Chlorine manufacturing plant operator

Who is a chlorine manufacturing plant operator?

A worker who controls electrolytic cells that produce caustic soda, chlorine and hydrogen from brine (sodium chloride) solution, according to specified standards.

What is dangerous about this job?

- Risk of electrocution, which may be caused by contact with faulty electrical installations or equipment (electrolysis cells) or when the work is carried out in a humid environment where electricity, chemical solutions and water are present.
- Hazard of explosion due to the formation of hydrogen/chlorine mixture in the presence of ignition sources, such as UV radiation, electrical equipment and hot surfaces. Such an explosion can occur when high concentrations of hydrogen are produced inside the liquefaction and absorption installations. Explosion as a result of overpressure in cylinders may cause injuries.
- Injuries of the eyes and other parts of the body caused by splashed liquids from electrolysis cells, uncontrolled chemical reactions, during addition of solutions and/or substances into an electrolysis cell, and during drainage of caustic soda from an electrolysis cell
- Exposure to adverse working environments (high temperature and humidity, vapours of corrosive substances).
- Exposure to chlorine can cause the burning of eyes, the nose and the mouth; lacrimation and rhinitis; coughing, sneezing, choking and substantial pain; nausea and vomiting; headaches and dizziness; syncope; fatal pulmonary oedema; pneumonia; conjunctivitis; keratitis; pharyngitis; burning chest pain; dyspnoea; haemoptysis; hypoxaemia; dermatitis; skin blisters.
- Exposure to caustic soda can cause severe burns, serious damage to the eyes and the respiratory tract, and in some cases severe pneumonia. The symptoms are: sneezing, throat pains and/or a runny nose (caustic soda is formed throughout the production of chlorine and is highly corrosive).
- Discomfort and psychological problems related to the prolonged wearing of protective clothing (such as heavy boots, aprons and other impermeable pieces), and to the worries (sometimes serious) caused by the awareness of the inherent dangers of this work.

Hazards related to this job

Specific preventive measures can be seen by clicking on the respective in the third column of the table.

Accident hazards	• Slips, trips and falls on wet and slippery floors due to the extensive use of water	1
	• Falls while carrying heavy loads such as bags/containers with various chemicals during the preparation of solutions for chlorine-cell electrolysis	
	• Hazards of being struck by the fall of cylinders used for the storage of chlorine gas, and during their handling while engaged in weighing, cleaning, loading and unloading operations	

	• Electrocution caused by contact with faulty electrical equipment (electrolysis cells) or installations, during work in a humid environment whose electricity, chemical solutions and water are present	2
	• Hazard of fire as a result of the release of hydrogen at the cathode, which can catch fire due to static electricity and/or a heat source such as a flame or a hot object; or from the exothermic reaction of chlorine with metals and certain organic materials; oxygen and other corrosive gases can contribute to the expansion of fire	3
	• Hazard of explosion due to the formation of hydrogen/chlorine mixtures and the presence of an ignition source, such as UV radiation, electrical equipment and hot surfaces; an incident can occur when high concentrations of hydrogen enter into the liquefier and the absorber; explosion as a result of overpressure in cylinders can cause various body injuries	3
	• Hazard of suffocation due to a release of hydrogen in confined spaces which expands quickly resulting in a drastic decrease of oxygen concentration	3 4
	• Burns caused by contact with hot surfaces such as electrolysis cells, hot solutions (the process of electrolysis occurs at a temperature of 100C°) etc.	5
	• Hazard of explosion from accumulation of large amounts of nitrogen trichloride (the substance is sensitive to shocks) and chlorine/hydrogen mixtures	
	• Burns and scalds caused by corrosive substances such as caustic soda that is produced as a secondary product in chlorine production	5
	• Injuries of the eyes and other parts of the body caused by splashed liquids from electrolysis cell, from fast uncontrolled chemical reactions, during the addition of solutions and/or substances into electrolysis cells, and during the drain of caustic soda from electrolysis cells	6
	• Exposure to high concentrations of chlorine can lead to death; two main causes that can lead to the accidental release of chlorine: 1) failure in installations, vessels and packages or in transportation; 2) overload of scrubbers	3
Physical hazards	• Exposure to an adverse working environment (high temperature and humidity, vapours of corrosive substances)	3
	• Exposure to excessive noise from mechanical equipment and/or cylinders intended for chlorine while handling, cleaning, filling, loading and unloading	7
Chemical hazards	• Exposure to chlorine can cause burning of eyes, nose and mouth; lacrimation and rhinitis; coughing, sneezing, choking and substantial pain; nausea and vomiting; headaches and dizziness; syncope; fatal pulmonary edema; pneumonia; conjunctivitis; keratitis; pharyngitis; burning chest pain; dyspnoea; hoemoptysis; hypoxoemia; dermatitis; skin blisters	3 8
	• Exposure to caustic soda can cause severe burns, serious permanent eyes and respiratory tract damage; and in some cases severe inflammation of the lung; symptoms: sneezing, throat pains and a runny nose; caustic soda is formed	5 8

	during chlorine production and is very corrosive	
	• Exposure to hydrogen, formed while during chlorine production, may cause headaches, sleepiness, dizziness, excitement, vomiting and unconsciousness; lack of oxygen may be fatal	3 4 8
	• There may be exposure to mercury via the skin, eyes and respiratory tract during chlorine production through mercury cell electrolysis; mercury is highly toxic: long-term exposure to the metal may be fatal; chronic exposure can produce central nervous system damage; may cause brain and kidney damage, digestive disorders and the damage of the reproductive system	5 8
	• These may be exposure to asbestos, a human carcinogen, during the production of chlorine by the diaphragm (asbestos diaphragm) cell process	8
Biological hazards	• No biological hazards specific to chlorine manufacturing plant operators have been identified	
Ergonomic, psychosocial and organizational factors	• Musculoskeletal injuries caused by overexertion and by awkward and harmful working postures while lifting, moving or hanging full cylinders with gases and/or cylinders intended for filling	9
	• Musculoskeletal problems related to permanent working postures (prolonged standing)	9
	• Discomfort and psychological problems related to the prolonged wearing of protective clothing (such as heavy boots, apron and other impermeable pieces), and related to the apprehension (sometimes serious) caused by awareness of the dangers of the workplace	

Preventive measures

1. Use safety shoes with non-skid soles and resistant to corrosive chemicals
2. Check periodically electrical equipment for safety before use and call a qualified electrician for testing and repair of faulty or suspect electrical equipment
3. Install effective exhaust ventilation to prevent air pollution; if necessary, wear personal respiratory protective equipement and instruct employees how to use it
4. Wear respirators when exposed to harmful aerosols, dusts, gases or vapours
5. Wear suitable clothing according to the nature of the work: long-sleeved shirts, long trousers, headgear, gloves and appropriate boots
6. Wear appropriate eye protection; consult a safety supervisor or a supplier

7 Wear appropriate ear protection; consult a safety supervisor or a supplier

8 Apply chemical safety rules when handling or working with hazardous chemicals; read MSDSs and consult a safety supervisor regarding specific chemicals

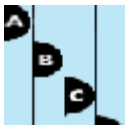
9 Use safe lifting and moving techniques for heavy or awkward loads; use mechanical aids for the lifting of heavy loads

Specialized information

Synonyms

chlorine manufacturing plant worker; chlorine-cell tender.

Definitions and/or description



Controls electrolytic cells to produce caustic soda, chlorine, or hydrogen to specified standards from brine (sodium chloride) solution: Regulates brine flow to cells, according to power input and strength of electrolyte. Observes flow through sight glasses; reads gauges, chart recorders, and manometer; and moves controls to regulate level of cell liquor, brine flow, cell pressure, current, and temperatures, within efficient operating limits. Turns valves and starts pumps to maintain specified back pressure on hydrogen and vacuum on chlorine. Observes gauges, turns valves, and starts pumps to tend auxiliary equipment, such as hydrogen scrubbers, water sprayers, condensers, and driers to purify, recover, or further process hydrogen, chlorine, and caustic liquor. Inspects cells, contact bars, pumps, turbines, and hydrogen and caustic outlets to detect overheating, stoppages, and leaks. Opens valves to flush lines and to draw sample of cell liquor. Measures specific gravity of liquor to facilitate process controls using hydrometer. Records data, such as temperatures, flow rate, operating time, and repairs made or needed. May replace glass and rubber tubing, nipples, and assemblies, and clean cell orifices and vents. When operating auxiliary equipment only to recover chlorine or hydrogen gas, may be designated Chlorine-Cell Tender (chemical); Hydrogen-Cell Tender (chemical). [DOT 558.382-026].

Related and specific occupations

Chemical practical-engineer; chemical technician; manufacturing engineer; hydrogen-cell tender; galvanizer; enameller.

Tasks

According; analyzing; changing; cleaning; closing; collecting; connecting; controlling; causing to flow; dipping; discovering; examining; following-up; helping; inspecting; installing; mixing; moving; observing; operating; opening; performing; processing; purification; regulating; removing; rotating; scrubbing; setting; starting-up; supervising; supplying; taking; teaching; testing.

Primary equipment used

Auxiliary equipment; centrifuge; cell orifices; chart recorders; condensers; containers; conveyors; driers; electrolytic cells; hydrometer; gauges; glass tubing; manometer; nipples; pumps; rubber tubing; scrubbers; tank; turbines; valves; vents; water sprayers.

Workplaces where the occupation is common

Chemical industry; chlorine manufacturing plant, etc.

Notes

1. Chlorine exposure occurs through inhalation, or skin or eye contact. When inhaled in high concentrations, chlorine causes emphysema and damage to the pulmonary blood vessels. Chronic exposure can cause corrosion of the teeth. Cardiac arrest may occur secondary to hypoxia.

2. Inhalation of small amounts of chlorine causes few or no symptoms. In larger amounts, it is a powerful irritant to the mucous membranes of the eyes, nose and throat.

Death is possible from asphyxia, shock, reflex spasm in the larynx and massive pulmonary oedema. Populations at special risk from chlorine exposure are individuals with pulmonary disease, breathing problems, bronchitis and chronic lung conditions.

Exposure limits:

- IDLH: 10 ppm (NIOSH, 1997)
- TLV TWA: 0.5 ppm (NIOSH 1997)
- TLV STEL: 1 ppm (ACGIH, 1999)
- ERPG-1: 1 ppm (AIHA, 1999)
- ERPG-2: 3 ppm (AIHA, 1999)
- ERPG-3: 20 ppm (AIHA, 1999)
- NIOSH REL: C 0.5 ppm (1.45 mg/m3) [15-minute]
- OSHA PEL: C 1 ppm (3 mg/m^3)

Health effects: Exposures of
1-3 ppm can cause mild mucous membrane irritation;
5-15 ppm, moderate irritation of upper respiratory tract;
30 ppm, immediate chest pain, vomiting, dyspnoea, and cough;
40-60 ppm, toxic pneumonitis and pulmonary oedema;
430 ppm, lethal over 30 minutes;
1,000 ppm, death within a few minutes.

Chlorine is produced by electrolysis of sodium chloride (common salt). In addition to chlorine, which is produced in a gaseous form, electrolysis also produces sodium hydroxide solutions (caustic soda) and hydrogen. Three different electrolysis processes are currently operated: 1) mercury cell electrolysis processes; 2) diaphragm cell electrolysis processes; 3) membrane cell electrolysis processes

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References

1. ILO Encyclopaedia of Occupational Health and Safety, 3rd Ed., Geneva, 1983.

2. ILO Encyclopaedia of Occupational Health and Safety, 4th Ed., Geneva, 1998.

3. Kirk-Othmer, Encyclopedia of Chemical Technology, 4th Ed., 1992.

4. U.S. Department of Labor: Dictionary of Occupational Titles – DOT, 2 Vol., 1991.

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