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Sodium chlorate (NaClO_3) safe handling and storage

Scope

This TIP provides basic information for personnel to unload and store bulk sodium chlorate (NaClO_3), solid and solution safely. It is vitally important that any new bulk sodium chlorate facility design be undertaken with advice from a producer of sodium chlorate in order to cover all of the unique design parameters for this material. Users of sodium chlorate are urged to comply with these standards and to periodically review their practices to ensure that they remain in compliance.

Definition

Sodium chlorate is delivered to pulp and paper users as a crystalline solid or as a nearly saturated solution in railcars, tank trucks, or barges. Its main use is as a feed chemical for the production of chlorine dioxide (ClO_2) for pulp bleaching. Sodium chlorate is a powerful oxidizing agent that should not be permitted to inadvertently contact organic chemicals, combustible materials, acids, or reducing agents. Provided that contact with incompatible substances does not occur, sodium chlorate is stable in both the solid and liquid forms.

Properties of Sodium Chlorate Crystal

Chemical name	Sodium Chlorate
Common name or synonym	Chloric acid, Sodium Salt, Chlorate of Soda
Formula	NaClO_3
Molecular weight	106.45
Physical State	Crystalline solid
Color	White; may be pale yellow due to impurities
Odor	Odorless
Corrosivity	Mildly corrosive to steel
Solubility	Highly soluble in water. (see below)
Specific Gravity @ 15°C	2.49
Decomposition Point	About 300 °C
Melting Point °C	248 – 261
Specific heat @ 20°C	0.225 cal/g °C
Heat of Solution @ 20°C	
20 wt. % solution	-45 cal/g absorbs heat on dissolving
40 wt. % solution	-38 cal/g

TIP Category: Automatically Periodically Reviewed (Ten-year review)

Properties of Sodium Chlorate in Water Solution

Common Name or synonym	Generator feed solution, chlorate solution		
Physical state	Liquid		
Composition (Typical):	40 to 50 per cent by weight of sodium chlorate and 50 to 60 per cent by weight water with small amount of impurities, mostly sodium chloride		
Color	Clear, colorless to a slight yellowish tint		
Odor	Odorless		
Corrosivity	Mildly corrosive to steel		
Solubility	Highly miscible in water: 101g/100 mL @20 °C		
Temperature °C	0	20	40
g/100 g H ₂ O	80	101	118
Wt. %	44.5	49.1	54.1
S.G. of solution @ 20°C	1.389	1.430	1.472
Boiling Point, °C	103 to 109		
Freezing Point	Crystallizes at about 6°C		
Specific Heat	0.7 cal/g °C @ 20°C and 40 wt. % solution		
pH	7 to 9		

Safety precautions

Identification

Sodium chlorate crystal is identified by:

UN number 1495
CAS registry number 7775-09-9
RTECS number FO0525000
ICSC number 1117
EC number 017-005-00-9.

It is a hazardous, oxidizing substance class 5.1.

Health hazards

Sodium chlorate presents no particular health hazard during ordinary handling operations. Contact with sodium chlorate irritates the eyes, the skin and the respiratory tract. The substance can also be absorbed into the body by inhalation of its aerosol and by ingestion. Ingestion of sodium chlorate may cause negative effects on the blood (hemolysis), DIC (disseminated intravascular coagulation), and multi-organ failure including the kidneys. The effects may be delayed.

Acute oral toxicity is possible. Symptoms of ingestion include nausea, vomiting, abdominal pains, cyanosis diarrhea and dyspnea. If 15-30 g (50 mL of saturated solution) is swallowed or inhaled, it is toxic, and it can be fatal. Death generally occurs from massive intravascular hemolysis and acute renal failure.

General safety precautions

The most important safety precaution to take when dealing with sodium chlorate is to prevent it from contacting combustible materials, organics, acids, or reducing agents.

Combustible materials such as wood, leather, and cotton can spontaneously combust after being splashed with sodium chlorate solution and then allowed to dry.

Sodium chlorate can react with organic contaminants to form shock-sensitive mixtures.

Acids present an additional hazard because when an acid contacts chlorate mixtures, it may generate toxic and/or explosive gases, namely chlorine and chlorine dioxide, on contact.

Incompatible substances of particular danger are: wood, sawdust, cloth, organic materials, organic greases and waxes, paper, acids, sulfur, sulfites, bisulfites, sulfides, alcohols, lint, packing materials, phosphorus, solvents, ammonium compounds, copper materials, metal salts, paint, powdered metals, foodstuffs, sugars, oils, and fats.

Personal protective equipment

Wear appropriate protective clothing when working near sodium chlorate. Have the following equipment available:

- Impervious coveralls and jacket (made of vinyl, neoprene, or PVC) that fit snugly at the neck. Place the jacket sleeves and trouser legs outside to keep solution from running into the gloves and boots. Do not tuck the jacket in.
- Steel-toed rubber boots.
- Rubber or neoprene gloves. The gloves should be loose-fitting for ease of removal in case the sodium chlorate does get inside.
- Close-fitting, splash-proof monogoggles with safety glasses at all times. When appropriate, use a face shield in addition to monogoggles to protect the face from splashing.
- A hard hat as it protects against overhead drips or spills.
- Note that scalding may result from hot solution and applicable personal protective equipment (PPE) must be worn.

Remove and wash contaminated clothing promptly. Leather boots and gloves are not recommended for working with sodium chlorate. Destroy them if they are contaminated with sodium chlorate. Contaminated material must be decontaminated prior to disposal.

Safety equipment

Well-marked safety showers and eye wash fountains should be readily accessible and inside a nearby heated structure. Water lines should be tested frequently and the water supply must be tempered (close to body temperature). Turning on either the shower or the eyewash should trigger an alarm to summon help.

Clear and safe access to the top hatches on a rail car is necessary for unloading. Fall protection should be supplied as part of the unloading station design. The top ports on rail cars may be equipped with metal cross bars to prevent personnel from being able to fall into the car being unloaded.

After unloading a rail car, the chemical unloader, still dressed in his/her safety gear should shower off with fresh water to remove all residual chlorate prior to leaving the area.

First aid

If sodium chlorate comes in contact with the skin, immediately flush the affected area with water for at least 15 minutes. If skin irritation continues after washing, obtain medical attention. When using a safety shower, activate the shower immediately while removing clothing. Clothing contaminated with chlorate should be kept wet. Contaminated clothing must not be worn home or to other areas of the work environment. Wash clothing before reuse.

For sodium chlorate solution contact involving only the eyes, use the eyewash fountain. Hold the eyelids apart and irrigate eyes and surrounding areas for at least 15 minutes. If irritation continues after eye washing, obtain medical attention immediately. Contact lenses should not be worn while working with this chemical.

Note that scalding may result from contact with hot solution.