

PRODUCT FILE

**NaOH**

**SODIUM HYDROXIDE**

CAS #

1310-73-2

MANAGEMENT OF OCULAR AND  
CUTANEOUS CHEMICAL SPLASHES

2011 EDITION



**PREVOR**

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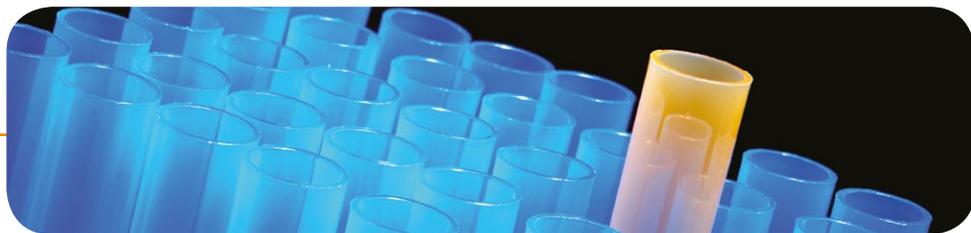


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## SODIUM HYDROXIDE

### MANAGEMENT OF OCULAR AND CUTANEOUS CHEMICAL SPLASHES

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## 1. KEY POINTS

### 1.1. HISTORY

Sodium hydroxide derives from sodium carbonate, formerly named "caustic soda". In Ancient Egypt, sodium carbonate was already mixed with lime to synthesize an alkali: the hydroxide ion  $\text{OH}^-$  in solution with the sodium ion  $\text{Na}^+$ . Through the ages, several processes were developed to synthesize it, such as the Solvay process in 1861. Today, sodium hydroxide is mostly produced by the electrolysis of a solution of sodium chloride.

### 1.2. DÉNOMINATIONS ET FORMULE

- Sodium hydroxide
- Lye
- Caustic soda
- Alkaline drain cleaner (in solution)
- Sodium hydrate
- Ascarite

SODIUM HYDROXIDE	
Formula	NaOH
Molar mass	40 g.mol <sup>-1</sup>
CAS number	1310-73-2
EINECS number	215-185-5
ICSC number <sup>(1)</sup>	0360

### 1.3. USE

Sodium hydroxide is one of the most used chemical substances in laboratory and in industrial environment, in the manufacture of paper pulp and of various chemical products: plastics, synthetic textiles, cleaning products for both domestic and industrial use, in the production of petrol and biodiesel, of soaps or even in the aluminum treatment. It is also a food additive (E524).



## 2. LABELLING

### 2.1. HAZARD LEVELS ACCORDING TO CONCENTRATION

- **EC classification in force until June 2015** for mixtures.

Product included in CLP00<sup>(2)</sup>.

SODIUM HYDROXIDE	HAZARD SYMBOL	RISK PHRASE
Concentration $\geq$ 5%	C	R35
Concentration from 2 to 4,99%	C	R34
Concentration from 0,5 % to 1,99%	Xi	R36/38
Concentration < 0,5%	-	-

*Title of risk phrases (EC classification)*

*R35 : Causes severe burns*

*R34 : Causes burns*

*R36/38 : Irritating to eyes and skin*

- **New labelling according to CLP regulation**, mandatory since December 2010 for substances and from June 2015 for mixtures:



**DANGER !**

H314 Causes severe skin burns and eye damage

SODIUM HYDROXIDE	CLASSIFICATION	HAZARD STATEMENTS
Concentration $\geq$ 5%	Skin corrosion Category 1A	H314
Concentration from 2 to 4,99%	Skin corrosion Category 1B	H314
Concentration from 0,5 % to 1,99%	Skin irritation cat. 2	H315
	Eye Irritation cat. 2	H319
Concentration < 0,5%	-	-

*Hazard statements (CLP regulation)*

*H314: Causes severe skin burns and eye damage*

*H315: Causes skin irritation*

*H319: Causes serious eye irritation*

## 2.2. OTHER CLASSIFICATION: THE AMERICAN CLASSIFICATION

**Red 0** - Flammability: non flammable chemical

**Blue 3** - Hazard to health: short-time exposure may cause temporary or persistent serious lesions

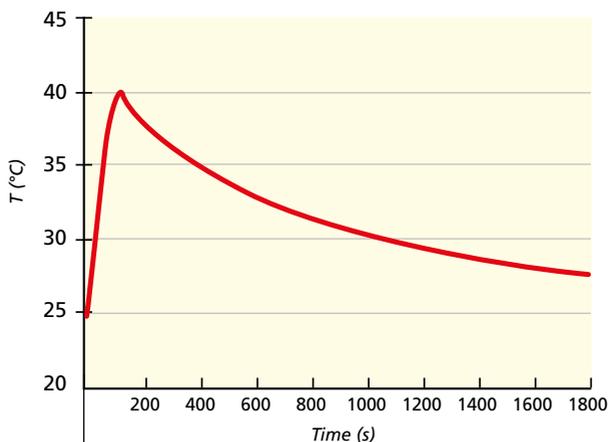
**Yellow 1** - Reactivity: stable in normal conditions, but may become instable under high temperatures or high pressures

**White COR** - Symbol specific to corrosives



## 3. CHEMICAL PROPERTIES

Pure sodium hydroxide is a white solid. It is translucent and very hygroscopic (great ability to attract and hold water molecules). It reacts easily with the water from the air or from any wet surface (phenomenon of deliquescence). The dissolving of caustic soda in water may be accompanied by heat release (*Figure 1*).



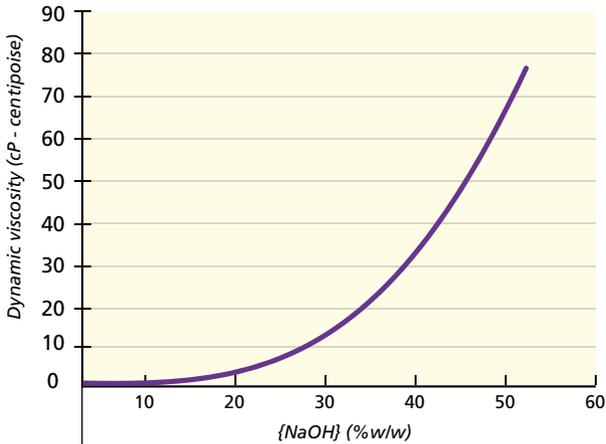
**Figure 1:** Temperature evolution during the dissolving of 1g of sodium hydroxide chips, in water



It is sold as: chips, flakes, granules, blocks, cubes or in aqueous solution. In the industrial environment, the most concentrated liquid form of sodium hydroxide is 50%, but then it is very viscous (Figure 2).

Water	1 cP (centipoise)
24% sodium hydroxide	7,1 cP
50% sodium hydroxide	78 cP
Olive oil	800-1000 cP

*Examples of viscosity at 20°C*



**Figure 2** : Evolution of the viscosity of a sodium hydroxide solution in relation with its concentration - Source: Handbook 87th issue 2006/2007 and Cèdre-2005

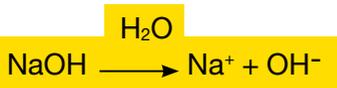
Molar mass	40 g.mol <sup>-1</sup>
Boiling point	1 390°C
Melting point	318°C
Vapour pressure	0,13 kPa at 739°C 2,67 kPa at 953°C 13,3 kPa at 1 111°C 53,3 kPa at 1 286°C
Specific gravity	2,13
Solubility in water (20°C)	109 g/100 mL
VME <sup>(3)</sup>	2 mg/m <sup>3</sup> <sup>(4)</sup>
PEL (TWA) <sup>(5)</sup>	2 mg/m <sup>3</sup>
STEL (TWA) <sup>(6)</sup>	-

Source: Toxicological sheet from INRS and ICSC sheet

## 4. CORROSIVITY OF SODIUM HYDROXIDE

### 4.1. CHEMICAL MECHANISMS

Sodium hydroxide is an alkali (strong base) because it dissociates completely in aqueous environment and thus releases the OH<sup>-</sup> ion.



$$\text{pK}_a = 14,8$$

The carbon dioxide from the air can dissolve in aqueous environment and react with sodium hydroxide to produce carbonates.



3 - French Occupational Exposure Limit

4 - In France, it is an indicative value

5 - Permissible Exposure Limit (Exposure limit value in a 8 hour day allowed by the Occupational Safety Health Administration)

6 - Short-Term Exposure Limit (Limit value for an exposure of less than 15 minutes, according to the OSHA)



The pH of the solution changes and depends on the balance with the  $\text{CO}_2$ ,  $\text{HCO}_3^-$  and  $\text{CO}_3^{2-}$  ions.

Sodium hydroxide oxidizes several metals with the emission of an explosive gas: the dihydrogen ( $\text{H}_2$ ).

For instance, with zinc:



aq: aqueous solution

s: solid form

g: gaseous form

## 4.2. CHEMICAL LESIONS DUE TO SODIUM HYDROXIDE

The great availability and the multiple utilizations of sodium hydroxide, both in the domestic and in the industrial environments, explain the frequency of the risk of accidental or deliberate chemical lesions.

Lesions may damage the skin, the eyes, the digestive system or the respiratory tract.

This file deals with cutaneous and ocular lesions.

The only danger of sodium hydroxide is corrosion /irritation which occurs for concentrations above 0.5%.

### 4.2.1. SKIN EXPOSURE

In contact with skin, sodium hydroxide causes a liquefaction necrosis with the saponification of the liquid cell membranes and the dissolution of the tissue proteins (Palao - 2010).

Lesions are characterized by a brown coloration and a gelatinous appearance. It is associated with pain, the precocity and intensity of which depend on the concentration and the time of contact.

Cutaneous lesions may be terebrant (slow penetration and spreading to the deep skin layers).



**Figure 3:** non-washed caustic soda burn, Source: Dr Lucien Bodson, CHU Liège (Liège University Hospital), Belgium

An *ex vivo* experimental study on human skin explants has enabled to follow the spreading and penetration of 50% caustic soda into skin, thanks to the histological observation of the alterations of the epithelial and dermal cells.

EXPOSURE TIME	OBSERVATION OF THE LESIONS
4 minutes	A clear cleavage appears in the middle of the <i>stratum corneum</i> (SC).
30 minutes	Clear disintegration aspects of the SC, without visible changes in the alive epidermal structure ( <i>Figure 7</i> ).
1 hour	Clear aspects of lysis of the corneocytes membranes (SC cells) in the upper SC layers.
2 - 48 hours	The lysis of the SC is complete and no cellular life is observed in the epidermis and in the papillary dermis (the most superficial part of the sub-epidermal layer - <i>Figure 8</i> ). This aspect remains identical until 48 hours of contact.

**Figure 4:** Chronology of lesion development on the human skin explants after exposure to 50% caustic soda

The very viscous 50% caustic soda penetrates into the *stratum corneum* in which it accumulates and causes clear destruction aspects after 30 minutes and afterwards clear aspects of lysis of the corneocytes membranes after 1 hour. After 2 hours of contact, the penetration of caustic soda into deep layers is massive and from 2 hours of contact, this fast spreading results in the absence of cellular life in the epidermis and in the papillary dermis. The kinetics of lesions evolution due to the exposure to 50% sodium hydroxide is thus very different from what is observed during the exposure to concentrated acids.

With the same model, 70% hydrofluoric acid penetrates fast and deeply within the first minutes of contact (Burgher - 2010).

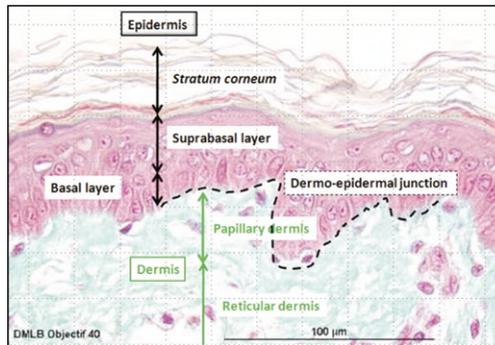


Figure 5: The different skin layers

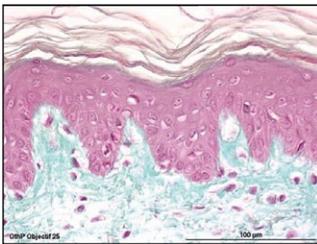


Figure 6: non-exposed skin explant.

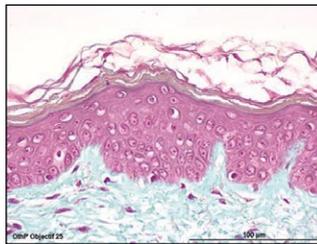


Figure 7: skin explant exposed to 50% NaOH for 30 minutes. The stratum corneum is unstructured.

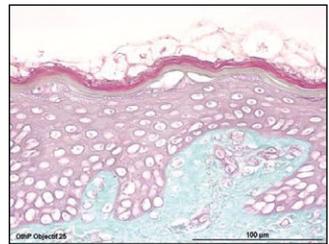


Figure 8: skin explant exposed to 50% NaOH for 2 hours. Cellular death in the epidermis and in the papillary dermis.

An unusual lethal case of splash by concentrated caustic soda under heat (at 95°C) has been published in the literature. The high temperature of the splashed chemical has increased the kinetics of hydroxide ion penetration into skin tissues and has deeply burnt the victim to the bones in some areas of the body. The time of contact of the substance with the body has been estimated approximatively at 13 minutes only. (Lee – 1995)



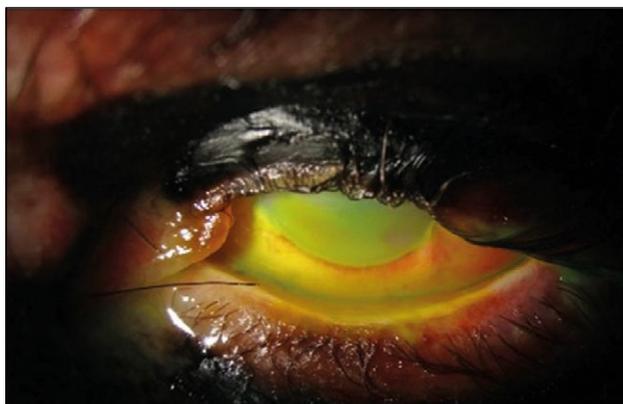
#### 4.2.2. EYE EXPOSURE

Clinically, in contact with sodium hydroxide, the cornea quickly loses its transparency. As it does for skin, the  $\text{OH}^-$  ion saponifies the fatty acids from the membranes and thus immediately causes the corneal epithelial cells death. The continuation of the corrosive spreading through the corneal stroma and to the anterior chamber of the eye can lead to the lens opacification and, in the most severe cases, to the complete destruction of the eyeball (Merle - 2008).

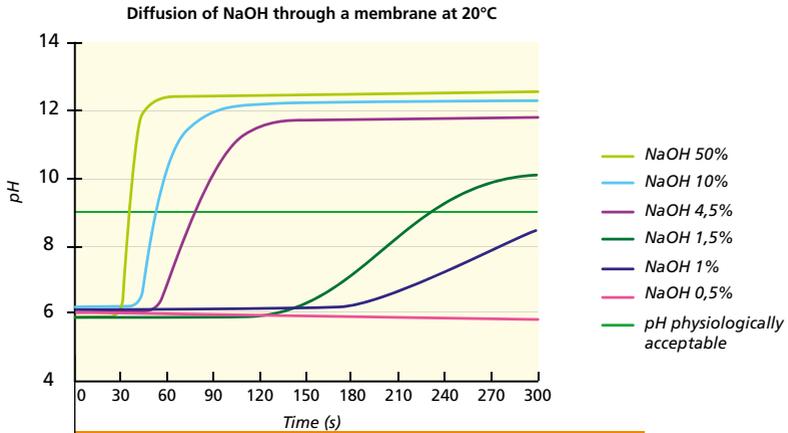
In *ex vivo* or *in vitro* experiments (Figure 10), the sodium hydroxide spreading can be measured in relation with the sodium hydroxide concentration or the time of contact. The higher the concentration of the solution is, the faster the penetration will be.

Thus, a 2 M (2 mol/l) sodium hydroxide solution completely penetrates the cornea within less than 40 seconds (Figure 11). In absence of an efficient and early enough washing, anatomical and functional lesions may be irreversible (Gérard - 1996).

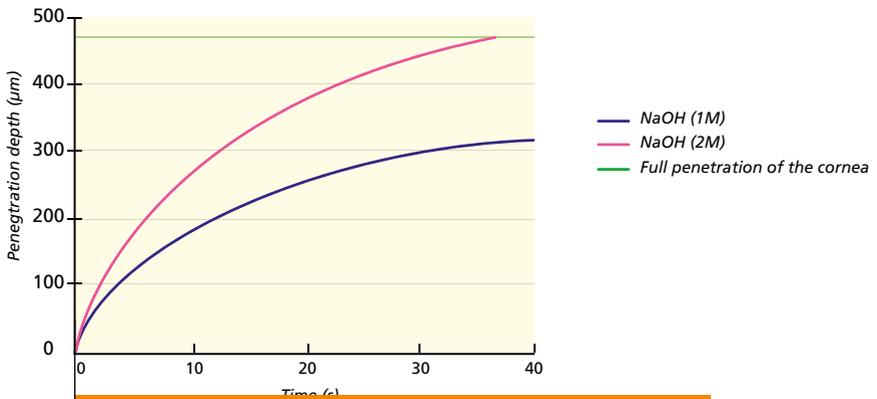
Nevertheless, below a 0.2 mol/l concentration, only a small penetration occurs and it causes no observable lesions. (Schrage – 2010).



**Figure 9** : Picture of ocular lesions due to an alkaline splash: milky and frosty aspect of the cornea. (Source: Pr Norbert Schrage, Aix la Chapelle, Germany)



**Figure 10:** *In vitro* model of the penetration of caustic soda through a semi-permeable membrane in relation with its concentration.



**Figure 11:** Penetration of NaOH through an *ex-vivo* rabbit cornea in relation with its concentration – Observation by OCT-HR<sup>(7)</sup> (Spöler - 2007)

## 5. MANAGEMENT OF THE CHEMICAL RISK DUE TO SODIUM HYDROXIDE

### > COLLECTIVE AND PERSONAL PROTECTIONS<sup>(8)</sup>

<b>COLLECTIVE PROTECTION</b>	<ul style="list-style-type: none"><li>• Capture of the emissions straight from the source</li><li>• Good ventilation</li><li>• Avoiding contact from any metallic object</li><li>• Proceeding to industrial operations in isolation</li></ul>
<b>PERSONAL PROTECTION</b>	<ul style="list-style-type: none"><li>• Face screens, watertight safety glasses, appropriate gloves, lab coat, apron ...</li></ul>

### > COMPATIBILITY TABLE FOR GLOVES

	LATEX	NEOPRENE	NITRILE	VINYLE (PVC)	POLYVINYL ALCOHOL (PVA)
SODIUM HYDROXIDE	+++	+++	+++	++	-

Source: NIOSH – Pocket guide

### > SPECIFIC RECOMMENDATIONS

It is essential that the sodium hydroxide dissolution in water is done progressively and under agitation in order to control a potential exothermic reaction.

## 6. EMERGENCY CARE MANAGEMENT OF A SODIUM HYDROXIDE SPLASH

### 6.1. EVALUATION OF WASHING METHODS

The danger of caustic soda is corrosion. Washing within the first minute of contact allows to avoid or to minimize the extent of the lesions.

Ideally the reactivity of the chemical must be stopped in surface before the product penetrates into the deep layers of the skin or eye. Historically washing with water has been the first significant step for the management of chemical splash.

8 - Report to complete description in INRS Toxicological Sheet #20 (Fiche Toxicologique INRS n°20) or NIOSH pocket guide

In case of an alkali splash, a few publications suggest a specific neutralization by weak acids such as acetic acid (Andrews - 2002). However, this neutralizing effect could be harmful if it is not thoroughly controlled (Falcu / INRS - 1997) (Exothermic reaction due to neutralization – acid burn developing after neutralization of a alkali splash with an acid, for instance).

### 6.1.1. WASHING WITH TAP WATER

Tap water is a polyvalent solution, which removes a big part of the chemical by a sweeping and diluting effect at the surface of tissues. However, washing with tap water requires an early intervention using a very big volume of tap water during a long time (Açikel – 2001, Yano - 1993). The ANSI Z358.1-2004 standard specifies that the showers must be reached within a 10 seconds time limit. Connected to the water supply network the showers must be able to deliver a 60 L/min flow for 15 minutes (European standard: EN 15154 -1).

In case of a splash of concentrated corrosives, tap water has sometimes shown some limitations with the possible development of severe burns due in particular to the lack of chemical action of tap water on the corrosive potential of caustic soda (O'Donoghue – 1996, Ma – 2007). Following washing with tap water, some observations mention the need of surgical operations because of the severity of the lesions resulting from caustic soda splashes (Winder – 1997, Wang – 1992).

### 6.1.2. WASHING WITH DIPHOTERINE®

While it keeps the properties of rinsing with tap water, an active washing allows acting on the chemical directly in order to limit its corrosive effects on the skin or eye.

The physical and chemical properties of Diphoterine® optimize and secure the effectiveness of the rinsing.

- Its amphoteric nature enables an extremely rapid return to the physiologically acceptable zone of pH.
- Its hypertonicity limits the penetration in depth of sodium hydroxide and generates a flow from the inside to the outside of tissues, and thus it attracts to the outside the quantity of chemical substance that might have already penetrated. (Schrage - 2004).
- Thanks to its polyvalence and its innocuity (Hall - 2002, Hall - 2009), Diphoterine® is a premium decontamination solution, even when caustic soda is combined with other corrosives or irritants.



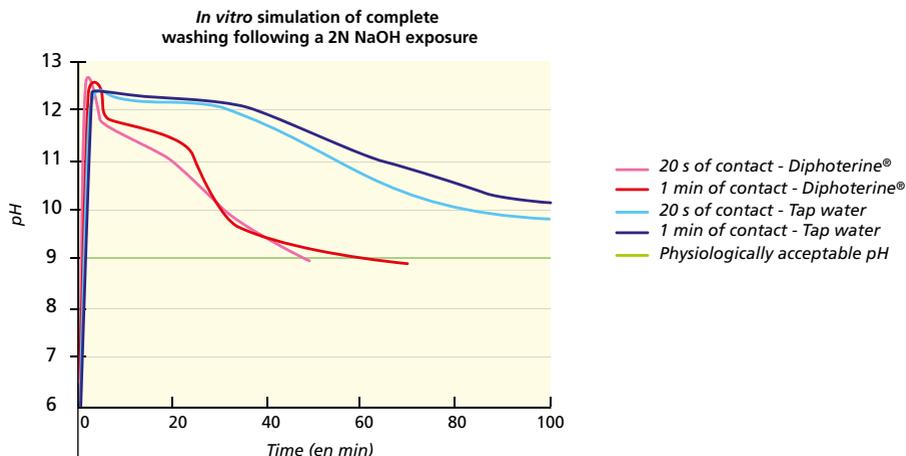
## 6.2. EXPERIMENTAL EVIDENCE OF EFFECTIVENESS

Several *in vitro* and *in vivo* studies have been realized on the interest of rinsing with Diphoterine® *versus* other rinsing methods after exposure to sodium hydroxide.

### 6.2.1 IN VITRO AND IN VIVO EXPERIMENTS

The effectiveness of Diphoterine® is experimentally compared with rinsing with water by an *in vitro* simulation of a splash of (2 mol/L) sodium hydroxide (Blomet - 2008). A model of semi-permeable membrane is used to represent the cornea. The experiment follows the pH evolution from both sides of the membrane, in other words: the external pH corresponding to the pH at the surface of the cornea and the internal pH for the pH of the anterior chamber of the eye (which is simulated by a 14‰ sodium chloride solution, with the same osmolarity as the aqueous humor of the eye).

Two kinds of experiment have been realized with a contact time of 20 seconds and one of 1 minute (Mathieu - 2007). Figure 12 shows the evolution of the internal pH.



**Figure 12:** *In vitro* experiment - Evolution of the internal pH according to time after a (2 mol/L) sodium hydroxide splash rinsed with water (blue curves) or with Diphoterine® (red curves).



For a 20 seconds contact and after 3 minutes of washing, the external pH is respectively 9.12 when using Diphoterine® and 12.8 when using tap water.

After 45 minutes, the internal pH is 9.25 when using the amphoteric solution and 11.5 when using tap water.

For a 1 minute contact, the pH curves follow the same trend as observed for a 20 seconds exposure but with a late decrease of pH. After 60 minutes, the internal pH is 9.4 when using Diphoterine® and 11.85 when using tap water.

Compared to washing with tap water, rinsing with Diphoterine® allows a faster return to physiologically acceptable values of pH, for times of contact of one minute or less.

An experimental study has given evidence of the significant interest of rinsing with Diphoterine® in comparison with washing with tap water or washing with a weak acid solution (Wang - 2009). Two different studies have been performed: a first static *in vitro* study following the evolution of pH and temperature on a 40% sodium hydroxide sample. A second *in vivo* study in rabbit follows the pH evolution and the evolution of the quantity of liquid which is necessary to reach a physiologically acceptable pH about 6-6.5 after a 5s exposure to 40% caustic soda. The temperature and healing time are also monitored.

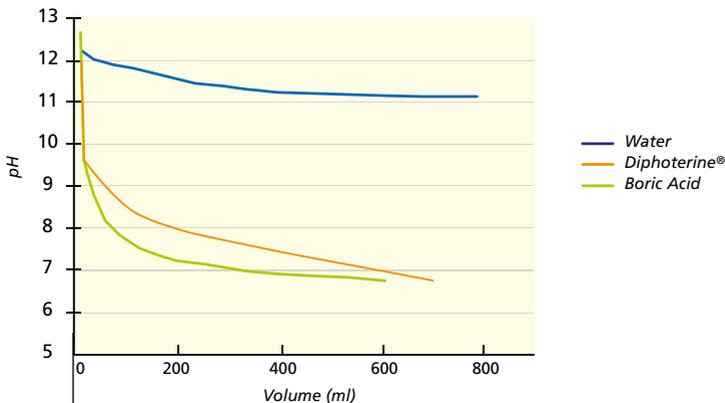


Figure 13: Graph showing the evolution of pH according to the quantity of test solution added to rinse the exposure to 40% NaOH

Diphoterine® is the only solution allowing a rapid return to a physiologically acceptable pH with no increase of temperature.

When rinsing with a weak acid solution, there is also a fast decrease of pH but it is combined with an increase of temperature (up to 37 °C).

When adding the same volume of water, the pH remains high (the temperature increases up to 31.5 °C for a 25 °C normal temperature).

*In vivo*, the healing time is shorter with Diphoterine® (12 days) than with other tested solutions (16 days when using a weak acid and 21 days for water).

### 6.2.2 EX VIVO EXPERIMENTS

The interest of rinsing with Diphoterine® was also shown by an *ex vivo* study on rabbit cornea using the EVEIT model (Spöler – 2007). The corneas were exposed to 1 mol/L sodium hydroxide concentrations for 20 seconds then rinsed with Diphoterine®. The interest of rinsing with Diphoterine® was observed by the OCT-HR<sup>(7)</sup> technique. Rinsing with Diphoterine® stops the evolution of the spreading and penetration of sodium hydroxide in the cornea.

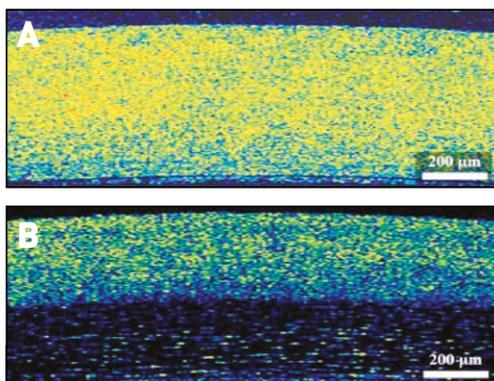


Figure 14: rabbit corneas, 16 minutes after a 20 seconds application of 500 µL 1 mol/l NaOH.

- A) without rinsing.
- B) after rinsing with Diphoterine®.

### 6.3. FEEDBACK ON THE USE OF DIPHOTERINE®

This paragraph gathers single cases or series of use of Diphoterine® on sodium hydroxide splashes. These experimental feedbacks of accidents in industrial environment ([www.prevor.com](http://www.prevor.com)) shows that when Diphoterine® is immediately used, the action of the hydroxide ion is stopped, which avoids or minimizes the appearance of lesions. An absence or a decrease of sick days or sequelae is observed too.



### 6.3.1 CLINICAL STUDY ON HUMANS

A clinical study was set up in Australia, in 3 alumina refineries from October 2006 to March 2008. The implementation of Diphoterine® was associated with specific inventory of all cutaneous splashes by alkali, sodium hydroxide being the main one. Exposed employees were trained and equipped with Diphoterine® sprays. Choice was given to use Diphoterine® or tap water in case of chemical splash. For each incident, the chosen washing solution used as primary action was recorded. The final study includes 180 cases of alkaline skin splashes. Using Diphoterine® first was favoured with time. Injuries are significantly less severe in this same group.

SOLUTION USED AS PRIMARY ACTION	DIPHOTERINE®	WATER
n° of cases	138	42
Time elapsed	1 min.	5 min.
No chemical lesion	<b>52,9 %</b>	21,4 %
Blisters or more severe signs	<b>7,9 %</b>	23,8 %

The implementation of Diphoterine® on these industrial plants was associated with a better chemical risk consciousness of employees as well as with a decrease in accidents rate (Donoghue - 2010).

### 6.3.2 CASE REPORTS

#### October 2008 – E.on, Åbyverket, Örebro - Sweden

In October 2008, while he was unloading 50% sodium hydroxide and unscrewing a pipe that was not completely empty, a tank truck driver was splashed on the leg by several liters of corrosive.

According to the internal protocol, a worker equipped with a Diphoterine® DAP must always be present on the unloading site during unloading operations. Witnessing the accident, this worker intervened. At first, because he didn't know the solution [Diphoterine®], the driver tried to find a water pipe to rinse his leg. But the worker persuaded him to use Diphoterine® and sprayed it on his legs. The driver quickly realized the effectiveness of Diphoterine®. He saw that there was no lesion. His hands had been slightly contaminated by caustic soda too. When rinsing with Diphoterine®, the « soap-like » effect left on by concentrated caustic soda, disappeared rapidly. Before, the driver had been trained to wash his hands with water for at least 10-15 minutes in order to eliminate this “soap-like” effect.

### July 2006 – Tolkim, Turkey

In a chemical plant in Turkey, a worker was splashed by 48% caustic soda (pH=14) while transporting this product to the quality control lab. He used a 200 mL MINI DAP within the first minute after splash and then a second spray 3 minutes later. He was given no sick days and had no sequelae.



**Picture of lesions taken on accident day:** erythema (redness)



**Picture taken 3 days after accident:** skin is back to normal condition.

**Figure 15:** Evolution of lesions rinsed with Diphoterine®, after a 48% caustic soda splash.

### February 2006, Firm manufacturing fertilizers, Sao Paulo, Brazil

As a worker was walking under pipes, he felt some drops falling on his helmet. It was 40% sodium hydroxide drops. He felt pain on his right cheek and on his neck. He immediately went to the medical unit where Diphoterine® was applied on the splashed areas. There was a little red spot on his neck. The worker felt that the pain was decreasing and then disappearing. 24 hours after, there was no more visible mark of the accident and the worker was not given any sick day.



**Rinsing of the neck with Diphoterine® on the accident day.**  
Slight erythema (red spot)



**Picture taken 24 hours after accident:** normal skin aspect.



**Rinsing of the cheek with Diphoterine® on the accident day.**



**Picture of the cheek taken 24 hours after accident:** normal skin aspect.

**Figure 16:** 40% caustic soda splash on neck and right cheek rinsed with Diphoterine® used as primary action



### 1998 - Bio Products Laboratory, Herts, United Kingdom

This pharmaceutical firm proceeded to the maintenance of its structures from May to September 1998. Although the staff had been trained on chemical safety before the maintenance works started, there were 6 accidents due to splash of corrosives:

- Sodium hydroxide on one hand (contact with a contaminated pipe),
- Caustic soda on the neck,
- Caustic soda in the eyes, on the face and chest
- Contamination of a hand by sodium hydroxide which had run under the glove
- Caustic splash on an arm
- Contamination of a wrist by caustic soda which had run under the glove.

After each exposure, Diphoterine® was immediately applied as a primary action. After being checked in the medical unit of the firm, all the victims went back to work within an hour after their accident. Only a slight erythema (red spot) was observed in some cases with spontaneous disappearance within a few hours.

### 1998 – Hydro Aluminium Expal, Luce - France

Historically, this plant has recorded two serious accidents due to splash of 98% sulphuric acid and of 30% sodium hydroxide. These accidents have resulted in long sick leaves and, in one case, in a surgical operation. Thus all the people involved in the safety of this site were highly motivated to modify the emergency protocol. Since Diphoterine® has been implemented, the plant has only registered minor incidents without any sick leave or sequelae. Users of Diphoterine® are deeply convinced of its effectiveness.

### 1994-1998 – Series of splash cases, Mannesmann, Germany

Between 1994 and 1998, Mannesmann reported 3 cases of caustic soda splash, two cases at ocular level and one case at cutaneous level, all immediately rinsed with Diphoterine® by the injured person. A second wash and medical checking were achieved in the infirmary of the firm.

Concentration	Splashed area	Additional treatment	Sick leave (days)	Sequelae
30%	Right eye	None	0	None
Basic solution (30%)	Right eye	None	0	None
45%	Knee	None	0	None

The initial and rapid rinsing with Diphoterine® avoided secondary care and sequelae in all 3 cases.

### **May 1995 –Aussedat Rey Paper mill - France**

A trainee drops a bottle of concentrated caustic soda. He is splashed on his face and right arm. Diphoterine® is immediately applied on his face and arm. 15 minutes later, he is checked in the infirmary and learns that his right foot has been attacked by caustic soda penetrating into his shoe. The nurse sprays Diphoterine® onto his foot. Only red patches can be observed on his face and arm while there is a more severe lesion on his foot. The severity of the observed lesion of the foot is due to the late rinsing.

### **October 1993 – Alcan Deutschland, Göttingen - Germany**

During a fixing operation, a worker was splashed by caustic soda in both eyes as well as on the face and chest. Within the 2 following minutes, he was washed with Previn® (the equivalent solution to Diphoterine® on the German market). After a clinical review, no lesion was observed. The accident resulted in no sequelae.

### **October 1993 – MEWA, Germany**

After a splash by 50% sodium hydroxide, a worker's arm was immediately rinsed with Previn®. No pain was felt and the worker was back to work on the same day.

### **November 1991 – ICI, Oissel – France**

After an ocular splash by sodium hydroxide, the immediate rinsing with Diphoterine® permitted to limit the attack to epithelial lesions i.e. to a superficial level. The spontaneous re-epithelialization returned the visual acuity back to normal standards.

### **January 1991 – Alusuisse, Burgundy – France**

A caustic soda chip gets into a worker's eye. Rinsed with Diphoterine®, the victim felt an immediate relief. The conclusion of the following ophthalmic examination was that the eye was normal. Then the accident resulted in no lesion.

### **January 1991 – Clairefontaine Paper mill, Etival – France**

After a caustic soda splash on his body, a worker was immediately rinsed with a Diphoterine® DAP, which resulted in no lesion and then no sick leave.

### **1991-1993 – Series of cases of base splash, Martinswerk, Germany**

Between 1991 and 1993, the firm Martinswerk (manufacturer of aluminum oxide and hydroxide) recorded 45 splashes of basic chemicals including 86% cases with sodium hydroxide (concentration from 40 to 600 g/L – as liquid solutions, chips or flakes, including 3 cases under heat).

There were 29 cases of cutaneous splash and 16 cases of ocular splash. The study (Hall – 2002) compared the use of different rinsing solutions: water, a diluted acetic acid solution and Diphoterine®, with the following assessment criterions:

- The sick leaves,
- The need of simple secondary care
- The need of medical treatment.

Compared with the use of diluted acetic acid and water, when Diphoterine® was used for the initial decontamination, the study led to the following conclusions:

- A great decrease of the sick leaves
- No secondary care.

## 7. ADVICES AND INDICATIONS ABOUT THE USE OF DIPHOTERINE®

Diphoterine® is an emergency rinsing solution for ocular or cutaneous chemical splash. Thanks to its amphoteric properties, it has a direct action on the irritant or corrosive potential of the chemical product. Because of its hyperosmolarity, it stops any in-depth tissue penetration. This maximizes washing, preventing and limiting corrosive lesions.

**In cases of ocular or cutaneous splashes with sodium hydroxide, we strongly recommend performing an early and prolonged washing with Diphoterine®. Diphoterine® stops the aggressiveness of sodium hydroxide.**

**In the event of an eye splash** with diluted sodium hydroxide, and a time of contact shorter than 10 seconds, use a 50 mL LIS. For a time of contact shorter than 1 minute, use a 500 mL bottle.

In case of a splash of solid caustic soda or of a very concentrated and viscous sodium hydroxide solution (approx. 50%), do a prolonged washing with 500 mL Diphoterine®.

In all cases, it is recommended to continue washing with a 200 mL Afterwash II® bottle (a comfort solution which is isotonic to cornea).

**In case of a cutaneous splash**, (hand, forearm, neck...) with a time of contact shorter than 1 minute, use a 100 mL Micro DAP or a 200 mL Mini DAP, depending on the splashed area.

For an extended body splash with a contact time shorter than 1 minute, use a 5 litres DAPD (autonomous portable shower).

Diphoterine® also shows an interest in cases of delayed washing (later than 1 minute). In such cases, lesions may have already developed. A prolonged washing limits lesions evolution and thus facilitates secondary care.

**In case of an ocular burn**, we recommend extending primary washing, performed with 500 mL Diphoterine®, by a second Diphoterine® washing of an optimal 5 minutes duration. In all cases, washing more than 15 minutes is not necessary.

**In case of a cutaneous burn**, we recommend continuing washing with secondary washing lasting for a time equivalent to 3 to 5 times the time of exposure to the chemical.

Please note that INRS highlights the importance of prolonged washing. The disappearance of pain does not indicate washing end. Therefore it is necessary to use the full content of the appropriate packaging.



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### TITLE OF RISK PHRASES (EC CLASSIFICATION)

R35	Causes severe burns
R34	Causes burns
R36/38	Irritating to eyes and skin

### HAZARD STATEMENTS (CLP REGULATION)

H314	Causes severe skin burns and eye damage
H315	Causes skin irritation
H319	Causes serious eye irritation



**PREVOR**

**ANTICIPATE AND SAVE**

Toxicology Laboratory & Chemical Risk Management