts.
- Conduct personal noise sampling on entry area and quality assurance employees.
- Encourage employees to report work-related symptoms.
- Require and train employees to wear hearing protection.



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