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INTRODUCTION

Sodium hypochlorite is a clear pale greenish yellow solution produced by a carefully controlled reaction of chlorine with caustic soda lye ($\text{Cl}_2 + 2\text{NaOH} \rightarrow \text{NaOCl} + \text{NaCl} + \text{H}_2\text{O}$).

The value of hypochlorite solutions as bleaches, deodorants, disinfectants and chemical reagents has long been recognised for its wide application both in industry and in the home. A solution of sodium hypochlorite is a safe and convenient way to chlorinate water for drinking purposes, in swimming pools and to control biological growth in cooling water systems. The bactericidal and deodorising properties are due to its capacity to destroy disease organisms and oxidise objectionable organic matter even at low concentrations. Sodium hypochlorite is a valuable reagent in chemical processing and is used both in the preparation of other chemicals and to destroy toxic wastes.

Historically hypochlorites are closely linked with chlorine itself. Scheele in 1774 discovered chlorine gas and observed its ability to destroy vegetable colours. A decade later, Berthollet recognised the value of chlorine water as a textile bleach and his efforts to produce a stable solution led to the discovery of hypochlorite by absorbing chlorine in a potash solution.

In 1789 a small works for the manufacture of this solution was established at Javel near Paris and "Eau de Javel" became a household name, which was later retained for the less expensive sodium hypochlorite.

In the following year Charles Tennant of Glasgow produced bleaching powder by reacting chlorine with hydrated lime. This easily transported powder soon stole most of the chlorine bleach market, Tennants' St. Rollox Works was for over half a century the centre for bleaching and powder production. As a result less attention was paid to sodium hypochlorite bleach liquors for over a century, although around 1820 Labarraque reacted chlorine with caustic soda solution and succeeded in producing the product we know today.

With the birth of the electrolytic chlor-alkali industry, around the turn of the last century, came a renewed interest in sodium hypochlorite. In the first instance, dilute hypochlorite solutions were prepared directly by allowing the immediate interaction of the chlorine and caustic soda produced during brine electrolysis. This production of "electrolytic bleach" was superseded by the controlled reaction of chlorine gas with caustic soda liquor and refinements of this operation have led to the modern manufacturing process.

This publication offers advice on systems, equipment and safety procedures to enable sodium hypochlorite to be handled safely and with confidence.

Storage installations should be designed to suit individual requirements. Guidance is given on most important items, but NCP Chlorchem welcomes the opportunity to discuss a customer's needs in detail at an early stage.

In accordance with the policy of NCP Chlorchem, all bulk storage installations must be inspected prior to the first delivery into the installation. The inspection is to check that essential requirements are present, and should not be interpreted as an approval of the installation by NCP Chlorchem. The suitability and safety of the installation is primarily the responsibility of the customer.

Should you be contemplating modifying a system, or installation a new one, we will be happy to provide advice and assistance.

PRODUCT IDENTIFICATION

Technical name and description:	Sodium hypochlorite
Trade Name:	Sodium hypochlorite
Chemical family:	Inorganic hypochlorite
Chemical name:	Sodium hypochlorite
Synonyms:	Javel Water
	Household bleach

Hazard classification

Group II or III Hazardous Substance

Class 8 – Corrosives

SABS 0228 – 1990 The identification and classification of dangerous substances and goods

Danger Group II or III

Labelling requirements : Corrosive

Chemical Abstracts No.: 7681-25-9

Hazchem Code: 2R

UN No.: 1791

Flashpoint: Not applicable

Odour: Strong chlorine odour

pH: Approximately 12

Boiling point: Approximately 110°C

Freezing point: -25°C

Flammability: Not flammable

Oxidising properties: Strong oxidising agent

Solubility – water: 100% m/m

TRADITIONAL APPLICATIONS FOR SODIUM HYPOCHLORITE

- Household bleach and sanitizer.
- Sanitising agent in industrial, institutional, farming and domestic formulated cleaners.
- Bleaching agent in paper and pulp industry.
- Oxidising agent in chemical industry.
- Sanitizer for water and effluent.

MANUFACTURING PROCESS (OCCIDENTAL)

Sodium hypochlorite (soda bleach) solutions can be prepared by reacting chlorine with solutions of caustic soda, soda ash (sodium carbonate), or a combination of caustic soda and soda ash. Soda ash processes produce less stable sodium hypochlorite solutions. For that reason, only the caustic soda processes will be discussed in this handbook.

Potassium hypochlorite, another bleach product, can be produced with the same equipment for production of soda bleach solutions.

As previously stated, chlorine will react with a caustic soda solution to produce sodium hypochlorite according to the following equation:

Chemical Formula - Sodium Hypochlorite

	Chlorine	+ Caustic Soda	→	Sodium Hypochlorite	+ Sodium Chloride	+ Water
Chemical symbol	Cl_2	+ 2NaOH	→	NaOCl	+ NaCl	+ H ₂ O
Molecular Wt.	70.91	+ 2(40.00)	→	74.45	+ 58.45	+ 18.02
Factor	1.00	1.13		1.05	0.82	0.25

PRODUCT SPECIFICATION

Description: Sodium hypochlorite is a clear pale greenish yellow solution.

Density: g/cm³ at 20°C 1,23 Min

Available Chlorine when despatched (Cl₂): % m/v 15 Min

Sodium Hydroxide (NaOH): % m/v 1,5 Max

Stability: When the solution is kept in the dark at a temperature of 20°C to 25°C and tested on the 14th day after date of despatch the available chlorine content shall not be less than 13% m/v. Nevertheless all hypochlorite solutions decompose slowly on standing with the formation of sodium chlorate and sodium chloride with the evolution of some oxygen.

STABILITY OF SODIUM HYPOCHLORITE SOLUTIONS

Sodium hypochlorite solutions decompose on standing. The rate of decomposition can, however, be minimised by selecting the conditions of storage with care. The stability of hypochlorite solutions is dependent upon five major factors:

1. Initial concentration of hypochlorite.
2. Temperature of the solution.
3. Concentration of certain metallic impurities, e.g. iron, copper, nickel and cobalt.
4. Alkalinity, or pH value of the solution.
5. Exposure to light.

Decomposition occurs in two main ways:

- 1) $3\text{NaOCl} \rightarrow 2\text{NaCl} + \text{NaClO}_3$
- 2) $2\text{NaOCl} \rightarrow 2\text{NaCl} + \text{O}_2$

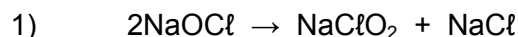
When solutions of good commercial quality are stored in the dark, over 90% of the decomposition takes place via the chlorate forming reaction (1) and 5 – 10% by the oxygen forming reaction (2). If certain metallic impurities are present they greatly accelerate the oxygen releasing reaction. Heat and exposure to light increase the rate of both modes of decomposition.

Commercial solutions of sodium hypochlorite are stabilised by sodium hydroxide. In neutral solutions they decompose rapidly to form sodium chlorate and chloride. In acid solutions chlorine gas is released.

1. Effect of Concentration

The decomposition of aqueous solutions of sodium hypochlorite in the dark to sodium chlorate and sodium chloride is kinetically a second order reaction, i.e. the instantaneous rate is proportional to the square of hypochlorite concentration. Consequently the rate of decomposition falls off rapidly as the solution loses strength.

The reaction takes place in two stages. In the first slow, rate determining step, sodium hypochlorite reacts to form sodium chlorite and sodium chloride.



In the second step, the sodium chlorite reacts rapidly with sodium hypochlorite to form sodium chlorate and sodium chloride.



The rate of decomposition is affected by the ionic strength of the solution. An increase in ionic strength leads to an increase in decomposition rate. All the electrolytes that are present, including the sodium hypochlorite itself, sodium chloride, sodium carbonate and sodium chlorate contribute to the ionic strength.

2. Effect of temperature

Temperature greatly influences the rate of decomposition of sodium hypochlorite solutions. Rises in temperature of 5°C will approximately double the rate of decomposition. The effect of initial concentration and temperature on the decomposition of solution of NCP sodium hypochlorite stored in the dark is shown in Table 1.

3. Effect of metallic impurities

The presence of certain metals or their compounds can greatly reduce the stability of hypochlorite solutions. The most powerful catalysts in promoting the decomposition are iron, nickel, cobalt and copper. Even a fraction of a part per million of one of these metals can cause a measurable increase in decomposition rate.

Iron is not strongly catalytic by itself but it can promote the action of the more highly catalytically metals and can cause discolouration of the liquid.

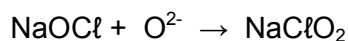
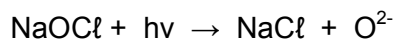
Sodium hypochlorite is manufactured to high standards of purity and the quantity of trace metals present is subject to close analytical control. In order to preserve the stability of the product it is essential to avoid contact with common metals such as iron, copper and nickel and also alloys of these metals, in particular brass and stainless steel.

4. Effect of alkalinity and pH

A slight excess of sodium hydroxide is essential for stabilising sodium hypochlorite solution; sodium carbonate is not effective. A minimum pH of 11 is necessary. In certain applications additional sodium hydroxide may be required, for example, to improve the cleansing action.

5. Effect of Light

Blue and ultra-violet light accelerate the decomposition of hypochlorite solutions by increasing the rate of both the oxygen and chlorate forming reactions. In addition the following reactions leading to the formation of sodium chlorite, also occur during photochemical decomposition.



In strong hypochlorite solutions, sodium chlorite from this reaction reacts rapidly with further hypochlorite to form sodium chlorate:

$\text{NaClO}_2 + \text{NaOCl} \rightarrow \text{NaClO}_3 + \text{NaCl}$ so that only a small portion of sodium chlorite remains. This is usually less than 1 gram per litre. On the other hand, in dilute solutions, the reaction between hypochlorite and chlorite is much slower and appreciable concentrations of chlorite may be found after a period of photochemical decomposition.

When sodium hypochlorite solutions are packaged, using opaque plastic bottles can eliminate the photochemical decomposition.

6. Freezing point of sodium hypochlorite and storage at low temperatures.

Standard commercial sodium hypochlorite contains 14 – 15% m/v available chlorine.

The sodium hypochlorite content as NaOCl is 1.05 x available chlorine and at the time of manufacture the sodium chloride content will be stoichiometrically equivalent to the sodium hypochlorite, viz:



If sodium hypochlorite is manufactured at a concentration of more than 16% available chlorine, salt is precipitated. Salting out should not occur from solutions with 14 – 15% available chlorine at normal temperatures, even after prolonged storage with decomposition to sodium chloride and sodium chlorate.

With cooling there is the possibility of the crystallisation of the pentahydrate $\text{NaOCl} \cdot 5\text{H}_2\text{O}$ at temperatures below -6°C although a wide range of super cooling is possible. Separation of $\text{NaOCl} \cdot 5\text{H}_2\text{O}$ can occur under extreme winter conditions. Complete solidification occurs at -26°C eutectic.

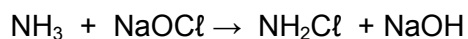
7. Chemical properties

Sodium hypochlorite is decomposed by acids giving a rapid evolution of chlorine gas. Alkalis have no reaction with hypochlorite. Alkali metal hydroxides are frequently used in formulations to act as stabilisers and to improve the cleansing action.

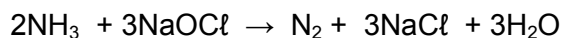
Hypochlorite undergoes exothermic decomposition with sodium or hydrogen peroxide with the liberation of oxygen. Although itself a powerful oxidant, hypochlorite reacts with many oxidising agents to liberate either oxygen or chlorine.

Reducing agents are oxidised exothermically by sodium hypochlorite. Sodium sulphite is oxidised to sulphate by sodium hypochlorite. Since sodium sulphite is widely available it can be used to treat moderate spillages of hypochlorite.

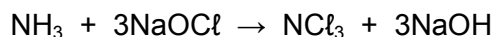
Ammonia reacts strongly with hypochlorite. The products depend upon both the pH of the solution and the ratio of the reactants. In neutral to alkaline solutions and approximately equal proportions of reactants, highly irritating monochloramine is formed:



In neutral or mildly alkaline solutions with an excess of hypochlorite, nitrogen is produced:



In acidic solutions with an excess of hypochlorite, nitrogen trichloride is produced.:



Nitrogen trichloride is a yellow oily liquid immiscible in water and can explode spontaneously.

Violent reactions with hypochlorite can also occur with certain groups of organic compounds. These include, alcohols, glycols, aldehydes, ketones and unsaturated halocarbons and hydrocarbons.

STABILITY OF SODIUM HYPOCHLORITE SOLUTIONS

Temp. °C	Initial concentration available chlorine	Approximate concentration (g/l) after Standing in the dark for:				
	Grams/litre	1 week	2 weeks	4 weeks	6 months	1 year
30	200	156	128	94	24	13
	185	151	128	97	27	15
	160	139	123	100	32	18
	120	112	104	92	40	24
	80	78	75	71	44	31
	40	40	39	38	30	24
25	200	175	155	127	42	24
	185	166	151	127	47	27
	160	149	139	123	54	33
	120	116	113	106	64	44
	80	79	78	76	58	45
	40	40	40	39	35	30
20	200	187	175	155	69	42
	185	175	166	151	75	47
	160	155	150	141	85	58
	120	118	116	113	84	64
	80	80	79	78	68	59
	40	40	40	40	37	35
15	200	193	187	176	105	71
	185	180	176	167	109	78
	160	157	155	150	111	85
	120	119	118	116	100	86
	80	80	80	79	74	69
	40	40	40	40	39	37
10	200	197	193	187	139	106
	185	183	180	176	139	111
	160	158	157	154	126	104
	120	120	119	118	110	102
	80	80	80	80	77	74
	40	40	40	40	39	39

PRODUCT PACKAGING

1. Mini bulk i.e. flow-bins: NCP Chlorchem will fill flow-bins, but flow-bins remain property of the customer.
2. Bulk road tankers: Minimum quantity per delivery - 10 ton.
Maximum quantity per delivery - ? ton.

DELIVERY OF SODIUM HYPOCHLORITE

Road tanker makes deliveries of sodium hypochlorite.

Personnel should be prepared to deal with abnormal situations. The tanker operator normally supervises discharge of product from road tankers. Customers should carefully consider the way that sodium will be received at their facility.

UNLOADING EQUIPMENT

- 1) All rod tankers are fitted with electrical transfer pumps.
- 2) The maximum head is 10m.
- 3) Heights greater than 10m: the customer must provide a discharge or booster pump.

Each tanker has two discharge outlets, i.e. one on either side. The rubber discharge hose is interchangeable.

Each vehicle is equipped with 5m of 50cm bore flexible hose with a standard flange.

DRIVER'S INSTRUCTIONS FOR DISCHARGE (Road Deliveries)

A typical set of instructions to the Tanker Services driver for discharge by transfer pump is indicated below. In the interest of safety it is strongly advised that customers ensure that the responsible person follow these recommendations.

1. On arrival the driver will report to the customer's responsible person.
2. The customer's responsible person will indicate the filling point at which the discharge is required.
3. The driver will position his vehicle safely and apply the hand brake. If the vehicle is on a slope, chocks must be used.
4. The driver will connect the flexible hose to the filling point. These are flange to flange connections, all eight bolts and rubber gasket must be used.
5. The customer's responsible person will sign the delivery note in the space provided to confirm that:
 - a) The receiving installation is in order and can take the quantity to be delivered.
 - b) The tanker is connected to the correct inlet valve.
 - c) The receiving inlet valve is open and the consignment may now be discharged.
 - d) There are no inflammable vapours within the discharge area.

The customer's responsible person must be available continuously during the discharge. We would recommend that the customer's responsible person wear full protective clothing, but that as a minimum requirement the responsible person concerned must wear goggles and rubber gloves during the discharge and subsequent operations. The driver will wear full protective clothing with which he is provided (full face protection, rubber gloves, jacket, trousers and rubber boots). As a safety precaution it is advisable that at all times during off-loading, water is running from a water hose adjacent to the unloading point.

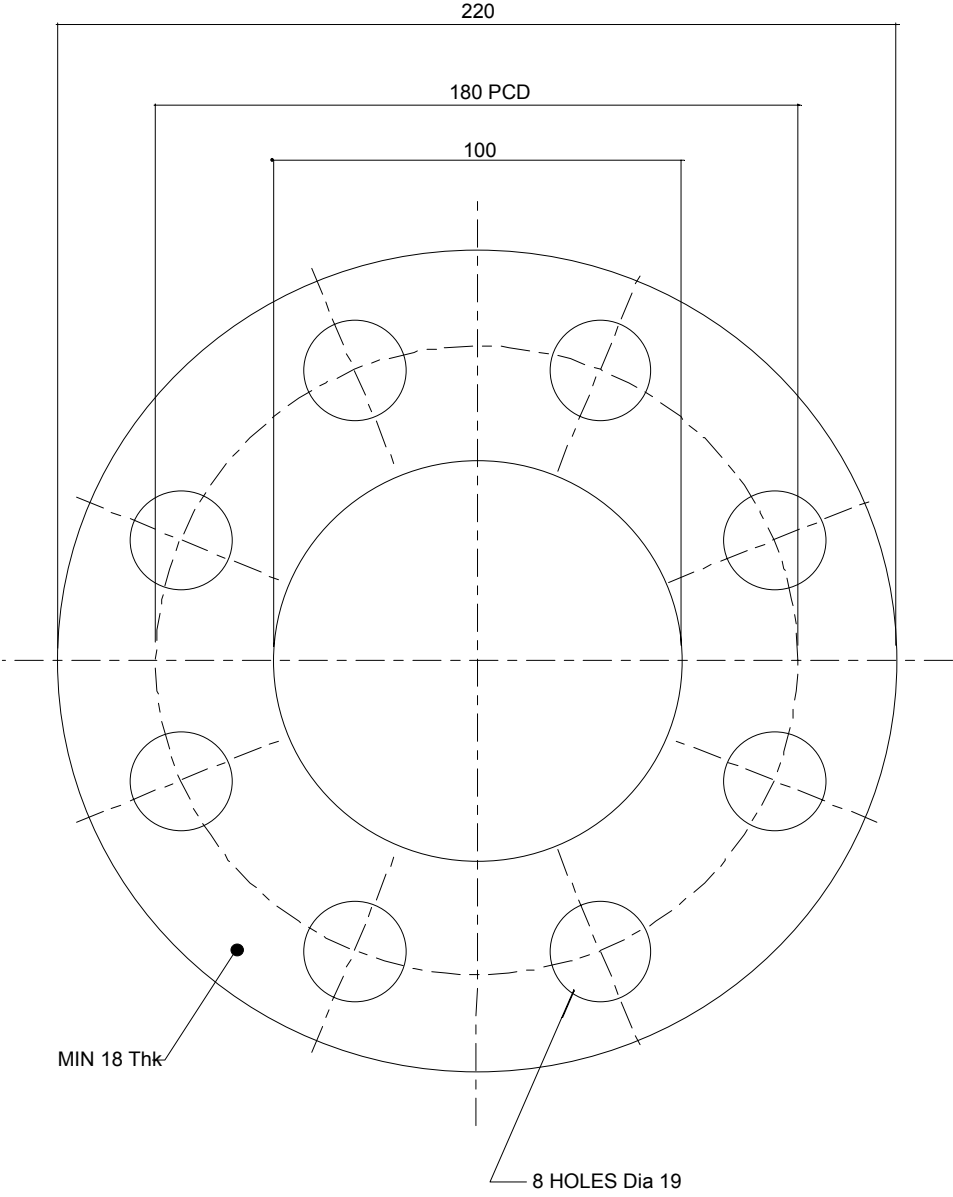
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6. The driver will open both outlet valve and the non-return valve on the tanker and start the pump. If the sodium hypochlorite does not discharge the pump must be shut-off and the outlet valves closed before taking action.
 7. At the end of the discharge the transfer pump must be switched off.
 8. The driver will close the tanker's outlet and non-return valve and the drain valve on the unloading point and the customer's responsible person will close the inlet valve.
 9. The driver will place a suitable container provided by the customer beneath the drain valve on the unloading point, and by opening this valve and raising the flexible hose, drain any sodium hypochlorite remaining into the container. The customer's responsible person will then dispose of the drainings in a responsible manner.
 10. The driver will close the tanker's outlet and non-return valve and the drain valve on the unloading point and the customer's representative will close the inlet valve.
 11. The driver will then disconnect the flexible hose, replace the stoppers in the hose and returning it to its housing on the tanker and securing it. The drains should then be flushed clear with water.
 12. The driver will request a further signature from the customer's responsible person, on the two delivery notes to certify that the load has been received in a satisfactory condition. The driver will then give one copy of the delivery note to the customer's responsible person for retention.

OVERFLOW FROM BULK TANK

If during discharge, the stock tank being filled should overflow, the driver is responsible for the immediate closing of the tanker outlet valve, and will then stop the transfer pump as soon as possible.

Coupling Flange - NCP

REV.		SIGN.	DATE	REVISIONS		REFERENCE DRAWINGS	



NOTE : FLANGE FACE TO BE RUBBER LINED
RAISED FACE FLANGES ARE NOT ACCEPTABLE

DRWN : J MIDDLETON	DEPT : INDUSTRIAL CHEMICALS	REFERENCE NUMBER	
DATE : JUNE 1999	SECTION : MODDERFONTEIN DEPOT	HYPO.TCW	
SCALE: DNS	TITLE : SODIUM HYPOCHLORITE	REV.	
	Coupling Flange - NCP		

DISCHARGE OF SODIUM HYPOCHLORITE

GENERAL

At present NCP Chlorchem delivers sodium hypochlorite in road tankers. The product is discharged via a transfer pump.

CUSTOMER RESPONSIBILITY

Note: The customer's responsible person must be available during discharge.

Refer: Driver's instruction for discharge.

DISCHARGE DANGERS

A critical period for sodium hypochlorite spillage to occur is during the off-loading procedure. Reasons for this being:

- 1) Piping not correctly secured which may fail under pressure.
- 2) Joint failure.
- 3) Gasket failure.

LEAKS & SPRAYS

A leak caused by flange failure is the more common type of leak.

Because the product is normally under pressure it sprays in all directions and is capable of covering a large area.

Many injuries result from operators having to move into the danger area to switch off the controls. It is therefore important that all equipment be easily accessible and clear of potential leaks/sprays.

ACCESS FOR TANKERS

Vehicles are approximately:

15 m in length

3,3 m in height

2,25 m in width

- 1) Access for vehicles of this size should be kept clear at all times.
- 2) Adequate room to manoeuvre the tanker must be available.
- 3) An overhead clearance height of 4,5m is required.

HAZARDOUS CHEMICAL LABELLING

Hazardous Substances Act

- 1) Hazchem labels are displayed on the rear and the sides of tankers to identify the material being transported. These labels may be placed on customer vessels for safety and identification.
- 2) Hazchem labels are available from NCP Chlorchem for use as bulk tank identification markers.

Safety Wall Charts

These are available from NCP Chlorchem and must be prominently displayed at all points where sodium hypochlorite is used or handled.

STORAGE INSTALLATIONS

MATERIALS OF CONSTRUCTION

Suitable Materials

Rubber-lined carbon steel, fibre reinforced plastic (FRP), rigid PVC reinforced FRP, RFP lined steel, HDPE/LLDPE rotary moulded are the most commonly used corrosion-resistant materials of construction. Steel tanks lined with plastic, glass and ceramic tiles have also been used.

(Suitable metals such as Hastelloy B. may be used, but it is not always financially viable).

Customers with an average to high off-take should look to rubber-lined steel tanks. However they do have some disadvantages:

1. Subject to external corrosion.
2. Difficult to detect lining failure.
3. Expensive and difficult to repair.
4. High cost.

Unsuitable Materials

Very corrosive to most metals.

HANDLING PRECAUTIONS

1. Liquid sodium hypochlorite makes floor slippery. Serious falls and injuries, complicated by sodium hypochlorite burns, may result if sodium hypochlorite is not immediately cleaned from floors. Sodium hypochlorite can be diluted by the application of large quantities of water. Make sure that waste sodium hypochlorite or products of neutralisation are not discharged directly into sewers or streams in violation of local requirements.
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2. Avoid bodily contact with any form of sodium hypochlorite. It must be immediately flushed from any part of the body (see First Aid section). Remove garments wet with sodium hypochlorite solution as quickly as possible.
 3. Do not mix sodium hypochlorite with water or acids except under the direction of a responsible person. The reaction is excessive and the boiling point may be exceeded, causing spattering. Use hot water with care.
 4. Know the location of the nearest shower and eyewash fountain.

Requirements of Bulk Installations

Storage installation should be designed to suit individual requirements. Sodium hypochlorite should be handled as a toxic and corrosive product.

Note: Any storage site requires the following parts to successfully handle and store sodium hypochlorite safely and deal with any hazards which may arise.

- 1) Easy access.
- 2) Bulk tanks.
- 3) Spillage area.
- 4) Bund.
- 5) Shower.
- 6) First aid equipment.
- 7) Water hose.
- 8) Respirators

Bulk tank requirements

Minimum requirements:

- 1) Discharge Line.
 - 2) Process Pipework.
 - 3) Level indicator.
 - 4) Vent.
 - 5) Overflow.
 - 6) Drain outlets.
 - 7) Tank manhole.
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Spillage area

Sodium hypochlorite is extremely corrosive to concrete and tar. Concrete surfaces should be protected with an epoxy or similar surface liner. Storage vessels should be erected inside a bund, which forms part of a spillage area.

Note: A bund is not a storage area. Leaks, spills or sprays during off-loading must be contained. Product must not be allowed to spill into the drainage network.

Bund arrangement

Whenever possible, stock tanks should be located inside a bund wall. The bund should be capable to containing 110% of the capacity of the largest tank within the bund. Chemicals, which react together, should not be stored within the same bund, e.g. sodium hypochlorite and hydrochloric acid. The base of the bund should be concrete and sloped to one end where a sump should be located to collect rainwater, or in the event of a bulk tank overflow, the chemical. Some means should be provided for emptying the sump, i.e. small hand pump or a pipeline sealed into the bund with a valve on the outside.

Stock Tank Capacity

- 1) The storage capacity of the bulk tank should be one week's usage plus one normal delivery.
- 2) A minimum capacity of approximately 20 tons is recommended.

Foundations

Concrete coated with PVC compound, protected by dense fair-faced engineering brick, laid in silicate cement.

Structure

- 1) Plastic tanks bedded on sand or seated on timber planks.
- 2) Steel or timber.
- 3) Steel tanks to be elevated on frame or structures to allow inspection.
- 4) Three coats of Dulux Factory tar will protect steelwork.

SAFETY EQUIPMENT

All bulk tank installations should be equipped with the following:

- 1) Safety showers.
 - 2) Hose pipes.
 - 3) Eye baths or bubble fountains.
 - 4) Respirators.
 - 5) Safety wall charts.
-

6) First aid equipment plus instructions.

- Note:**
- a) Equipment must be correctly maintained.
 - b) Personnel must be trained to operate the safety equipment.
 - c) Safety equipment must be visible from all points.

VENT AND OVERFLOW ARRANGEMENT

Bulk storage tanks should be adequately vented.

The design of the vent/overflow arrangement will depend upon the material of construction of the tank and the design of the tank.

General recommendations are:

- a) Vertical rubber-lined carbon steel tanks, plus all types of plastic tanks, should have separate vent and overflow lines. A lowest point discharge line is recommended for complete drainage.

The overflow lines should be at least 100 mm diameter, and should be located on the side of the tank away from the inlet line. The overflow line should be extended down inside the bund and arranged to cause the minimum amount of splashing. The overflow line should be luted if a vent scrubber is fitted to the tank.

The vent line must be at least 150 mm diameter, and located on the top of the tank away from the inlet line. As a minimum requirement, the vent line should point vertically upwards and be fitted with a weather cowl, or be turned through 180°.

There must be adequate disengagement space of at least 350 mm between the level of the overflow line and the level of the vent.

- b) Horizontal rubber lined carbon steel tanks, and all plastic tanks designed to withstand a pressure of 2.1 bar gauge (30 psig) in accordance with BS.5500:1985, should have as a minimum requirement an 80 mm diameter combined vent/overflow line. The line should be taken off vertically from the top of the tank and then turned through 180° and extended down inside the bund in order to confine any spray, which may ensure from it at the end of the discharge. A small anti-vacuum hole (6mm diameter) should be drilled in the vent line, facing the tank and just above bund wall level, to prevent the tank being put under vacuum conditions should the end of the vent line become sealed (i.e. excessive level of rain water in the bund could possible cover the end of the vent line).

Gaskets

Gaskets should comprise chemically resistant natural rubber or PTFE.

LEVEL INDICATION

ALL STOCK TANKS SHOULD BE FITTED WITH A LEVEL INDICATOR.

Polymer tanks can be fitted with a suitable sight panel, which is well protected.

Other suitable level indication equipment:

1. Sight glass.
2. Dip tube pneumaticator (FRP or Polypropylene).
3. D.P. cell.
4. Hydrostatic gauge.

Note: Level indicators should be visible from the loading point.

PROCESS PIPEWORK

1. Unplasticised PVC.
2. PVC reinforced with fibreglass.
3. Rubber-lined mild steel.
4. Polyethylene.
5. Non-metallic pipes have the advantage of not requiring painting, but may be more costly to support.

Natural rubber gaskets are recommended for flanged joints. The use of other materials that may be considered suitable should be discussed with the bulk tank supplier before use.

For small installations, piping manufactured from polymer materials have the advantage of:

1. Low cost.
2. Simplicity of fitting.
3. Readily available.

Rubber lined steel while satisfactory has the following disadvantages:

1. Expensive to repair.
2. Subject to external corrosion.
3. Difficult to detect failure of linings.
4. High costs.

Caution: All pipe work must be well supported.

Pumps

1. Centrifugal pumps of rubber lined cast iron or suitable plastic construction.
 2. Braided PTFE should be used for packed glands.
 3. Mechanical seals of corrosion resistant material must be used.
 4. Magnetically driven pumps suitable for all plastic construction are also recommended.
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VALVES

1. Plastic valves.
2. Saunders Ebonite Line Q diaphragm.
3. Rubber or glass lined valves.

CLEANING OF BULK TANKS

Stock tanks, particularly carbon steel tanks, may require cleaning after a period of years. First drain the tank as thoroughly as possible using a system, which enables the drainings to be returned to the process. Positively isolate all tank connections by disconnection from the sodium hypochlorite system. A large plastic bucket should be placed under the drain point to catch any waste material. The tank should then be filled twice with water, settled and drain slowly via the effluent system.

The tank should then be air purged. Personnel entering the tank must be given clearance in accordance with the factories act i.e. safe entries into vessels. Personnel entering the tank must wear breathing apparatus and full protective clothing. After use, this clothing must be washed. The tank wall should be hosed down and any residue brushed through the drain point to effluent.

ACCIDENTAL RELEASE MEASURES

CLEAN-UP METHODS

Small spills

1. Personnel responsible for cleaning-up the spill must wear protective clothing i.e. an approved respirator, face shield, rubber boots and rubber gloves.
2. Contain the spill and soak up with absorbent material that does not react with spilled chemical. (Earth, sand or absorbent material).
3. Put material in suitable, covered, labelled containers.
4. Neutralise spill area with sodium sulphite or soda ash and flush area with water.
5. Do not get water inside containers.
6. Contaminated absorbent material may pose the same hazards as the spilled product.
7. Wash all contaminated clothing before re-use.

Large spills

1. Avoid contact with spilled material. All personnel involved must wear goggles, rubber boots, rubber gloves, protective clothing, and an approved respirator.
 2. Keep upwind and out of low areas.
 3. Avoid inhaling vapour.
 4. Prevent material from entering sewers, waterways, confined spaces or surface water.
 5. Stop or reduce leak if it can be done without risk.
 6. Recover spilled sodium hypochlorite if feasible.
 7. Contain spill with earth, sand, ash or other inert absorbent material which does not react with spilled material. Never use combustibles such as sawdust to absorb and contain a leak or spill.
 8. Collect material in suitable, covered, labelled polyethylene containers.
 9. Dispose of contaminated product and materials used in cleaning in a manner approved by local regulatory authorities.
 10. After removal, neutralise spill area with large amounts of water to an approved effluent system. Take care not to mix with other reactive materials.
 11. Water fog or spray may be necessary to knock down vapours.
 12. Contact fire, emergency services and supplier for additional advice **Emergency No. (011) 976-2115.**
 13. B.A. sets may also be required depending on the density of the fumes emitted.
 14. Notify Government Occupational Health & Safety and Environmental Authorities.
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SAFE HANDLING OF SODIUM HYPOCHLORITE

When handling sodium hypochlorite the proper equipment must be used and the correct clothing must be worn.

Special attention must be given to safe working conditions and safe working practices must be implemented. Operators should be familiar with:

1. The hazards surrounding of sodium hypochlorite.
2. Proper emergency procedures.
3. First Aid.
4. Safety equipment.

PERSONAL PROTECTION

Respiratory

Use NIOSH approved canister type respirators suitable for chlorine. Full respiratory protection (including self-contained breathing apparatus) should be readily available in case of an emergency.

Hand

Neoprene, Viton or butyl rubber gloves.

Eye

Gas-tight chemical safety goggles. Where there is any possibility of splashing or spraying of sodium hypochlorite wear a face shield/chemical splash goggle combination.

Skin

Impervious gloves, coveralls, boots, and/or other resistant protective clothing to prevent all possible skin contact. Neoprene, Viton and butyl rubber are suitable materials for protective clothing. An impervious acid-resistant full-body encapsulating suit and respiratory protection may be required in some operations. Have a safety shower/eye-wash fountain readily available in the immediate work area.

Resistance of Protective Clothing

Resistance	Protective Clothing
EXCELLENT	Neoprene, nitrile blended polyvinyl chloride (PVC).
GOOD	Chlorinated polyethylene, viton coated neoprene, natural rubber, nitrile, Viten Saranex, butyl coated neoprene, chlorobutyl, polycarbonate, neoprene blended PVC, styrene-butadiene rubber (SBR).
FAIR/POOR	PVC, polyurethane, neoprene blended SBR, SBR coated neoprene.

FIRST AID MEASURES

Physiological Properties:

Sodium hypochlorite solution is corrosive to human tissues. If swallowed it can cause severe local burns to the mouth, throat and digestive tract. Contact with the skin causes burns unless washed off promptly. Contact of the solution with the eye causes severe burns, which will result in permanent eye damage unless it is removed immediately. Prolonged inhalation of the vapour given off by sodium hypochlorite solution, particularly if the sodium hypochlorite has been contaminated, will lead to irritation of the respiratory tract. The vapour may also cause irritation of the eyes.

First Aid Comment:

Consult a physician and/or the nearest Poison Control Centre for all exposures except minor instances of inhalation or skin contact.

Product in Eye

Immediately flush the contaminated eye(s) with gently flowing water for at least 30 minutes, holding the eyelid(s) open. Neutral saline solution may be used as soon as it is available. DO NOT INTERRUPT FLUSHING. If necessary, keep emergency vehicle waiting. Take care not to rinse contaminated water into the non-affected eye. If irritation persists, repeat flushing. The victim should be transported to hospital as soon as possible.

Product on Skin

Remove contaminated clothing immediately, drench the contaminated area with running water for at least 30 minutes. DO NOT INTERRUPT FLUSHING. If necessary keep emergency vehicle waiting. Transport victim to hospital as soon as possible. Completely decontaminate clothing, shoes and leather goods before re-use or discard.

Product ingested

Never give anything by mouth if victim is rapidly losing consciousness, or is unconscious or convulsing. Have victim rinse mouth thoroughly with water. DO NOT INDUCE VOMITING. Give victim approximately 300 ml of water (1 cup). If vomiting occurs naturally, have victim lean forward to reduce risk of aspiration. Repeat administration of water. Transport victim to hospital as soon as possible.

Product inhaled

Take proper precautions to ensure you own safety before attempting rescue; e.g., wear appropriate protective equipment, use the "buddy" system. Remove source of contamination or move victim to fresh air. If unconscious, do not give anything to drink, give artificial respiration and chest compression or place in the recovery position as necessary. If conscious make the casualty lie or sit down quietly, give medical oxygen if available. Lung congestion may occur – a conscious casualty with breathing difficulties should be placed in a sitting position. Immediately transport victim to an emergency medical facility. Symptoms may be delayed up to 48 hours after exposure.

Traumatic shock

The person administering first aid must say alert to traumatic shock of the patient. Traumatic shock can follow serious injury.

Signs of Shock

1. Pale, moist, cool skin.
2. Shallow, irregular breathing.
3. Weak pulse.
4. Perspiration – lips, forehead, palms and armpits.

Shock should be treated by lying the patient down and keeping the patient as warm and as comfortable as possible. The patients feet may be raised approximately 30 centimetres from the surface; unless, a head injury has occurred, or the patient complains of added discomfort.

ACCIDENTAL GENERATION OF CHLORINE GAS

The production of chlorine gas at a sodium hypochlorite installation would normally only occur if an acid was inadvertently mixed with the sodium hypochlorite. Provided adequate precautions are taken to prevent such an occurrence, the potential hazard from chlorine will be minimal. However, should chlorine be released, the effects could be serious, which is why the sodium hypochlorite user should be aware of its effects.

Physiological properties of chlorine

Up to approximately 1,000 ppm v/v the gas is invisible becoming more visible as a green gas as the concentration increases. Chlorine is toxic by inhalation and causes difficulty in breathing even at low concentrations. 1 ppm v/v is just detectable by smell. Exposure to levels greater than 3 – 6 ppm v/v irritation of the eyes, nose, throat and respiratory passages with coughing, sneezing, wheezing and shortness of breath. 15 – 20 ppm v/v induces immediate distress and may cause damage to the lungs (pneumonitis and pulmonary oedema). Higher concentrations are very dangerous and can be fatal within a short period. These effects may be delayed following over-exposure.

Emergency procedure for chlorine gas release

1. Move away from the affected area and remove any clothing, which has been contaminated by the gas.
 2. Warn people in the vicinity to keep up-wind of the release.
 3. DO NOT enter the affected area unless it is necessary to do so. If it is necessary, self contained breathing apparatus must be worn.
 4. If the situation cannot be controlled, telephone 10111 to obtain assistance from the Fire Brigade and Police. Also notify the emergency services at NCP Chlorchem on emergency telephone (011) 976-2115.
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Treatment

A doctor should examine all persons who have been gassed with chlorine as serious symptoms may develop at a later stage. Until the doctor arrives

1. Immediately

SUMMARY

Bulk delivery vehicles

PRODUCT:	Sodium hypochlorite
FACTORY:	Chloorkop
VEHICLE:	Various
LOAD:	Increments of 6000kg
DISCHARGE FLANGE:	Bottom 50 mm NB Schedule 40 Table 10/3 flange
O.D.:	220 mm
P.C.D.:	180 mm
HOLES:	8
HEIGHT FROM GROUND:	1,0m – 1,3m approx.