ETHYLENE DICHLORIDE (EDC) HANDBOOK

OXYCHEM
TECHNICAL INFORMATION
11/2014

Dallas-based Occidental Chemical Corporation is a leading North American manufacturer of basic chemicals, vinyls and performance chemicals directly and through various affiliates (collectively, OxyChem). OxyChem is also North America's largest producer of sodium chlorite.

As a Responsible Care® company, OxyChem's global commitment to safety and the environment goes well beyond compliance. OxyChem's Health, Environment and Safety philosophy is a positive motivational force for our employees, and helps create a strong culture for protecting human health and the environment. Our risk management programs and methods have been, and continue to be, recognized as some of the industry's best.

OxyChem offers an effective combination of industry expertise, experience, on line business tools, quality products and exceptional customer service. As a member of the Occidental Petroleum Corporation family, OxyChem represents a rich history of experience, top-notch business acumen, and sound, ethical business practices.

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MANUFACTURING

The chemical compound 1,2-dichloroethane, commonly known as ethylene dichloride (EDC), is a chlorinated hydrocarbon, mainly used to produce vinyl chloride monomer (VCM, chloroethene), the major precursor for PVC production. It is a colorless liquid with a chloroform-like odor. Ethylene dichloride is also used generally as an intermediate for other organic chemical compounds, and as a solvent.

Ethylene dichloride is produced through the iron(III) chloride catalyzed reaction of ethene (ethylene) and chlorine.

$$H_2C=CH_2 + Cl_2 \rightarrow Cl\text{-}CH_2\text{-}CH_2\text{-}Cl$$

In subsequent reactions, notably to vinyl chloride (chloroethene), hydrogen chloride is formed and re-used in a copper(II) chloride catalyzed reaction, to also produce 1,2-dichloroethane from ethene and oxygen.

$$H_2C=CH_2 + 2\ HCl + ½\ O_2 \rightarrow Cl\text{-}CH_2\text{-}CH_2\text{-}Cl + H_2O$$

OxyChem uses both reactions to manufacture EDC, the first is a direct chlorination reaction (see Figure 1) and the second is an oxychlorination reaction (see Figure 2). Many licenses for variations of each type of process exist today. Figure 1 and 2 are general process descriptions for each type of reaction.

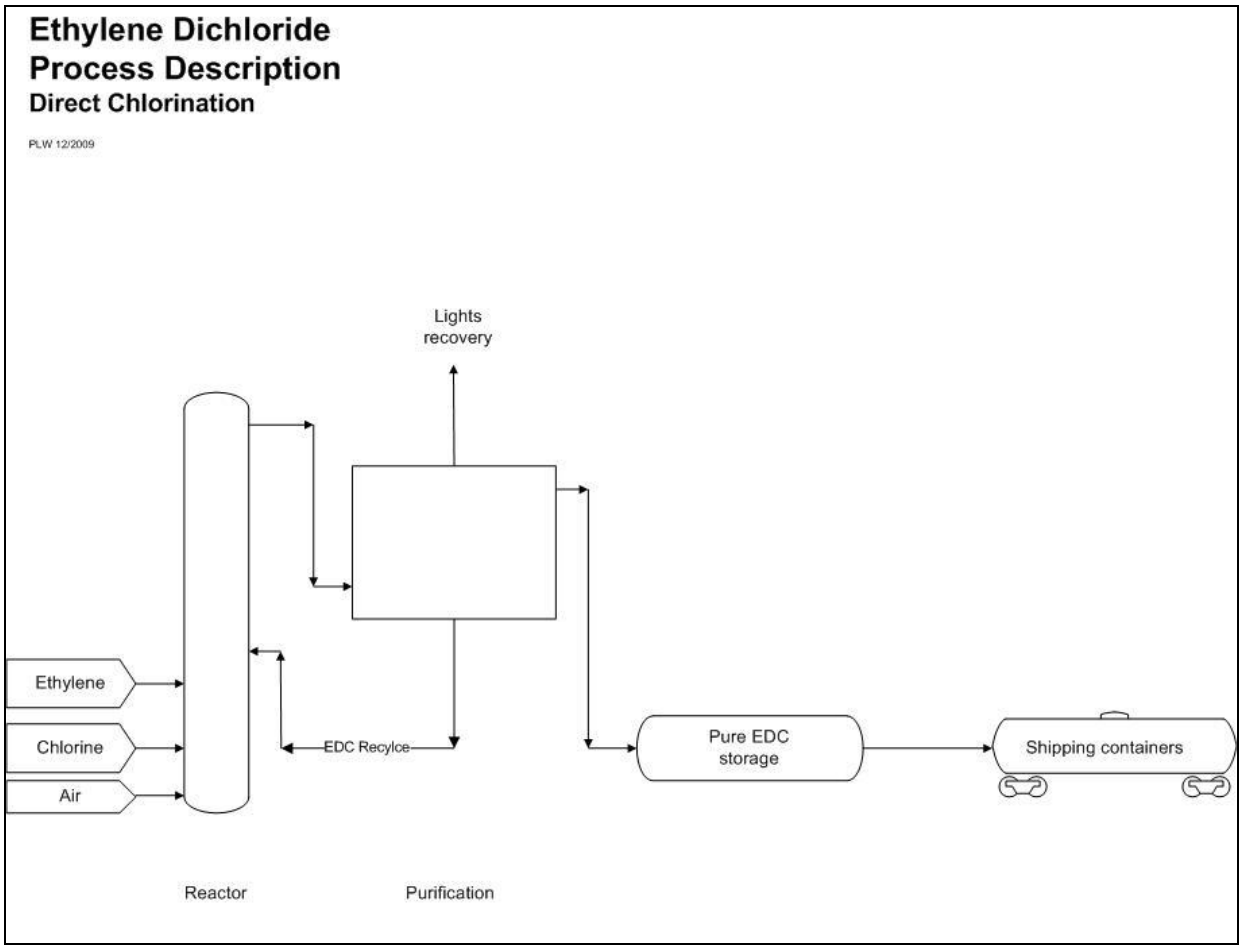


Figure 1: Direct Chlorination Reaction

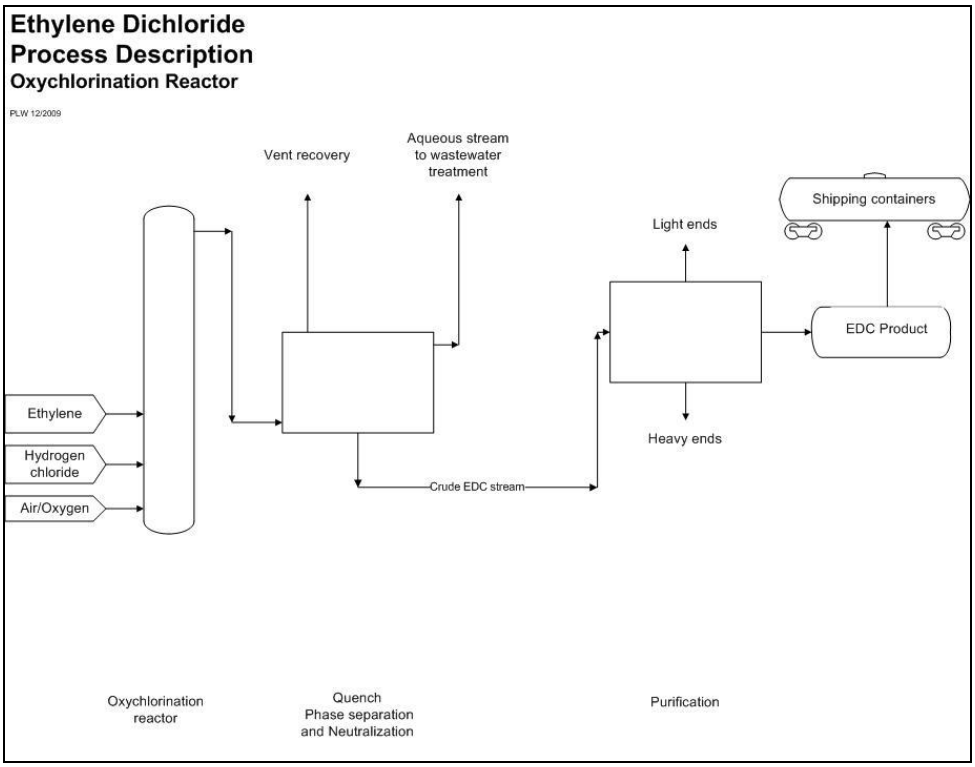


Figure 2: Oxychlorination Reaction

ETHYLENE DICHLORIDE USES

EDC is used primarily as a raw material in the manufacture of vinyl chloride monomer (VCM). The vinyl chloride, in turn is used to manufacture polyvinyl chloride (PVC) resin. EDC is also used as an intermediate in the manufacture of chlorinated and fluorinated compounds.

EDC has been used as a solvent in the textile, metal cleaning and adhesive industries.

SPECIFICATIONS AND PRODUCT GRADES

OxyChem produces and markets Technical Grade Ethylene Dichloride at the Geismar, LA facility with a minimum purity of 99.9% by weight. Material produced and shipped from OxyChem's Geismar, LA plant conforms to the chemical testing requirements of several industrial standards such as the General Use EDC for the ACS Specifications for Reagent Chemicals, 10th Edition; the Food Chemicals Codex, 8th Edition. The manufacturing process for EDC does not incorporate all of the measures specified in the Food and Drug Administration's current Good Manufacturing Practices (cGMP). It is the responsibility of the user to assess their use of EDC products in food, feed, or pharmaceutical related applications and to determine whether appropriate regulatory requirements are being met. OxyChem Technical Grade EDC meets the Military Specification MIL-D-10662-D which was replaced by ASTM D5960-03. OxyChem also manufactures EDC at its Convent, LA plant. Product manufactured at Convent, LA is marketed as Finished Grade Ethylene Dichloride with a purity of greater than 99.9% by weight.

OxyChem's Technical Services Department can provide more product information. Call or write the

Technical Services Department
OxyChem
P.O. Box 12283, Wichita, KS 67277-2283
800-733-1165, Ext.1.

SAFETY AND FIRST AID

Hazards

EDC is a flammable, toxic chemical and should be handled with extreme care. Personnel should be properly trained in the handling of EDC and should always wear the proper protective equipment when working with, and around EDC. All users

Figure 3: Personal Protective Equipment

should read the proper Material Safety Data Sheet (MSDS) before handling EDC. The primary health hazard associated with the use of EDC is overexposure due to the inhalation of vapors above the OSHA PEL.

The Occupational Safety and Health Association (OSHA) has established Permissible Exposure Limits (PEL) of 50 ppm. The PEL is the allowable average concentration to which workers may be exposed, 8 hours per day, five days a week, without adverse effects. OSHA has also established a Short Term Exposure Limit (STEL) of 100 ppm ceiling for EDC, which is a 15 minute average exposure that should not be exceeded. Also OSHA has established a Peak (5 minutes in any 3 hour period) of 200 ppm. Likewise, the American Conference of Governmental Industrial Hygienists (ACGIH) has established Threshold Limit Values (TLV) of 10 ppm for this product. Work areas employing EDC should be isolated and contained. A local exhaust should provide adequate ventilation to limit solvent vapors to below exposure limits.

It is recommended that employees be provided with and required to use chemical impervious clothing, gloves, boots, splash proof goggles and other appropriate protective clothing necessary to prevent any possibility of skin contact with EDC. Material types which may be considered for this service include fire resistant clothing, Barricade, Teflon, Viton, PE/EVAL, CPF3, Responder®, and Tychem®. Face shields can augment protection provided by splash-proof goggles and safety glasses, but are not intended to replace these safety appliances. (See Figure 3)

Respiratory Protection

OSHA requires that employees using respirators should be properly fitted and trained in their use.

Basically there are 3 types of respirators:

1. Escape: In areas where the unexpected release of EDC vapors may lead to potentially dangerous exposure, appropriate escape respirators should be carried by or be readily accessible to each employee. The most common respirator used for this purpose is the mouthpiece respirator. This respirator contains a single cartridge with a mouthpiece and nose clip. Employees should only use this respirator when escape times are short and airborne concentrations of EDC vapors are low. (See Figure 4)

Figure 4: Mouthpiece Respirator
(Escape Only)

2. Air Purifying Respirators: Air purifying respirators contain cartridges or canisters of absorbent or reactive material to remove harmful gases from breathing air. These respirators are available as either half face or full-face units. For EDC service, use a cartridge or canister designed for EDC service. (See Figure 5)

Where vapor concentration exceeds or is likely to exceed OSHA or NIOSH recommended Exposure Levels, a cartridge or canister respirator should be used. NIOSH has set a 1 ppm eight hour time weighted average for EDC and a 2 ppm fifteen minute short term exposure limit. When working in environments where airborne concentrations are irritating to the eyes, full-face piece respirators should be used. Cartridge or canister respirators are strictly air-purifying devices and must never be used in an oxygen deficient atmosphere (less than 19.5% oxygen by volume), in environments immediately dangerous to life or health (IDLH), or areas containing unknown concentrations of EDC the NIOSH limit is set at 50 ppm.

Figure 5: Full Face Air Purifying Respirator

It is important to remember that cartridges and canisters have a limited service life. Conditions such as humidity, chemical concentrations in the workplace, other chemicals in the workplace, and frequency of use will affect cartridge and canister service life. Therefore, an evaluation of workplace conditions should be made to determine the appropriate cartridge/canister replacement schedule.

3. Self-contained Breathing Apparatus: Self-contained breathing apparatus (SCBA) can provide respiratory protection in an oxygen-deficient environment and in situations where unknown concentrations of EDC vapors are present. The SCBA can also provide protection in emergency situations. (See Figure 6)

The SCBA is an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user (OSHA definition). A full-face mask is always used with this type of apparatus. OSHA requires that when wearing the SCBA in an Immediately Dangerous to Life and Health (IDLH) atmosphere, the SCBA must be operated in the pressure demand mode and be certified by NIOSH for a minimum service life of thirty minutes. Escape SCBA devices are commonly used with full face pieces or hoods and, depending on the supply of air, are usually rated as 3 to 60 minute units.

Figure 6: Self-Contained Breathing Apparatus

OSHA requires that all respirators must be NIOSH approved and shall use breathing gas containers marked in accordance with the NIOSH respirator certification standard, 42 CFR part 84. For further information on regulations pertaining to respirator equipment, see 29 CFR 1910.134 and 30 CFR § 57.5005 For additional information see DHHS (NIOSH) Publication No. 2005-100, *NIOSH Respirator Selection Logic 2004* or Publication No. 87-116, *NIOSH Guide to Industrial Respiratory Protection*.

Safety Precautions

In the absence of air and water, EDC is stable to 160°C (320°F). In contact with air or water it is

subject to very slow hydrolysis or oxidation, either reaction offers the possibility of the formation of trace amounts of HCl. This can lead to discoloration in storage tanks. EDC can be stored in vessels made of common materials of construction, except aluminum, magnesium, zinc, and their alloys.

Avoid contact with pure oxygen, strong alkalis, alkali metals, open flames and welding arcs, or other high temperature sources which induce thermal decomposition to irritating and corrosive HCl.

EDC is extremely flammable with a "Tag Closed Cup" flash point of 13°C (55.4°F). This solvent must be stored in a National Fire Prevention Association (NFPA) Class I area. Proper grounding and bonding procedures should be followed.

Dry chemical, carbon dioxide, foam, water fog or spray should be used to extinguish fires. Water may be ineffective, but should be used to keep fire-exposed containers cool.

Safety showers and eye wash fountains should be located in the immediate work area and clearly marked. These units should be tested on a regular basis. Portable or temporary systems are available. Every precaution should be taken to ensure that a suitable system is in place and operational before handling EDC. Only trained and properly protected personnel should be allowed to enter areas where EDC is present. ANSI Standard Z358.1 contains placement and performance criteria for emergency eyewash and shower equipment.

Before entering tanks or opening pipelines that have contained EDC, they should be completely emptied and checked for vapors before entering. Do not enter a confined space (which includes tanks or pits) without following proper entry procedures such as 29 CFR 1910.146.

Good housekeeping practices are important where ethylene dichloride is used. If a ethylene dichloride leak occurs, evacuate the area and eliminate all ignition sources. Response personnel should wear self-contained breathing air and protective equipment to prevent contact with vapor, liquid or hazardous decomposition products.

In all cases, explosion-proof ventilation should be provided to keep concentrations below explosive limits.

See Page 15 of this handbook for specific recommendations on spills and precautions.

First Aid

Eye Contact - Direct contact of EDC with the eyes will result in pain, watering, and inflammation. To prevent eye contact, protective eye wear (such as splash goggles, a full face shield, or safety glasses with side shields) must be worn. If eyes come in contact with EDC, hold the eyelids apart and flush the eye gently with a large amount of lukewarm water for at least 15 minutes, forcibly holding eyelids apart to ensure complete irrigation of all eye and lid tissues. Washing eyes within several seconds is essential to achieve maximum effectiveness. GET MEDICAL ATTENTION IMMEDIATELY.

Skin Contact - Prolonged exposure of the skin to EDC will remove the skin's natural oils, causing the affected area to become red, rough and dry. If exposure continues, the EDC may produce a burning sensation. Prolonged contact with EDC can cause contact dermatitis. To prevent irritation, wear protective clothing (including gloves) when working with EDC. If skin comes in contact with EDC, immediately wash exposed skin with plenty of water while removing contaminated clothing, jewelry and shoes. Wash clothing and thoroughly clean shoes before reuse. GET MEDICAL ATTENTION IMMEDIATELY.

Inhalation – Overexposure to vapors may result in dizziness, drowsiness, depression, headache, nausea, mental dullness, loss of coordination, or in extreme cases, death.

To avoid overexposure to EDC vapors, monitor the EDC vapor concentration in the work place. If vapors are found above the OSHA PEL, install engineering controls (such as localized ventilation) to reduce EDC vapor concentrations to a safe operating level. In areas where the concentrations of EDC vapors are either unknown or cannot be maintained below the limits, workers must be equipped with NIOSH approved respirators as per the OSHA Respiratory Protection standard.

If EDC is inhaled, remove individual to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. If respiration or pulse has stopped, have a trained person administer Basic Life Support (Cardio-Pulmonary Resuscitation/Automatic External Defibrillator) and CALL FOR EMERGENCY SERVICES IMMEDIATELY.

Ingestion – Accidental ingestion of EDC may result in irritation of the gastrointestinal tract, nausea, vomiting, diarrhea, unconsciousness and death. EDC is a liver and kidney poison. Proper labeling, handling and storage of EDC will reduce the likelihood of accidental ingestion. If ingestion occurs, never give anything by mouth to an unconscious or convulsive person. If swallowed, do not induce vomiting. If vomiting occurs spontaneously, keep airway clear. Do not give fluids. GET MEDICAL ATTENTION IMMEDIATELY.

NOTE TO PHYSICIAN: This material is an aspiration hazard. Risk of aspiration must be weighed against possible toxicity of the material (see ingestion) when determining whether to induce emesis or to perform gastric lavage. This material sensitizes the heart to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material.

Traumatic Shock - Whenever injured persons are being cared for, the person administering first aid should watch for signs of traumatic shock. Traumatic shock may follow serious injury and is a depressed condition of many body functions due to inadequate blood circulation throughout most of the body. Signs of shock are pale, moist, cool skin; shallow and irregular breathing; and weak pulse.

Beads of perspiration may be noted about the lips, forehead, palms, and armpits. The patient may become nauseated.

To treat shock, keep the patient lying down and as warm and comfortable as possible. Raise the patient's feet eight to twelve inches unless there is head injury, breathing difficulty, or if the patient complains of added pain.

TOXICITY

Up-to-date toxicity information is available from the Material Safety Data Sheets. Read the MSDS before use.

The OxyChem Technical Service and Product Stewardship organizations, as well as many trade associations, including the Chemical Manufacturers Association (CMA), have trained personnel to answer questions about the toxicity of this product.

Chronic exposure can produce central nervous system effects, kidney damage, liver damage, and cancer. Short term exposure can be harmful or fatal if swallowed, nausea, vomiting, central nervous system effects, absorption may occur

EDC is classified by NTP as an Anticipated Human Carcinogen; and by IARC as a Human Inadequate Evidence, Animal Sufficient Evidence, Group 2B carcinogen.

REGULATORY

The following is a summary of regulations and sources that may pertain to EDC.

U.S. Environmental Protection Agency

- Clean Air Act: EDC is included on the Clean Air Act, Section 112(b) list of Hazardous Air Pollutants. http://www.epa.gov/air/caa/
- Clean Water Act: Water Quality Criteria
  - Based on fish/shellfish and water consumption =0.38 µg/L
  - Based on fish/shellfish consumption only =37µg/L

http://www.epa.gov/water/

- Comprehensive Environmental Response, Compensation, and Liability Act: Releases of EDC in excess of the Reportable Quantity of 100 pounds must be reported. http://www.epa.gov/lawsregs/laws/cercla.html
- Emergency Planning and Community Right-to-know Act: EDC is a listed substance that is subject to reporting requirements under Section 313 of the act. These reports are often called Toxic Release Inventory (TRI) Reports. http://www.epa.gov/lawsregs/laws/epcra.html
- Resource Conservation and Recovery Act
  - Characteristic Toxic Hazardous Waste code D028. The code applies if waste contains 0.5 mg/L or more EDC as determined by the Toxicity Characteristic Leaching Procedure.
  - Listed Hazardous Waste Codes in which listing is based wholly or partly on EDC include: U077, F024, F025, K018, K019, K020, K029, K030, and K096

http://www.epa.gov/lawsregs/laws/rcra.html

- Safe Drinking Water Act—Maximum Contaminant Level (MCL)= 0.005 mg/L http://www.epa.gov/lawsregs/laws/sdwa.html
- Toxic Substances Control Act—EDC is subject to an enforceable consent agreement. http://www.epa.gov/lawsregs/laws/tsca.html

Food and Drug Administration

• EDC has a maximum permissible level in bottled water =0.005 ppm
http://www.fda.gov/Food/FoodIngredientsPackaging/default.htm

World Health Organization

• EDC is subject to the Prior Informed Consent (PIC) Convention. The designation was based on pesticide uses, not on industrial uses. According to the PIC Convention, export of a chemical can only take place with the prior informed consent of the importing Party.
http://www.who.int/en

These summaries also do not address any similar state or local regulations, some of which may impose additional or different obligations from those imposed by federal regulations. All users are responsible for a complete review of the applicable regulations pertaining to their own operation.

HANDLING AND STORAGE

Shipping

Barge Unloading

Only properly trained personnel should be involved in unloading operations. An operator must be present throughout the unloading procedure. Written procedures must be readily available. A safety shower and eyewash must be readily accessible. The unloading area must be adequately lighted. All DOT regulations in CFR, Title 49 must be obeyed.

1. Barges and vessels should be docked at a Coast Guard approved water front facility equipped with dock-side unloading lines. Before unloading, check to ensure all applicable parties (Coast Guard, state regulatory agencies, etc.) have been notified and all paperwork is correct and up-to-date. Once docked, check to ensure the vessel is properly moored. Do not begin transferring product until all security inspections have been performed by the appropriate authorities (Coast Guard, DOT, Shipping Authority or Marine Inspection, etc.).

2. Verify that the receiving lines and tank are properly labeled, and that there is sufficient volume to hold the delivered product. Ship, barge, and vessel unloading connections are typically equipped with 6 or 8-inch connections. Check to make sure that the dock-side transfer lines and connections are appropriately sized to match those of the shipping vessel. If the receiving tank contained another product be sure that it is clean, dry and odor free and check to make sure the dockside storage tank is empty and has been purged with nitrogen to a dew point of at least -40°C (-40°F) and to an oxygen concentration of 10 volume percent or less.

3. Check all lines to make sure they are clean, dry, and free of contamination. The vessel's pump should be inspected to ensure it has the proper gasket and packing materials, and that it is clean, dry, and free of contamination. Make sure the pump has been checked by the Coast Guard and has passed inspection. Inspect transfer lines and hoses from the ship to the dock to the manifold, ensuring all lines are clean, dry, free of contamination, and constructed of the appropriate EDC resistant materials.

4. Have the surveyor sample the vessel's tank and check for appearance, color, moisture content, and specific gravity. Sampling should only be accomplished with a closed system that has built-in capabilities to handle vents, provide nitrogen, process unused liquid volume and results in a sample in a closed container.

5. After the surveyor has verified that the product is within specification requirements, connect the dock-side unloading line to the ship's manifold.

6. Establish an electrical ground for the dock side manifold, storage tank, and unloading lines.

7. Ensure that workers involved in the unloading procedures are fitted with the proper safety equipment including safety shoes, hard hats, gloves, protective glasses or face shield, and the appropriate respiratory equipment. Only properly trained personnel should be involved in unloading operations. An operator must be present throughout the unloading procedure.

8. It is recommended and may be required by law to connect the vents from the storage tank and the vessel's tank together to reduce vapor emissions to the atmosphere. If this is not possible, supply dry nitrogen make-up to the vapor space of the vessel's tank and vent the storage tank to an appropriate emission control system.

9. Open the appropriate valves start the pump and begin unloading.

10. When one foot of product has been unloaded, stop unloading and have the surveyor obtain a sample from the storage tank and again test for appearance, color, moisture content and specific gravity. If the product is within specification range, finish unloading the product. If the product does not meet specification requirements, call OxyChem Customer Service.

11. After all the product has been unloaded, shut off the pump, then shut off the valve on the suction side of the pump. Purge the transfer lines free of EDC by blowing the lines clear, with nitrogen.

12. Close the storage tank inlet valve. Disconnect the unloading line at the ship's manifold, then at the dock manifold. Hoses with couplings that automatically close upon being uncoupled are recommended.

13. Have the surveyor obtain another sample from the dock side storage tank, and have it analyzed for each specification item to certify the tank's contents.

TANK TRAILER or TANK CAR UNLOADING

Only properly trained personnel should be involved in unloading operations. An operator must be present throughout the unloading procedure. Written procedures must be readily available, and followed.
A safety shower and eyewash must be readily accessible. The unloading area must be adequately lighted. All DOT regulations in CFR, Title 49 must be obeyed.

1. Tank trucks or Tank cars containing OxyChem EDC should be located on a level, paved surface in a designated unloading area.

2. All unloading and receiving areas for EDC should be surrounded by total containment for the control of potential spills and leaks. Where large scale containment (i.e., diking) is not practical, drip pans or other suitable containers must be placed under connections in the event of a leak.

3. Set hand brakes and wheel chocks, and establish an electrical ground for the tank truck or tank car, unloading lines, pump, and storage container.

4. Verify the tank truck's or tank car's contents by sampling or check the placards, bill of lading, and certificate of analysis. Verify that the receiving tank and lines are properly labeled, and that the tank has sufficient volume to hold the delivered product.

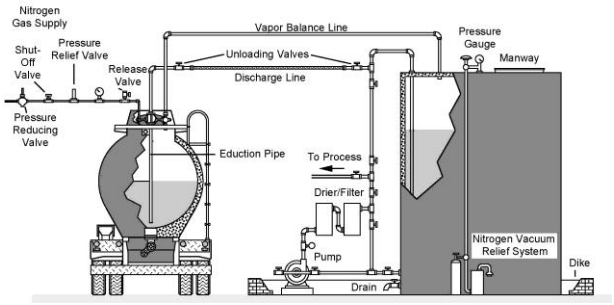


Figure 7: Tank Truck or Tank Car Top Unloading Diagram

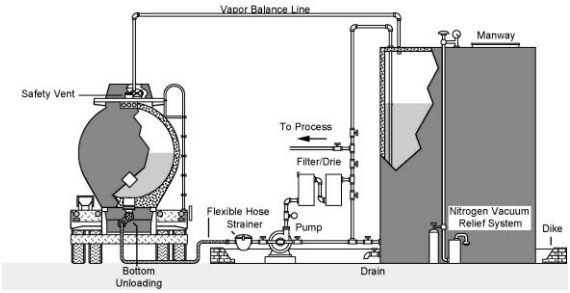


Figure 8: Tank Truck or Tank Car Bottom Unloading Diagram

5. Check all transfer lines and hoses to make sure they are clean, dry, and free of any contamination. Whenever possible, use pumps and flexible hoses dedicated to EDC service. Tank trucks can be provided with their own pumps upon request and several sections of chemically resistant hoses. Verify that they are compatible with the product received. The size and location of the valves and/or outlets will differ somewhat from truck to truck. Inspect all connections and the pump to ensure they contain the proper gasket material and packing, and that they are clean, dry and free of contamination. Tank cars have valves on the top of the car under the dome cover.

6. Connect one section of the 2-inch flexible hose to the tank truck's 2-inch bottom or rear unloading valve and to the suction side of the pump. If using the tank truck's pump, connect another section of the hose from the pressure side of the pump to the storage tank or permanent unloading line. Connect the

unloading line to the liquid valve connection at the manway on the tank car and connect return vapor line to the vapor valve connection on tank car. Check to make sure all connections are secure.

Figure 9: Truck Trailer Rear Product Outlet

7. Ensure that workers involved in the unloading procedures are fitted with the proper safety equipment including safety shoes, hard hats gloves, protective glasses or safety shield, and the appropriate respiratory equipment. Only properly trained personnel should be involved in unloading operations. An operator must be present throughout the unloading procedure.

8. Release any pressure in the trailer or car by slowly and carefully opening one of the safety vents on top of the trailer or car. EDC vapors should be vented through an emission control system during unloading. Whenever possible, connect the vents from the storage container and the shipping vessel allowing them to breath the same vapor space, thereby eliminating vapor emissions to the atmosphere.

9. Open the storage tank inlet valve, followed by the tank truck's or tank car's unloading valve. Turn on the pump and begin transferring product. At the same time, have another operator check all connections for any sign of leaks.

10. After the tank truck or tank car is empty (or the pump can no longer remove EDC), shut off the pump, close the tank inlet valve, then close the trailer's or car's unloading valve. Disconnect the flexible 2-inch unloading line from the trailer or tank car and drain as much EDC as possible. Disconnect the flexible line to the suction side of the pump, and collect any dripping in a suitable container. Close the valve on the pressure side of the pump, and disconnect the hose.

11. If the tank truck's pump was used to unload the container, close the valve on the pressure side of the pump, then close the tank inlet valve or the valve at the end of the dedicated unloading line. Disconnect the flexible hose and collect any EDC remaining in a suitable container.

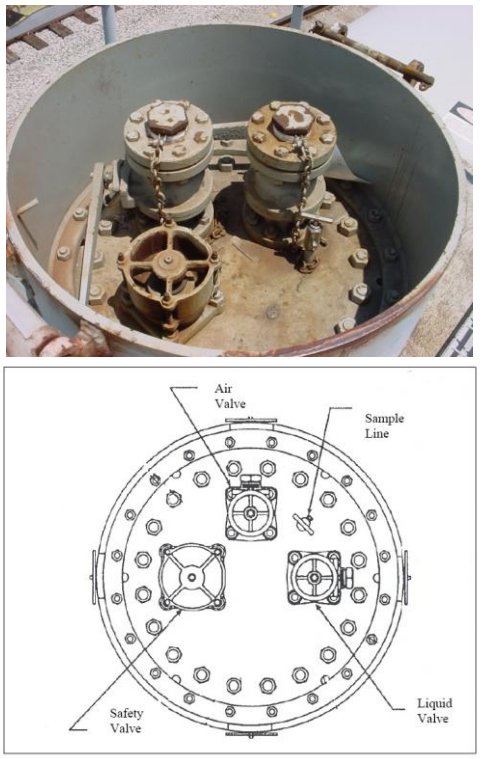


Figure 10: Typical Dome Valve Arrangement

12. Reseal the tank truck or tank car by closing the safety vent. Replace any caps that may have been used to keep the valves clean. Remove hand brakes and wheel chocks before releasing the trailer or tank car.

Pressure Unloading

Tank trucks or tank cars containing OxyChem EDC may also be pressure unloaded. Nitrogen (dew point less than -40°C/-40°F) should be used to pressure offload moisture sensitive EDC. **EDC should not be pressure off loaded with air due to its flammable characteristics.**

Storage & Equipment

Written procedures detailing requirements for proper handling, safety equipment, first aid training, unloading and loading procedures are good practice and in many cases, required by law. They should include detailed instructions for handling and reporting spills.

Considerable care should be taken when transferring EDC to maintain high product quality. These same careful practices will ensure the health and safety of workers, and ensure that no EDC is allowed to escape into the air, soil or water.

An above ground tank must be used whenever a large volume of EDC is to be stored at a customer or terminal site. Storage tanks should be large enough to contain a minimum of 150% of the normal delivery volume.

Storage tanks previously used to contain other products may be used for storage, but must be thoroughly cleaned, water tested, drained and dried prior to being placed in EDC service. New tanks should be prepared in the same manner. Since water testing is not always sufficient to detect small liquid or vapor leaks, the tank should be monitored closely during the initial filling with EDC to check for leaks not detected during water testing. A halide meter (or equivalent) should be used for monitoring. It is recommended that the halide meter be used as part of a routine maintenance program.

Storage tanks may be mounted horizontally or vertically. Storage tanks used for EDC should meet the American Petroleum Institute (API) Standard 650, Welded Tanks for Oil Storage; API standard 620, Design & Construction of Large, Welded, Low-pressure Storage Tanks; ASME Section VIII, or other suitable design and fabrication standards. All local regulations concerning above ground storage tanks should be reviewed and all permits obtained before installing a bulk storage system.

Bulk storage containers should be constructed of mild, carbon, or stainless steel. **Do not use aluminum as a material of construction for any wetted metal parts.** Storage tanks should not be constructed of, nor contain, any non-compatible plastic components.

The storage tanks exterior should be cleaned, primed and painted with a white or aluminum colored paint to aid in keeping the tank and its contents cool.

Storage Tank Pads or Saddles

Saddles used to support horizontal tanks may be constructed of reinforced concrete or steel. The design of the concrete pad or saddle foundation (if horizontal) should be based on at least the total weight of the tank filled with EDC.

Dikes

All storage tanks should be diked to contain the tank contents in the event of a spill or tank rupture. They should be large enough to contain the tank's volume, and an additional appropriate volume as a safety factor. **(Containment volumes and diking requirements are often defined and mandated by individual states and localities. Regulations must be reviewed prior to construction.)** Dikes may be constructed of concrete or concrete treated with a EDC resistant epoxy-phenolic sealant. Where diking does not apply, EDC resistant buckets or other appropriate portable spill containers should be used.

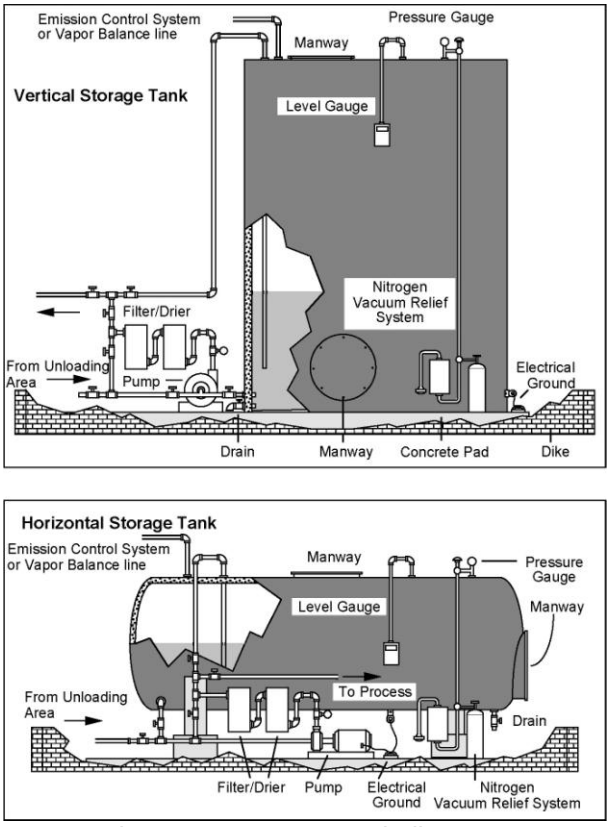


Figure 11: Storage Tank diagrams

Manways

Manways on tanks are necessary for access to the tank for inspection and cleaning. Two manways, 24 inches in diameter, are desirable. One manway should be located on top of the tank, while the second should be positioned on the side near the base for empty tank inspection and clean out procedures.

Piping

Carbon steel is the material of choice for piping. Transfer pipes are typically 2-inch in diameter, but may be as large as 6-8 inches for barge and vessel

deliveries. Fittings may be carbon steel or stainless steel, and may be threaded, flanged or welded. Threaded piping is only recommended for sizes less than 3/4" in diameter. It is essential that the pipe be threaded two full turns before applying threading compound or Teflon® tape to eliminate the possibility of contaminating the interior of the pipe. All pipes should be free of oils and any other contaminants prior to being placed in service.

Drain Lines
Storage tanks should be equipped with a flanged and valved outlet drain at the floor level to allow the tank complete drainage if necessary. This outlet should be located such that it can be tied into a pump. Since this outlet is rarely used, the valve should be plugged and equipped with a locking system to prevent any accidental releases.

Outlet Line
An outlet line for normal EDC withdrawal should be located 3-4 inches above the tank floor. It should be tied into the drier-filter pump system. This piping system ensures that clean, dry EDC can be loaded without duplication of equipment. A safety valve should be provided between the tank and the pump as a means for shutting off the flow of EDC should a problem arise with the pump.

Valves
Ball, gate, globe or plug valves are suitable for use with EDC. Construction may be steel. Ball valves should have monel balls and stems; seats should be carbon filled PTFE, and globe valves should have 13% chrome trim and hard-faced Stellite seats. Valve stems may be packed with PTFE or graphite impregnated PTFE. Ball, gate or plug valves are generally preferred where full line flow is desired. Globe valves are used where throttling is necessary.

Pumps
Pumps may be either positive displacement or centrifugal type, and can be constructed of steel, cast iron, or bronze. All packings must be made of EDC resistant materials such as PTFE. Pumps used for drumming should supply EDC at a rate of approximately 50 gpm. The pump should be located so that a positive head pressure is always maintained on the suction side.

Bypass Line
A bypass line must be provided when utilizing a positive displacement pump, and is recommended for centrifugal pumps to protect against pipe damage and undue strain on the pump.

Emergency Shut-Off Valve
An emergency shut-off valve should be located at the outlet of the vessel feeding the pump.

Meters
A meter of Hatellow C, mild or stainless steel construction with PTFE packing should be used with EDC. For best results, it should also contain an air eliminator, strainer, and temperature compensator. **EDC meters must not be constructed of any reactive metals such as aluminum, zinc or magnesium alloys.**

Tank Level Indication
Several gauging methods are used to determine the EDC volume inside storage tanks. Typically dP cells, sonic, or a float with electronic read out are used.

Electrical Ground
An electrical ground line is a required safety feature that provides a point of discharge for any build-up of static electricity from pumping dry EDC.

Hoses
Recommended materials of construction include braided or seamless stainless steel, polytetrafluoroethylene (PTFE or Teflon), and some grades of Viton®. If a composition other than stainless steel or Teflon is used, it must first be tested to ensure compatibility with EDC.

Gaskets
Gaskets used in the service of EDC may be constructed of PTFE envelope gasket material or GRAFOIL. If a composition differing from those mentioned above is to be used, it must first be tested with the EDC to ensure compatibility.

Other Non-Metal Wetted Parts
All non-metal wetted surfaces such as internal pump, valve and meter parts must be constructed of components that are inert to EDC, such as Teflon. **Neoprene and natural rubber parts cannot be used for EDC service**. Other plastic products such as ultra-high molecular weight, high molecular weight, irradiated, or cross-linked polyethylene, polyvinyl alcohol, or other common polymeric compounds must first be tested with EDC to ensure compatibility.

Line Filters
Filters of small micron pore size can be used to remove insoluble contaminants that can accumulate through product transfers. Filters should be made of solvent resistant materials, and should be adequately sized for the required flow rate.

Line Driers
EDC can absorb moisture from the air during product transfer. Desiccants such as Drierite® (calcium sulfate), molecular sieve (4A), alumina or certain ion exchange resins (Dow X811) may be used for drying liquid EDC. Before using another desiccant material, laboratory tests should be run to determine compatibility and performance. The EDC filter and drier should be arranged in series such that product passes through each during transfer to and from storage.

Pressure/Vacuum Relief System
Tanks should also be equipped with a pressure-vacuum relief system to maintain the integrity and safety of the tank. The set points for such a system are typically design values of the vessel.

Safety Seal
If the storage tank is fitted with a liquid overflow line, the line must be equipped with a seal. A filled U-trap can serve as a seal, but the use of a seal pot is recommended.

Vent Scrubbers
An emission control device such as a scrubber or low temperature condenser, may be fitted to the vent (and may be required by law). Vent scrubbers may contain an EDC trapping media, such as activated carbon, to prevent EDC emissions to the atmosphere.

Maintenance of Storage Facilities

One of the primary hazards associated with the use of EDC occurs when employees are exposed to high concentrations of the solvent vapor in an enclosed area. Adequate ventilation must be supplied to remove vapors before hazardous concentrations can accumulate. EDC vapors are expected to be highest during storage tank clean out. During confined area entries, special care must be taken to ensure employee safety. **The following procedures were adapted from the ASTM D 4276, Standard Practice for Confined Area Entry and are listed as a starting point for developing procedures. You must follow the OSHA requirements given in 29 CFR 1910.146.**
(For the purpose of these instructions, a confined area entry refers to the entering of any tank vessel, sump, pit, duct, tank car, tank truck, van trailer, or enclosed space in which EDC was contained.) It should be noted that EDC vapors are heavier than air and will concentrate at the lowest point.

Clean Out Preparation
All personnel involved in tank clean out procedures should be properly trained in safe entry and rescue procedures. They should have a working knowledge and understanding of the hazards that may exist.

Entry into confined spaces should be by written entry permit, issued by the responsible supervisor or other qualified person. The purpose of the entry permit is to ensure that a checklist of precautions has been reviewed prior to entry. This permit is an authorization and approval in writing certifying that all existing hazards have been evaluated, and necessary protective measures have been taken to ensure the safety of the worker. The permit should be valid for a limited time only (usually 8-10 hours), and a new permit should be required in the event of any job interruption or any indication of changes in job conditions. Issuance of the entry permit should address all of the following considerations:

Vessel Entry
1. All process lines exiting or entering the confined space should be disconnected, capped off, and blinded. Closing of valves alone is not adequate protection.

2. Pumps connected to the enclosed area or any other mechanical or electrical equipment, especially conveyors, are to be locked out by locking the main electrical switch in the “OFF” position.

3. A system for positive ventilation should be provided prior to, and during, entry periods. Fans, exhaust vents, air movers, or natural drafts that are capable of ventilating the confined air space within several minutes are necessary.
4. Prior to entry, the enclosed space must be tested for oxygen content, lower explosive limit, and toxic vapor concentration. The oxygen content must be between 19.5% and 23.5% in all levels of the tank. The atmosphere must be non-explosive (< 10% of the lower flammability limit), and be absent of toxic vapors. The concentration of EDC vapors may be determined using the appropriate NIOSH approved gas detection tubes, a calibrated halide meter, portable flame ionization gas chromatograph, or a portable infrared (IR) analyzer.

5. Personal protective equipment should include an approved respirator (Self Contained Breathing Apparatus [SCBA]) or supplied air respirators are recommended), hard hat, safety glasses or splash goggles, gloves, and long sleeves. In

addition, any person entering the enclosed area must be fitted with a safety harness and lifeline. The lifeline should be secured outside the entrance.

6. When entry into the vessel must be made through a top opening, a hoisting device or other effective means must be provided to lift the worker out of the space. Ladders must be in place for entrances and exits where the drop or climb involves a depth of more than three feet.

7. Self-contained breathing apparatus or supplied air respirators should be available at the vessel entrance. These devices must be worn if testing finds the EDC level to be above the OSHA Permissible Exposure Limit (PEL).

8. A second person must be available at the area entrance and in sight of the person inside at all times. They should be equipped with proper safety equipment and adequate communications equipment for summoning additional help if necessary (i.e. a two way radio, whistle, etc.). Under no conditions should this observer enter the affected area without others standing by. If the observer is required to leave his or her post, the person inside the enclosed space must exit.

9. Approved low-voltage electrical equipment must be used where the atmosphere in the confined area may contain flammable vapors or where the atmosphere could contain EDC vapors within their flammable limits. All electrical circuits should be equipped with a ground-fault interrupter.

10. Entrances to confined space should be posted, identifying the area as a confined space and that a permit is required for entry. During the work, when there is more than one entrance to the confined area, signs indicating that workers are inside, posted at each entrance, are advised.

11. Before entering an EDC storage tank or other EDC vessel for cleaning or inspection, any remaining EDC should be drained or removed by vacuum, and placed in a safe container awaiting disposal or reuse. The tank should then be nitrogen dried or steamed or filled with water, drained, ventilated, and checked for presence of EDC vapors.

12. Remove metal fines or chips, rust, and all other insoluble contaminants from the tank bottom. Scrape any baked on contaminants if necessary using an appropriate wire brush to avoid sparking. Repair defects to the tank surface as necessary.

13. After removing insoluble contaminants, rinse all EDC wetted surfaces thoroughly with an alcohol or water rinse. If cleaning a tank where acidity has been a problem, all EDC wet surfaces should be scrubbed with a wire brush and a 5% soda ash (sodium carbonate) or baking soda (sodium bicarbonate) solution to remove metal chlorides and visible patches of corrosion.

    Strong alkalis, such as caustic soda (sodium hydroxide, NaOH) or caustic potash (potassium hydroxide, KOH), must not be used. They can react with EDC to form explosive mixtures.

14. After cleaning, rinse the tank thoroughly with several successive water rinses to remove any remaining impurities. Dry the tank completely by ventilating for several hours. Do not refill with EDC until the tank is completely dry.

15. Close manways and all other openings and secure vessel. Open the appropriate entrance and exit lines, and prepare the tank to be filled with EDC. (New gaskets are recommended to ensure the integrity of the product and to prevent leaks.) For large bulk storage tanks, purge the tank with nitrogen to a dew point of -40°F. An oxygen content of less than 1% may also be desired.

SPILLS AND PRECAUTIONS

EDC is a flammable solvent. Direct contact with open flames or a high energy heat source will result in combustion as well as corrosive, noxious gases. If combustion occurs, quench flames using water, dry chemical, foam, or carbon dioxide (CO2).

Work areas that employ EDC should be fire resistant and well ventilated to limit the concentration of potentially flammable vapors.

During EDC transfers from one container to another, equipment should be properly grounded and bonded to prevent the build up of static electricity. If discharged, this build up could create an igniting spark.

TECHNICAL DATA

PRODUCT SAMPLING

1. In general, an eight ounce sample is adequate for confirming product specifications. Before transferring bulk shipments of OxyChem EDC, the shipping vessel should be sampled and analyzed to ensure product quality.

2. Sampling should only be accomplished with a closed system that has built-in capabilities to handle vents, provide nitrogen, process unused liquid volume and results in a sample in a closed container.

3. Samples should be stored in glass with polyseal screw caps or caps lined with poly-fluorocarbons. Caps made of other HDPE or irradiated PE may also be used if non-volatile residue is not important. If caps are metal lined, make sure neither tin nor aluminum are used. Do not use plastic coated (inside or outside) sample bottles when sampling EDC since the plastic coating can contaminate the product.

4. For barges, vessels, and one compartment trucks, a single sample is sufficient. For multiple compartment trucks or barges, samples should be taken and analyzed for each compartment.

5. Samples taken as retains should be labeled with the product name and grade, name and address of supplier, date sent, date received, barge, vessel, truck ID number, and lot number. Samples should be stored in a safe, dry place, away from direct sunlight for an appropriate period, generally ninety days. Afterwards, they should be added to the customer's inventory, or disposed of in accordance with all federal, state, and local regulations.

PHYSICAL PROPERTIES

Some of the physical properties of ethylene dichloride are listed below:

Chemical Formula CH_2ClCH_2Cl
CAS number 107-06-2

Names: Ethylene dichloride, 1,2-Dichloroethane, sym-dichloroethane, ethlyene chloride, EDC, Dutch liquid, Dutch oil
Molecular Weight 98.96

Elemental Composition
Carbon 24.27%
Hydrogen 4.07%
Chlorine 71.66%

Flash Point
Open Cup ..... 18°C (64°F)
Closed Cup..... 12.85°C (55°F)

Index of refraction ..... 1.4421 at 25°C
Boiling Point ..... 83.44°C
Freezing Point ..... -35.66°C
Explosive Limits in air ..... 6 - 16%
(volume % at 25°C and 1 Atmosphere)

Density See graph on page 17—Figure 12
Vapor Pressure See graph on page 18—Figure 13
Water Solubility See graph on page 19-Figure 14.

Figure 12: Density Vs. Temperature

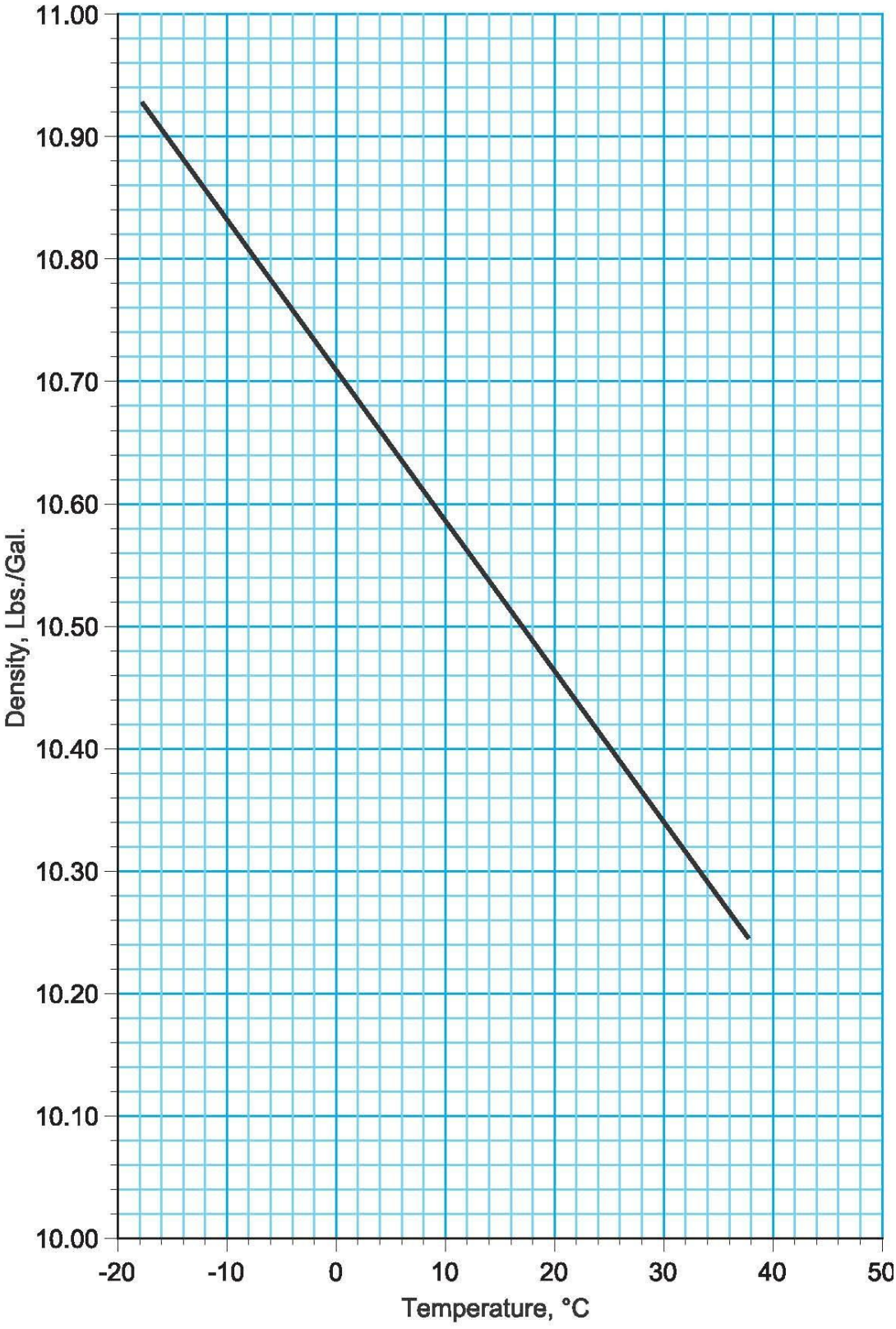


Figure 13: Vapor Pressure Vs. Temperature

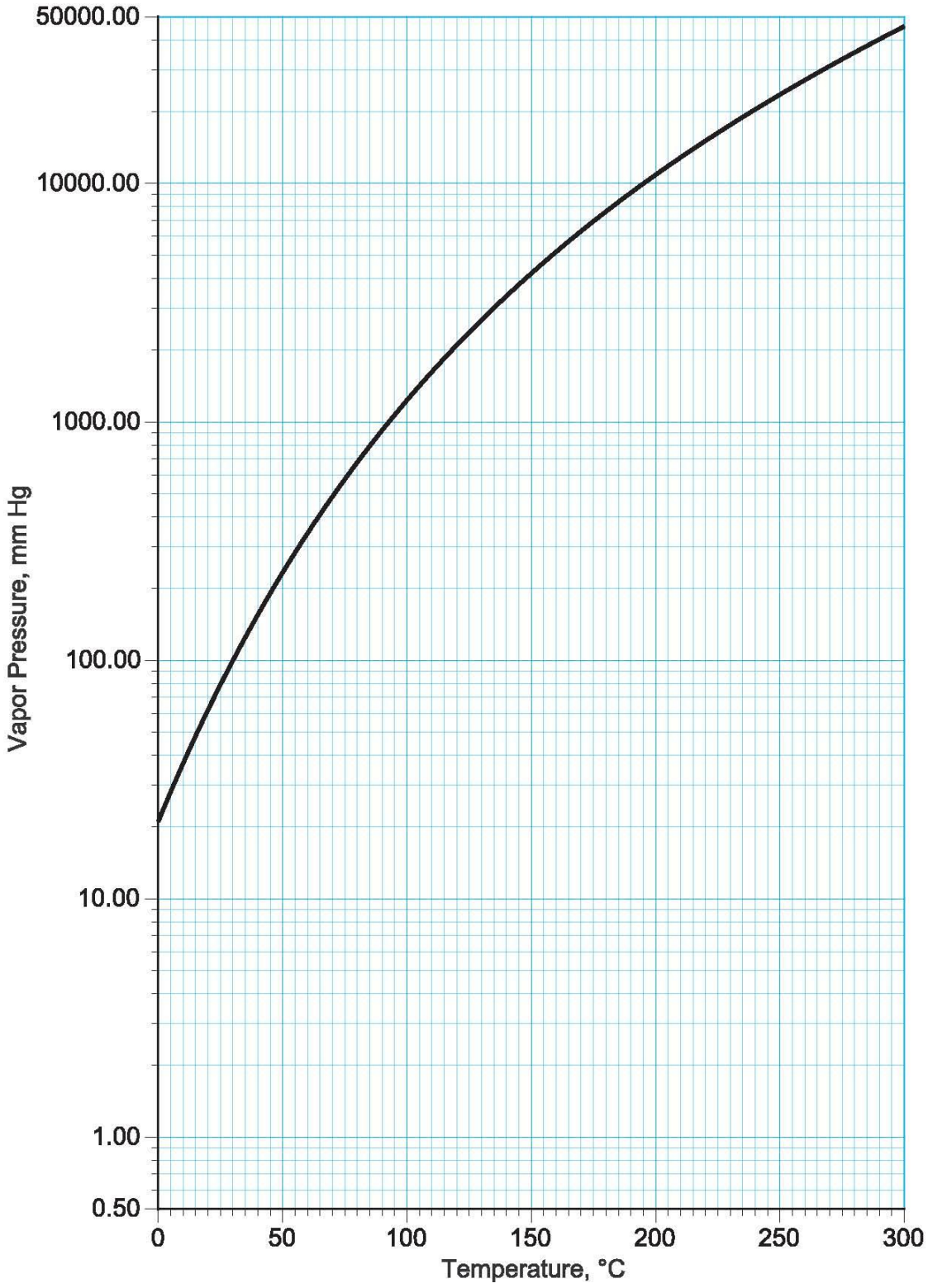
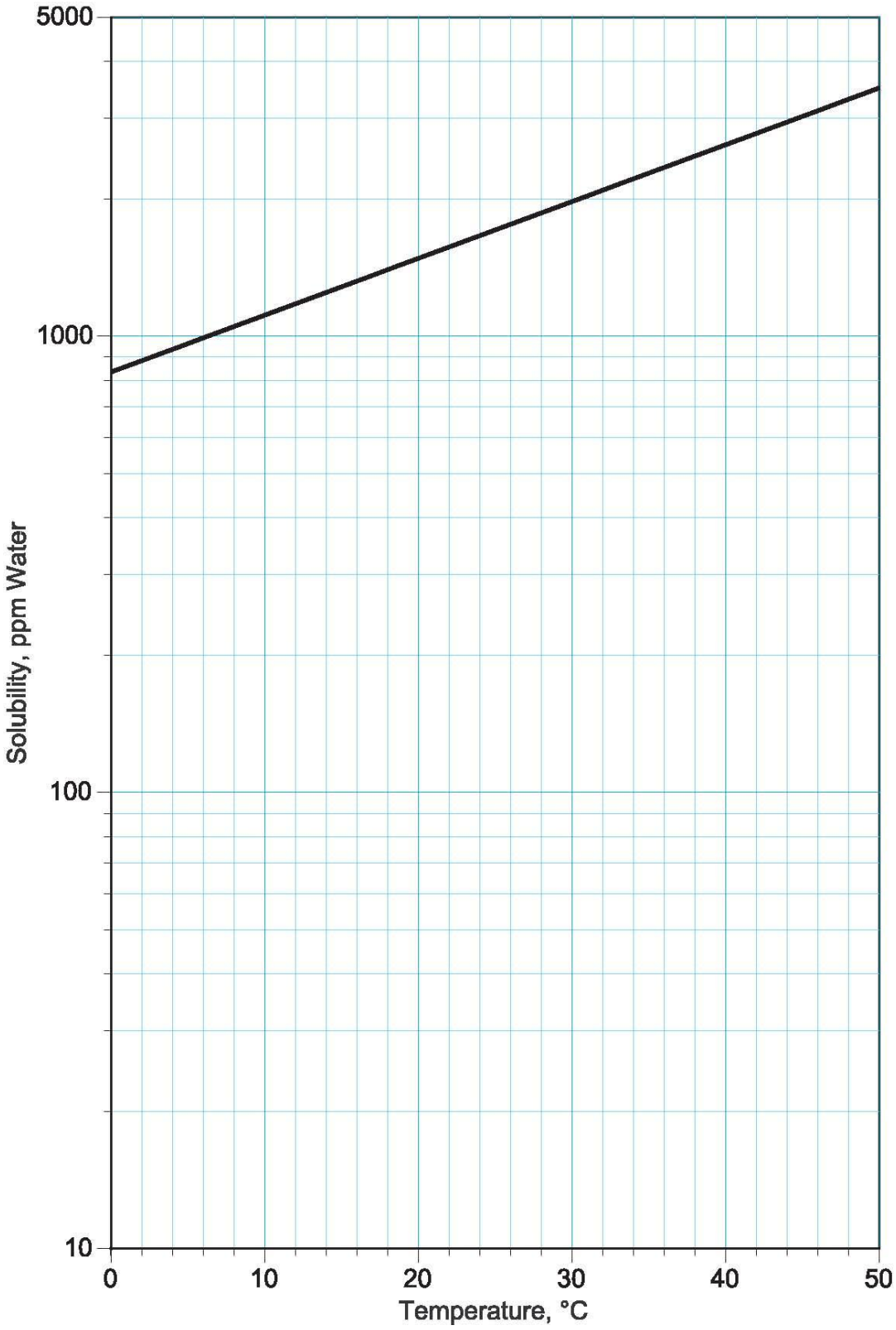


Figure 14: Solubility of Water in EDC Vs. Temperature



FURTHER INFORMATION

More detailed information on EDC or any of its specific applications is available on request through the OxyChem Technical Service Department.

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