

Wastewater Treatment Plant Occupational Health and Safety Bulletin

This bulletin is a guide to assist CUPE members in British Columbia (“BC”) to understanding the risks of exposure in wastewater treatment plants, to minimize exposure to these risk factors and to provide information for prevention and compensation under WorkSafeBC.

Exposure to toxic substances, pathogens and other hazardous materials can have a significant long-term impact on workers and their families with many workers experiencing lifelong disabilities. There are also risks of injury to the head, feet, hearing including crush injuries, lacerations. This bulletin will primarily focus on exposure to chemicals and pathogens.

I. Introduction

Workers in the wastewater treatment sector are responsible for the day-to-day operation, maintenance, trouble-shooting and handling of special problems of municipal, industrial, and other wastewater treatment plants. Occupations can include Level 1 WWR (Wastewater) Plant Operator, Level 2 WWR Plant Operator, Senior Operator, Water Resources Specialist, Maintenance Operator, etc in both municipal and private facilities. Certification is set by the Applied Science Technologists and Technicians of BC (ASTTBC).

II. Injury Statistics

There is a lack of BC statistics for injuries and exposure in this sector. WorkSafeBC does not have statistics specific to this field, nor do many other jurisdictions within North America. In the United States (“U.S.”), this sector contains both recycling and waste management, therefore, the injury and fatality rates are combined.

A 2009 U.S. Occupational Safety & Health Administration report put the incidence rate at 4.1 per 100 workers in the U.S. Slips and trips are the number one cause of injury (TPO, 2013). The most common physical injuries are strains and sprains to the back.

There is little information about the long-term effects of exposure to chemicals and pathogens. There is conflicting evidence regarding the development of cancer although pancreatic cancer appears to be higher in this sector¹. Generally, there is a much higher rate of injury generally than other occupations (Spellman, 2013).

III. Who is Affected:

¹ Early studies from the European Union.

This sector includes workers involved with sewer inspection, maintenance work and sewage treatment plants operation. Most workers are male between 35 and 55 years of age. Workers may be employed in public or private facilities. Most workers are unionized in BC.

IV. What are the Hazards:

Workers in this sector are exposed to a variety of hazardous chemical and biological materials contained within the effluents and the reagents used in the water processing or generated during the water treatment.

Chemical agents may cause acute poisoning, chemical accidents (e.g., skin burns, injury to the eyes, etc.) damage to the respiratory system, allergies, dermatitis, chronic diseases, etc. Biological agents include pathogens such as bacteria, protozoa, viruses, helminths and fungi.

There may be injuries by slips, trips and falls on wet floors; by falls into treatment ponds, pits, clarifiers or vats and by splashes of hazardous liquids; they may suffer cuts and pricks from sharp tools, contusions, etc.

There is also exposure to hazards related to work in confined spaces (NIOSH, 2015).

Strains and sprains are the most common types of injuries.

The three primary types of exposure risks are:

1. Biological

There is a high potential for illnesses arising from contact with viruses, bacteria and other microorganisms in sewage.

The most serious viral risk is hepatitis. The most serious bacterial risk is tetanus.

The main routes of exposure are hand-to-mouth contact. Breathing in a suspension of particles (aerosols) is a less common means of exposure but may occur whenever sewage is agitated or aerosolized. This occurs most commonly near incoming wastewater inlets and sludge treatment areas.

2. Chemical

Confined spaces containing sewage can sometimes be deficient in oxygen due to organic oxidation and displacement by carbon dioxide. They can also contain flammable gases such as methane and toxic gases such as carbon monoxide and hydrogen sulphide. Carbon monoxide, carbon dioxide, and other exhaust gases may sometimes be present due to a poorly located gasoline engine or generator exhausting into the confined space. Chloroform is a common byproduct of disinfection.

3. Metals

As per Brown (1997), metals are generally not air-stripped into the air in sufficient quantities to be significant (with the exception of mercury). Therefore, they accumulate either in sludge or pass through into the receiving water. Other possible hazards include asbestos and radioactive materials from medical facilities.

The five main categories of pathogens are:

- Bacteria
- Viruses
- Protozoa
- Helminths (parasitic worms) (CDC, 2002)
- Fungi (CDC, 2002)

Treatment processes do not eliminate the risk of exposure. As per Brown (1997), the primary treatment process may remove 80 - 90% of Salmonella; 50% of Mycobacterium; and coliform removal varies from 27 - 96%. The secondary treatment process removes from 50 - 90% of these pathogens. Activated sludge has a low removal rate of 85 - 99% for pathogenic bacteria. Waste solids do contain surviving pathogens. Anaerobic digestion appears to reduce pathogens by 74% to 97% (Brown, 1997; CDC, 2002). Tuberculosis, roundworms and certain enteric viruses appear highly resistant to treatment processes.

The two primary routes of pathogen and chemical contact are:

1. Inhalation

This is the most common route for chemicals or pathogens to enter the body, usually via:

- air-stripping from wastewater
- bubble aeration
- workers working near weirs, outfall and aerated tanks
- dewatering processes
- drying, compacting, incineration
- exposure to chemicals while removing debris from treatment plant equipment (Brown, 1997)

The affected areas of the body initially include the nose, throat and upper respiratory tract. Secondary areas are the eyes and lower respiratory tract (Brown, 1997).

“Gas eye” due to hydrogen sulfide exposure is common² in this sector.

² Conjunctival and corneal tissue inflammation.

The most common specific pathogen exposures include (Lamfers, 2012; Brown, 1997):

- Fecal streptococcus
- Mycobacterium tuberculosis
- Gastroenteritis Enteroviruses (67 types), Rotaviruses, ("24-hour flu")
- Infectious Hepatitis
- Serum Hepatitis
- Aseptic Meningitis
- Adenoviruses (31 types), Reoviruses, Coronavirus
- Poliomyelitis
- Salmonellosis, Typhoid Fever
- Shigellosis
- Gastroenteritis (Escherichia coli)
- Amoebic Dysentery, Ameobiasis
- Giardiasis
- Meningoencephalitis
- Balantidiasis
- Parasitic worms (roundworms, hook worms, tapeworms)
- Fungi
- Allergic asthma caused by exposure to sewer flies

2. Skin Contact

This is a route of entry for both chemicals and pathogens. This includes being splashed in the mouth or on the skin. Chemicals can be absorbed through the skin from contact with wastewater or sludge. Disease organisms can enter the body through cuts, abrasions or needle sticks such as when removing screenings from a bar screen (Brown, 1997).

V. Worker Education:

Education about personal hygiene and safe work practices is extremely important to minimize contact with sewage and to prevent illnesses. While the employer bears the primary responsibility, everyone in the workplace needs to exercise caution.

Pre-planning, careful attention to personal hygiene and proper use of personal protective equipment (PPE) can greatly reduce the associated risks of exposure to sewage. It is essential that information be provided to the worker on reducing the risks of exposure and injury. Examples of worker practices include the following:

- Avoid direct contact with sewage.

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- Avoid aerosolizing sewage water or minimizing exposure time in areas where aerosolizing is occurring. Make sure ventilation systems are functioning properly when working around areas where sewage may be aerosolized.
- Thoroughly cleanse all exposed injuries with soap and water and keep them covered with a bandage (preferably waterproof) while at work. Seek medical attention immediately after suffering cuts or penetrating injuries.
- If a worker is suffering from a skin problem, they should see a physician before working with sewage.
- Avoid touching the face, mouth, hands, eyes or nose with dirty hands or other items and avoid nail biting.
- Thoroughly wash the hands and face with soap and water before eating, drinking or smoking.
- Eat/smoke in designated areas away from sewage contamination. These areas must be kept free from contamination by leaving any protective clothing and boots in a separate area, for example.
- Use appropriate protective clothing at work (coveralls) and personal protective equipment (boots, gloves, plastic face shields) and, where required wearing respiratory protective equipment.
- Remove personal protective clothing and footwear at the end of the shift and leave it at work.
- Shower and change out of work clothes before leaving work.
- Report damaged equipment.
- Report all work-related symptoms to the employer and the physician. These may include:
 - i. cramping stomach pains, diarrhea, vomiting
 - ii. yellowing of the skin
 - iii. symptoms of breathlessness, chest tightness and wheezing
 - iv. redness and pain of the eyes
 - v. skin rash and/or pain

Tests for disease exposure can include:

- i. skin tests for tuberculosis and fungal infections
- ii. liver function tests for hepatitis

- iii. white blood cell (leukocyte) counts
- iv. urinalysis for fibrinogen degradation product (FDP) concentration

Workers with these symptoms should see a physician. Make sure that the physician is aware of conditions of work and potential exposures.

VI. Employer Responsibilities Including Implementation of Control Measures

What do the WorkSafeBC Act, Regulations and Policy say about air quality and hazardous substances exposure?

A. Applicable RSCM II Policy items include #12.00, #25.10, #26.10, #26.22, and #29.10 as well as RSCM I Policy items from the pre-2002 / 2003 changes in legislation and RSCM I Policy where exposure occurred prior to 2002 / 2003.

B. Applicable BC WorkSafeBC OHS Regulations³ include:

- Section 3.10, which states in part that:

Whenever a person observes what appears to be an unsafe or harmful condition or act the person must report it as soon as possible to a supervisor or to the employer, and the person receiving the report must investigate the reported unsafe condition or act and must ensure that any necessary corrective action is taken without delay.

- Part 3, Division 3 - General Duties of Employers, Workers and Others
- Part 3, Rights and Responsibilities
- Part 3, Section 4.13 – Risk Assessment
- Part 3, Section 4.14 – Emergency Procedures
- Part 3, Section 4.16 – Training
- Part 4 - General Conditions
- Part 4 - Working Alone or In Isolation
- Part 4, Section 4.44 – Entrapment
- Part 4 - Occupational Environment Regulations
- Part 4 - Indoor Air Quality
- Part 5 - Chemical Agents and Biological Agents - Chemical Agents and Biological Agents - Definitions, Designation as Hazardous Substances, and General Information Requirement

An important section of Part 5 states that:

“5.2 General information requirement

³ Regulations and Policy are subject to frequent annual changes. Check with WorkSafeBC regularly.

If a worker is or may be exposed to a chemical agent, or biological agent designated as a hazardous substance in section 5.1.1, which could cause an adverse health effect, the employer must ensure that

- (a) the identity of the chemical agent or biological agent, its possible effects on worker health and safety and any precautions required to protect the health and safety of the worker are clearly indicated by labels, SDSs, or other similar means,
- (b) the information required by paragraph (a) is clearly communicated to the worker,
- (c) written procedures are prepared and implemented to eliminate or minimize a risk of exposure to a chemical agent or biological agent by any route that could cause an adverse health effect, and to address emergency and cleanup procedures in the event of a spill or release of a chemical agent or biological agent, and
- (d) the supervisor and the worker are trained in and follow the measures required in this Part and Part 6 of this Regulation for the safe handling, use, storage and disposal of the chemical agent or biological agent, including emergency and spill cleanup procedures.

[Amended by B.C. Reg. 319/2007, effective February 1, 2008.]

[Amended by B.C. Reg. 30/2015, effective August 4, 2015.]”

- Part 6 – Biological Agents
- Part 7 – Noise, Vibration, Radiation and Temperature
- Part – Toxic Process Gases
- Part 8 – Personal Protective Clothing and Equipment
- Part 9 – Confined Spaces
- Part 12 – Tools, Machinery and Equipment
- Part 13 – Ladders, Scaffolds and Temporary Platforms
- Part 32 – Evacuation and Rescue

What specific actions should employers take? These include the following (CDC, 2002; EPA, 2015):

- Conduct Safety Tailboard sessions at the beginning of each shift.
- Conduct a Risk Assessment. This is a critical part of ensuring a safe work place and identifying risks. See Figure 1 as an example of follow-up.
- An employer must provide first aid services, supplies and equipment and provide a first aid room as per the applicable requirements of OHS legislation.

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- Since pathogens are a natural part of sewage, the hazard cannot be eliminated. A site-specific assessment of the risk of worker's exposure to the hazards of sewage must be completed.
- Improve engineering controls such as ventilation.
- Ensure that workers and management (and supervisors) understand risks through education on hazards, the importance of following safe work practices and the importance of hygiene measures. Regular industry training may also be required per the industry association and legislation.
- Ensure workers use appropriate PPE such as liquid-repellant coveralls and gloves, boots, goggles, respirators, and splash-proof eye/face shields. If respirators are needed, a comprehensive program must include respirator fit testing and a respirator code of practice.
- Label piping.
- Cover the primary clarifier weir area.
- Ensure workers remove contaminated clothing after completion of a job (Lamfers, 2012).
- Ensure workers shower at work and change into clean clothes (Lamfers, 2012).
- Establish a proper system for purchase, inspection and maintenance of PPE.
- Ensure areas for storage of clean and contaminated equipment and personal effects are segregated and separate from eating facilities, and have facilities readily available for decontamination of workers.
- Develop and implement policies and procedures for post-exposure management of workers exposed to bio hazardous material.
- Where feasible, substituting Class A biosolids could reduce the pathogen exposure risks during land application compared to applying Class B biosolids.
- Monitor the source material coming from the wastewater treatment facility.
- Check monitoring results to assure they meet specified Class B or Class A standards prior to land application operations.
- Monitor stored biosolids prior to application to assure that the biosolids are properly stabilized and that unacceptable re-growth or cross-contamination from sub-standard material has not occurred.

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- Where local conditions permit, inject biosolids below the soil, or incorporate (thoroughly mix) into tilled soil.
- On windy days, avoid spreading or disturbing dry biosolids (e.g., compost) that would create dust.
- On windy days, avoid spreading biosolids by high-pressure spray to limit aerosolization.
- Avoid unnecessary mechanical disturbance and contact with land-applied Class B biosolids during the period when public access is restricted.
- Equip heavy equipment used at storage and application facilities with sealed positive pressure, air-conditioned cabs that contain filtered air recirculation units.
- Monitor worker exposures when adjusting precautions to address site-specific issues.
- Consider suppressing the droplets just above the surface by using:
 - single layer screen - 100-200mesh
 - multiple layer or knitted mesh screen
 - fiber beds
 - foam or granular bed
 - flat plate or slats over the tank
 - water spray to beat down the wastewater droplets
 - rotating brush
- Consider collecting the droplets by:
 - sedimentation
 - multiple cyclone
 - scrubber
 - electrostatic precipitator
 - fabric filtration (Brown, 1997)

VII. Basic Hygiene for Workers (CDC, 2002)

In addition to the safety precautions for workers and employer, there are basic hygiene practices that can reduce the likelihood of exposure and injury. These include:

- Wash hands thoroughly with soap and water after contact with biosolids.
- Avoid touching face, mouth, eyes, nose, genitalia, or open sores and cuts while working with biosolids.

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- Wash hands before eating, drinking, smoking, and before and after using the bathroom.
- Eat in designated areas away from biosolids handling activities.
- Do not smoke while working with biosolids.
- Use barriers between skin and surfaces exposed to biosolids.
- Remove excess biosolids from footwear prior to entering a vehicle or a building.
- Keep wounds covered with clean, dry bandages.
- Flush eyes thoroughly, but gently, if biosolids contact eyes.
- Change into clean work clothing on a daily basis and reserve footwear for use at work site or during biosolids transport.
- Do not wear work clothes home or outside the work environment. Use gloves to prevent skin abrasion.

VIII. Conclusion:

Unionized workers enjoy more effective enforcement of legislated labor protections such as safety, health, and overtime regulations (Mishel and Walters, 2003; Zullo, 2012; Frazis, Gittleman, et al. 1995). This is important in sectors with high injury rates such as wastewater treatment. Employers and workers should update safety practices, procedures and education on a regular basis. CUPE has developed many Guides, templates and forms for numerous aspects of prevention and compensation. See the CUPE BC OH&S website at <http://www.cupe.bc.ca/committees/occupational-health-and-safety> for many of these. These are updated frequently, so ensure these are current.

IX. Further Information and Sources

Accidents and Injuries in the Waste Management Sector

http://oshwiki.eu/wiki/Accidents_and_injuries_in_the_waste_management_sector

Alberta Water & Wastewater Operators Association. <https://awwoa.ab.ca/>

American Waterworks Association. <http://www.awwa.org/>

Atlantic Water & Waste Water Association. <http://www.acwwa.ca/>

ACWWA Library. Safety series. <http://www.acwwa.ca/library/libraryvideos.html>

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Ahrens, M. (2012). Worker Casualties involving Wastewater, Sewers or Sewage Treatment Plants and Fire Incidents at Water or Sanitation Utilities.

https://www.nfpa.org/Assets/files/AboutTheCodes/820/1855%20-%20Wastewater_Sewers_or_Sewage_Treatment.pdf

BC Water & Waste Association. <https://www.bcwwa.org/>

Brown, H.J. (1997). Health Hazard Manual: Wastewater Treatment Plant and Sewer Workers. Cornell University ILR School.

Canadian Association for Occupational Health and Safety. <http://www.ccohs.ca/>

Canadian Water and Waste Water Association. http://www.cwwa.ca/home_e.asp

CUPE BC OH&S Committee. Guides, templates and forms.
<http://www.cupe.bc.ca/committees/occupational-health-and-safety>

Environmental Factor. (2014). National Institute of Environmental Health Sciences.
<http://www.niehs.nih.gov/news/newsletter/2014/2/science-wastewater/>

Environmental Protection Agency (EPA): Biosolids. Homepage at: www.epa.gov/owm/bio.htm

Forrester, M. (2014). Poisoning Injuries Associated With Water and Wastewater Treatment Facilities. Journal of Occupational and Environmental Medicine.
http://journals.lww.com/joem/Citation/2014/03000/Poisoning_Injuries_Associated_With_Water_and_18.aspx

Guidance For Controlling Potential Risks To Workers Exposed to Class B Biosolids. (2002). Centers for Disease Control. <http://www.cdc.gov/niosh/docs/2002-149/pdfs/biosolidsb.pdf>

Gustafson, R. (2013). Infection Control in the Community. Vancouver Coastal Health.

Health Canada. (2015). Implementing GHS in Canada. <http://www.hc-sc.gc.ca/ewh-semt/consult/2013/ghs-sgh/amendments-modifications-eng.php>

Hurt at Work – The Dark Side of Recycling and Waste Mgt (2015)
<http://www.solidwastemag.com/waste-management/hurt-at-work-the-dark-side-of-recycling-and-waste-mgt/1003279563/>

International Hazard Datasheets on Occupation. Waste Water Treatment Plant Operator.

Issues in the Waste and Recycling Field

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<http://www.overholtlawyers.com/blog/2015/07/survey-reveals-safety-issues-in-waste-and-recycling-field.shtml>

Kerri, F., Dendy, B., Brady, J., & Crooks, W. Advanced Waste Treatment. A Field Study Training Program. (No date). California State University, Sacramento. <http://files.eric.ed.gov/fulltext/ED286743.pdf>

Lamfers, J. (2012). Prevention is Key to Avoiding Infections and Infectious Disease by Wastewater Utility Personnel. *The Kansas Lifeline*, July 2012. <http://www.krwa.net/lifeline/1207/028.pdf>

Let's Talk Safety. (2015). American Waterworks Association. <http://grcity.us/enterprise-services/Water-System/Documents/2015%20Let's%20Talk%20Safety%20Benefit.pdf>

Local Services Act. Subdivision Regulations. BC Government.
http://www.bclaws.ca/civix/document/id/complete/statreg/262_70

National Center for Infectious Diseases (NCID). Viral Hepatitis Resource Center at:
www.cdc.gov/ncidod/diseases/hepatitis

National Water and Waste Water Conference, October 25 to 28, 2015.
<http://www.cwwawatergo.com/technical-program/>

New Report: U.S. Recycling Workers Exposed to Safety Hazards and High Injury Rates
<http://ehstoday.com/safety/new-report-us-recycling-workers-exposed-safety-hazards-and-high-injury-rates>

Sewerage System Regulation. Public Health Act. BC Government.
http://www.bclaws.ca/civix/document/id/complete/statreg/326_2004

Spellman, R. (2013). Handbook of Water and Wastewater Treatment Plant Operations (3rd Edition). CRC Press.
<https://books.google.ca/books?id=dXxcAgAAQBAJ&pg=PA26&lpg=PA26&dq=Wastewater+injury&source=bl&ots=I2XrGyC4w4&sig=GklBaiPx1h29D9V8F1IRnTh0z6A&hl=en&sa=X&ved=0CEYQ6AEwCGoVChMlMr2uuJ7eyAIVT-ljCh3Y7AaT#v=onepage&q=Wastewater%20injury&f=false>

Tips for Pennsylvania Wastewater Workers on Staying Healthy at Work. (No date).
<http://www.dep.state.pa.us/dep/deputate/waterops/redesign/subpages/tipsforwwworkers.htm>

Treatment Plant Operator.
http://www.tpomag.com/online_exclusives/2013/10/wastewater_plant_injuries_plummet_with_proactive_safety

U.S. Occupational Safety & Health Administration. <https://www.osha.gov/>

Waste Management and Recycling. Ontario Ministry of Labour

http://www.labour.gov.on.ca/english/hs/sawo/pubs/fs_wastemanagement.php
 Western Canada Water Magazine. <http://wcwwa.ca/resources/magazine/>

WorkSafeBC. Risk Assessments.

<https://www2.worksafebc.com/topics/ergonomics/FAQ.asp?ReportID=33232>

X. Figures

Figure 1: Sample Air Quality Investigation Process

