Caustic soda lye

Product Application Guide

Caustic soda lye is a solution of sodium hydroxide (NaOH) in water. It is a strong base with a wide range of applications in different industries. Caustic soda lye is a transparent, viscous and odorless solution which crystallizes at lower temperatures. It is a stable product that does not degenerate when exposed to light, heat or other factors. Contamination occurs by contact with materials on which it has a corrosive effect. When exposed to air, caustic soda lye absorbs carbon dioxide causing a white cloudiness or even a precipitate of sodium carbonate.

Our Caustic Soda Soda is not produced / marketed as food additive (E 524), feed additive, cosmetic or pharma grade. If you wish to use this product in any food or feed applications, please contact our technical service department.

Available product supply forms

Solutions of sodium hydroxide in water with concentrations varying from 20 to 50 % w/w.

Delivery Unit

Caustic soda lye is delivered in bulk by:

- Road tank cars
- Rail Tank cars
- ISO-containers
- Barge or sea vessel

The available modality can differ per manufacturing site. The actual Full Truck Load (FTL) is geospecific and can therefore differ due to local regulations and legislation.

Product Identification

CAS No.
1310-73-2

EINECS/ELINCS No.
215-185-5

REACH No.
01-2119457892-27

Formula
NaOH (aq)

UN Code
1824

Production process

Available technologies

Caustic soda is obtained from the electrolysis of salt. A solution of this salt (NaCl) in water is decomposed in an electrolytic cell by the passage of an electrical current (DC). There are three different types of electrolysis processes:

- Membrane electrolysis
- Mercury electrolysis
- Diaphragm electrolysis

Nouryon Industrial Chemicals produces their caustic soda lye only via the sustainable membrane electrolysis process.

Membrane electrolysis process

In the membrane process the membrane divides the electrolysis cell in the two parts: the anode and cathode compartment. The anode and the cathode are separated by an ion-exchange membrane. Only sodium ions and a little water pass through the membrane. The impoverished brine is de-chlorinated and re-saturated with solid salt. After purification the brine is recirculated over the cell. The caustic soda lye leaves the cell with a 32% concentration, and can be concentrated to 50% in a later stage in the process.

Application possibilities

Aluminium Industry

To digest bauxite, for smelting plants and rolling mills, for etching semi-finished and finished products.

Automotive Industry

For degreasing and paint stripping.

Building Industry

For production of bitumen emulsions, for removing paints and varnishes; preparation of construction materials.

Chemical and Pharmaceutical Industry

Basic auxiliary and processing material in the chemical industry and many related branches.
To prepare sodium compounds, water glass (soluble glass, sodium silicates); for neutralization purposes, pH-adjustment (alkalizing), and as compound of industrial cleaners; waste air cleaning.

Cellulose Gum

Large scale production of methylcellulose, derivatives thereof and carboxymethylcellulose which are used in many different applications, e.g. as paste and wallpaper glue, additive for construction materials, thickening agent (foodstuff additive, in cosmetic and pharmaceutical formulations), emulsifying and disperging agent, protective colloid, etc.

Farming

Disinfectant of stables to control foot-and-mouth disease of cattle. Cleaning of machines and pipes especially for milk collecting apparatus.

Fat and Oil Factories

To purify edible oils and fats, and to remove oil and fat residues.

Food & Beverage Industry*

Production of food and beverage, e.g. to produce pretzels. Generally for pH-adjustment (neutralization), cleaning and disinfection of glassware, machines, tools and rooms, e.g. in dairies and in dairy farms to clean milk churns, centrifuges, pasteurization vessels, milk bottles etc.

Gasworks

For absorption of acidic gases and vapours, for ammonia recovery.

***Note:** Caustic Soda lye produced by Nouryon Industrial Chemicals can be used in the EU as processing aid in the food or feed industry as they fulfil all purity requirements (chemical parameters) of applicable food or feed additive monographs and regulations as mentioned on our product specification sheet.*

The caustic soda production facilities of Nouryon Industrial Chemicals are not registered as EU food or feed facility after the European Food or Feed Laws (Regulation (EC) 852/2004 or Regulation (EC) 183/2005 and others) and that as a result of these regulations our Caustic Soda lye must not be used as food or feed additive in the EU.

This statement does not relieve the end user from the obligation to ensure that a processing aid does not pose any adverse health effect in the final food or feed product. For generally permitted uses of this product in the EU we refer to the eSDS, which lists all REACH registered uses with their safe use conditions.

Leather Industry

Used in liming process to help swell the hides or skins.

Metal Industry

To remove paint and oil from metal and making of black finishing agents (bronzing, burnishing).

Mining

For pH adjustment in coal and ore flotation.

Natural Adhesive and Gelatin Factories

For digestion, neutralization and disinfection.

Oil Production and Refining

For oil wells, pH regulation in exploratory drilling, refining, desulphurization and water treatment, waste air cleaning.

Pulp Mills and Paper Industry

To extract cellulose (pulp fiber) from wood, straw and rags; for pulp refining, processing of cellulose and paper.

Surfactants and Soap Industry

Manufacture of surfactants (soaps, detergents, washing powder, health care products); pH-adjustment.

Textile Industry

Processing of cotton and used in the dyeing process of synthetic fibers such as nylon and polyester.

Waste Water Treatment

To neutralize acid wastewater and sewage; as auxiliary flocculant.

Water Treatment

Treatment of drinking water and industrial water (water softening, pH adjustment and regeneration of ion-exchange resins).

Wood and Furniture Industry

Cauterizing and paint removing of wood and furniture.

Safety and Handling

- Caustic soda lye is a strong base. It reacts violently with strong acids and water under production of heat.
- Caustic soda lye reacts with base metals such as aluminum forming flammable and potentially explosive hydrogen gas.
- Thermal decomposition can lead to release of irritating gases and vapors. Both the vapors as the solution have a corrosive effect on human tissue, potentially causing severe damage (burns) to respiratory tracts, eyes, skin, and gastrointestinal tract.
- In case of the possibility of dangerous contact with caustic soda lye personnel have to be equipped with suitable protection equipment. During unloading the operator and driver should at least wear chemical-resistant overalls, gloves, boots/shoes and closed goggles. Rubber and PVC are well resistant materials for these.

This information is to our best knowledge. For additional safety data and/or PPE usage, we refer to our material safety data sheets (MSDS).

Dispatch and storage

Unloading tanker trucks

The overall safest method for unloading a tanker truck is at ambient pressure with a local pump as part of the customer's installation.

When no local pump is available, tanker trucks are emptied by pressurizing the tanker vessel, pushing the caustic soda lye out into the storage tank. All tanker trucks are equipped with an air compressor, with up to 0.2 MPa (2 bar) over-pressure. This means that the maximum conveying height for caustic soda lye is approximately 10 metres.

Materials for Tanks, Containers, piping and mounted equipment

Caustic soda lye is a strong base and therefore corrodes most metals.

Metals:
Equipment made of carbon steel suffices well for 50% NaOH up to temperatures of max. 50°C. For 32% NAOH this maximum lies at approx. 60°C. When using carbon steel a very slight contamination with iron (Fe) must be expected. Should this prove unacceptable, stainless steel must be used, e.g. 304L, 316L.

In addition to the normal overall corrosion, concentrated caustic soda can, at higher temperatures, cause stress corrosion.

At temperatures between 50°C and 90°C, stainless steel with more than 10% nickel (Ni) can be used. Aluminum (Al), magnesium (Mg), zinc (Zn) and tin (Sn) are unsuitable since they lead to pronounced corrosion with simultaneous hydrogen formation.
The use of these metals and their alloys, such as brass and bronze must therefore be strictly avoided.
Centrifugal pumps, including impellers of high-grade cast iron or stainless steel as well as pumps made of PP and PVC are well-suited. Pumps with mechanical seals are preferred to those with gasket sealing.
Seal-less pumps are also well applicable.

Flange gaskets of PTFE or EPDM rubber with steel inlay are recommended for use with synthetic piping. For metal piping, graphite with stainless steel interior linings are preferred.

Non-metals
Materials based on silicates such as glass, enamel, ceramic and concrete can become corroded within an unacceptably short period. This corrosion is strongly dependent on the factors of concentration and temperature. Ceramic tile floors, glazed stoneware pipes and cement drains and floors are sufficiently resistant to short-term contact with cold, diluted caustic soda in the case of spillage that is rinsed with water.

Fibreglass-reinforced polyester with an interior lining op polypropene (PP) or polyvinyl chloride (PVC) are recommended as synthetic construction materials, especially for storage tanks. A maximum temperature of ca. 80°C applies foor PP and ca. 50°C for PVC. HDPE tanks are suited for the storage of cold caustic soda to temperatures of ca. 40°C. Epoxy resin can be used up to 80°C. For larger storage tanks, Polyethene (PE) is not recommended as contruction material. Thermosetting plastics such as polyester, vinyl ester and phenolic resins are definitely not suitable for contact.

Piping
Piping is just like the storage tanks preferably made of stainless steel or an appropriate plastic. When a slight contamination with iron (Fe) can be accepted, carbon steel is also suitable.

To prevent the piping from freezing solid during winter months, they must be equipped with an insulated sleeve and when required even a heat source between pipe and sleeve.

Valves, seals and pumps
For normal use, shut-off valves made entirely of carbon steel are sufficient. At high temperatures and minimum iron pick up is unacceptable, stainless steel must be used. Membrane valves with alkali-proof rubber membranes are also very suitable.

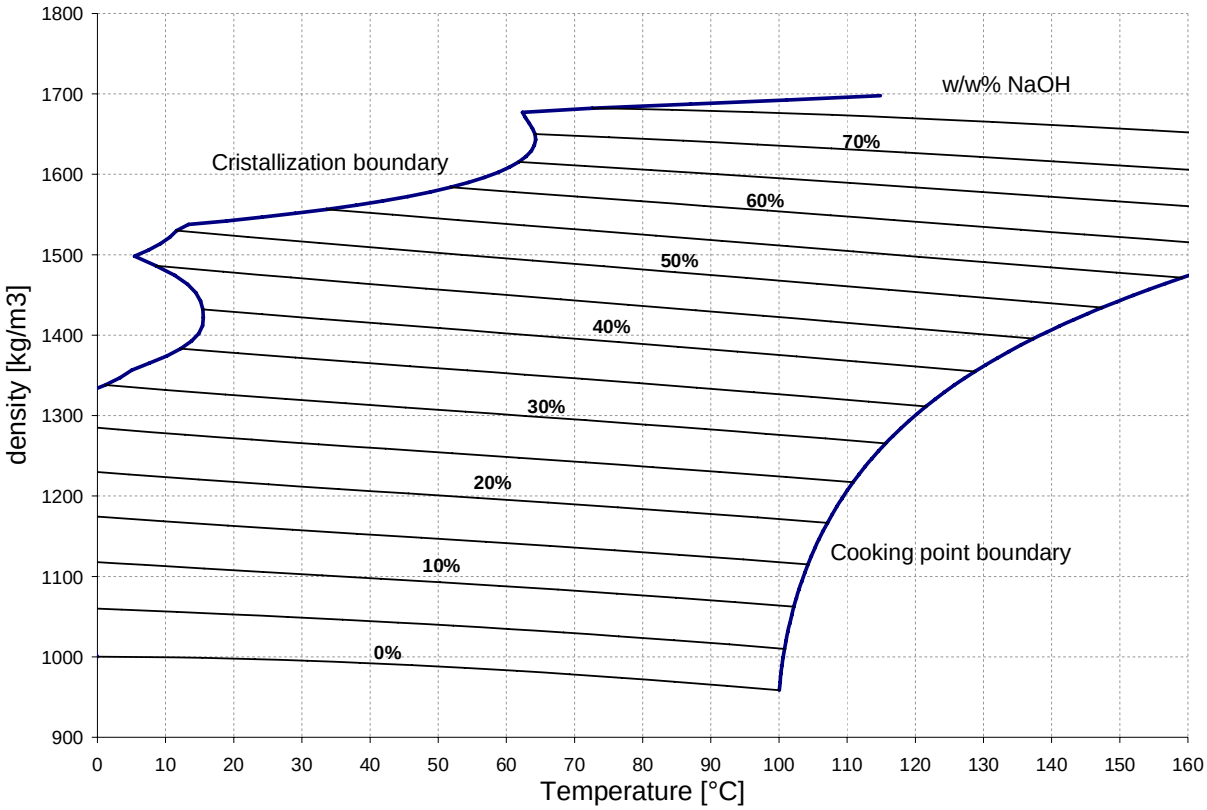
Technical Data and physical properties

Physical properties

Molecular Weight HCl	g/Mol	40.00
Density	g/cm³, kg/L	1.5237
pH	-	
Boiling Temperature	ºC	147,4
Freezing Temperature	ºC	11.6
Specific heat Capacity (C_p)	kJ/(kg·K)	3.23
Dynamic Viscosity	cPa.s	68.8
Flash point in air	ºC	- (non-inflammable)
Explosion limits in air	ºC	- (non-explosive)

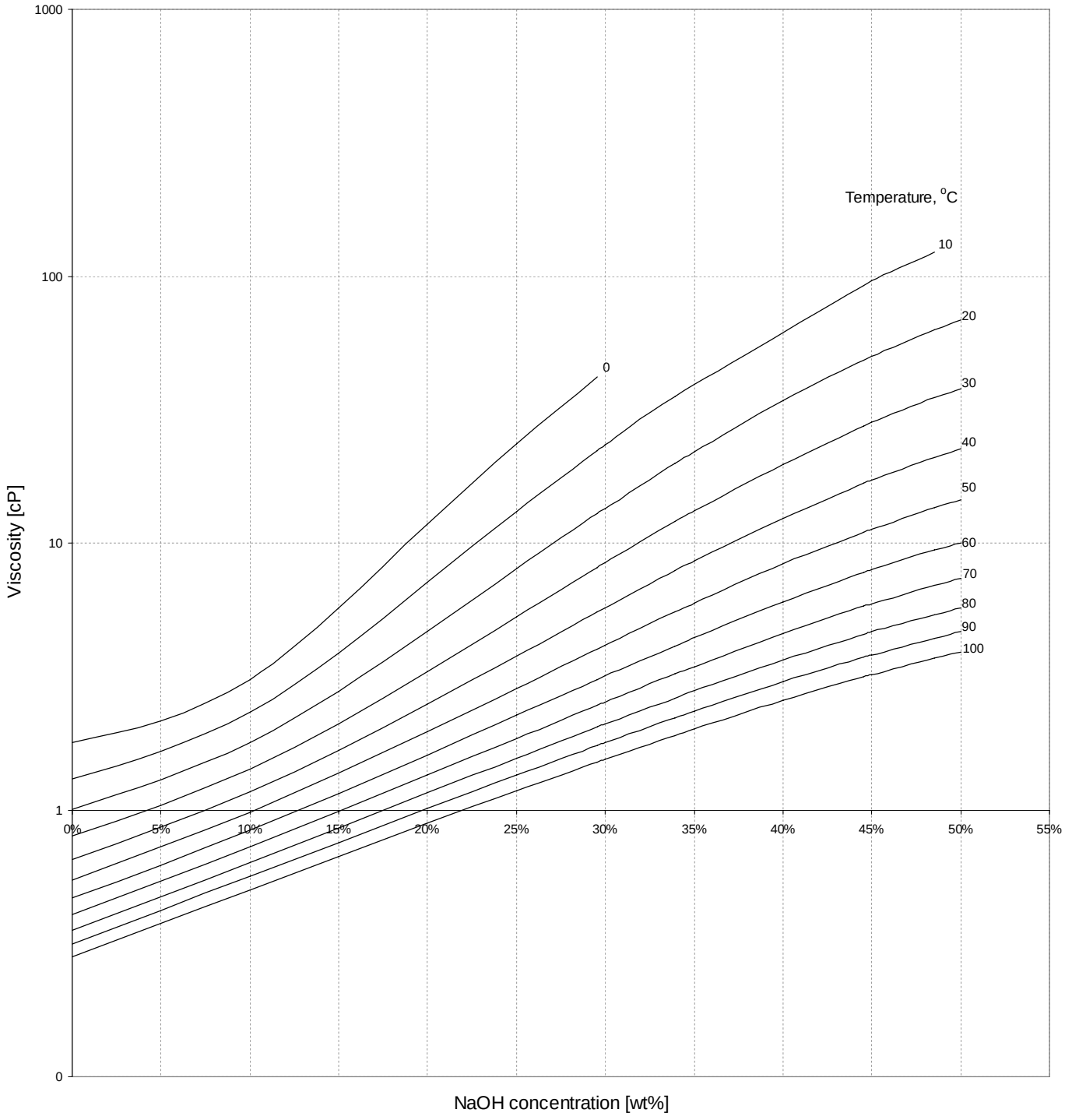
Reference: Nouryon data from own engineering software or recognised literature for Caustic soda lye 50% at the standard conditions of 20 ºC and 1013 mbar

Density of caustic soda lye



Concentration	Density (kg/l)					
	T (C)					
w%	10	20	30	40	50	60
10	1117.1	1108.9	1104.3	1099.5	1094.2	1088.9
20	1224.4	1219.1	1213.6	1207.9	1202.0	1196.0
24	1268.6	1262.9	1257.1	1251.2	1245.1	1238.8
28	1312.4	1306.4	1300.2	1294.2	1287.8	1281.4
30	1334.0	1327.9	1321.7	1315.4	1309.0	1302.5
32	1355.2	1349.0	1342.7	1336.2	1329.8	1323.2
40	1446.7	1430.0	1423.2	1416.4	1409.5	1402.7
46	1494.7	1487.3	1480.5	1473.4	1466.3	1459.3
50	1540.0	1525.3	1518.1	1510.9	1503.8	1496.7

Viscosity of Caustic soda lye as function of the temperature and concentration



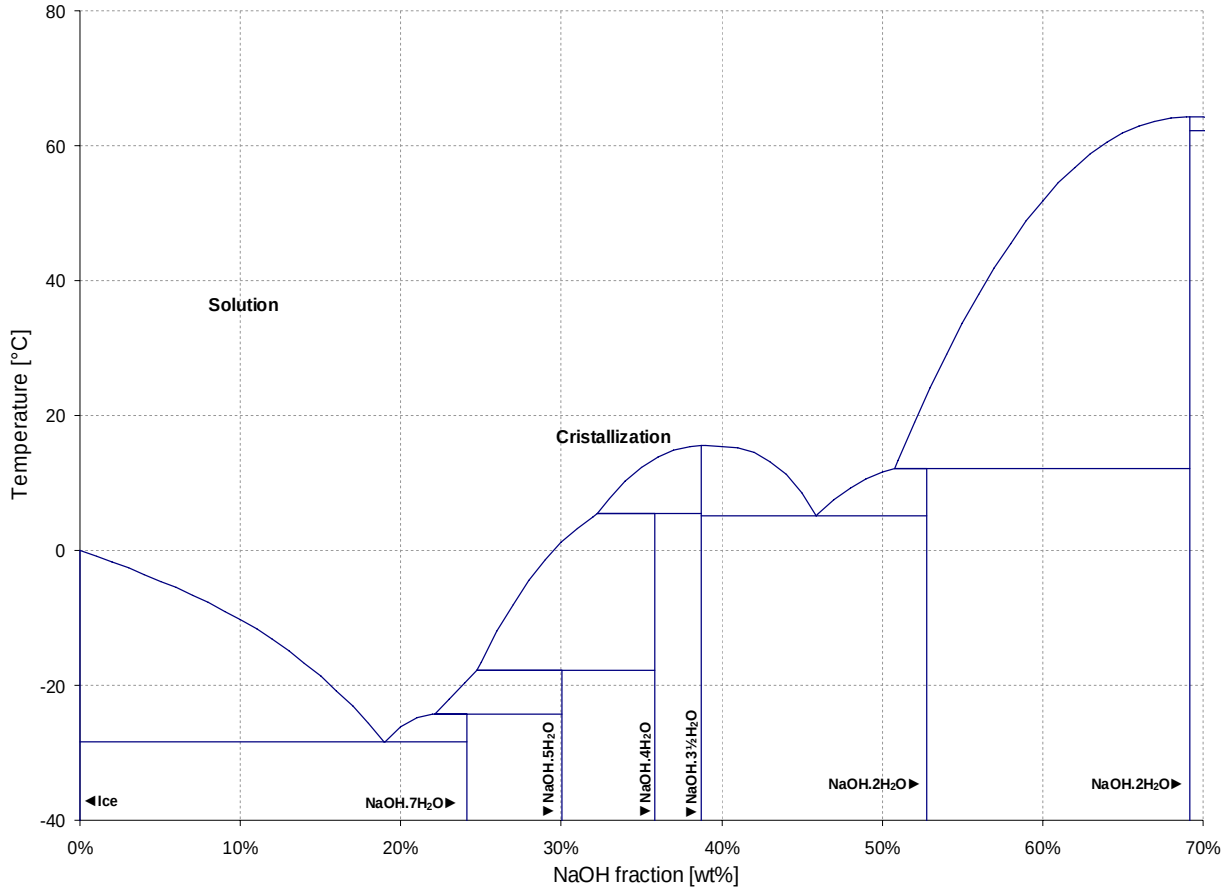
Solubility Chart Caustic Soda Lye

Caustic Soda lye is a solution of sodium hydroxide in water. The solubility in water is high, but at temperatures above the freezing point of water hydrates of sodium hydroxide can crystallize.

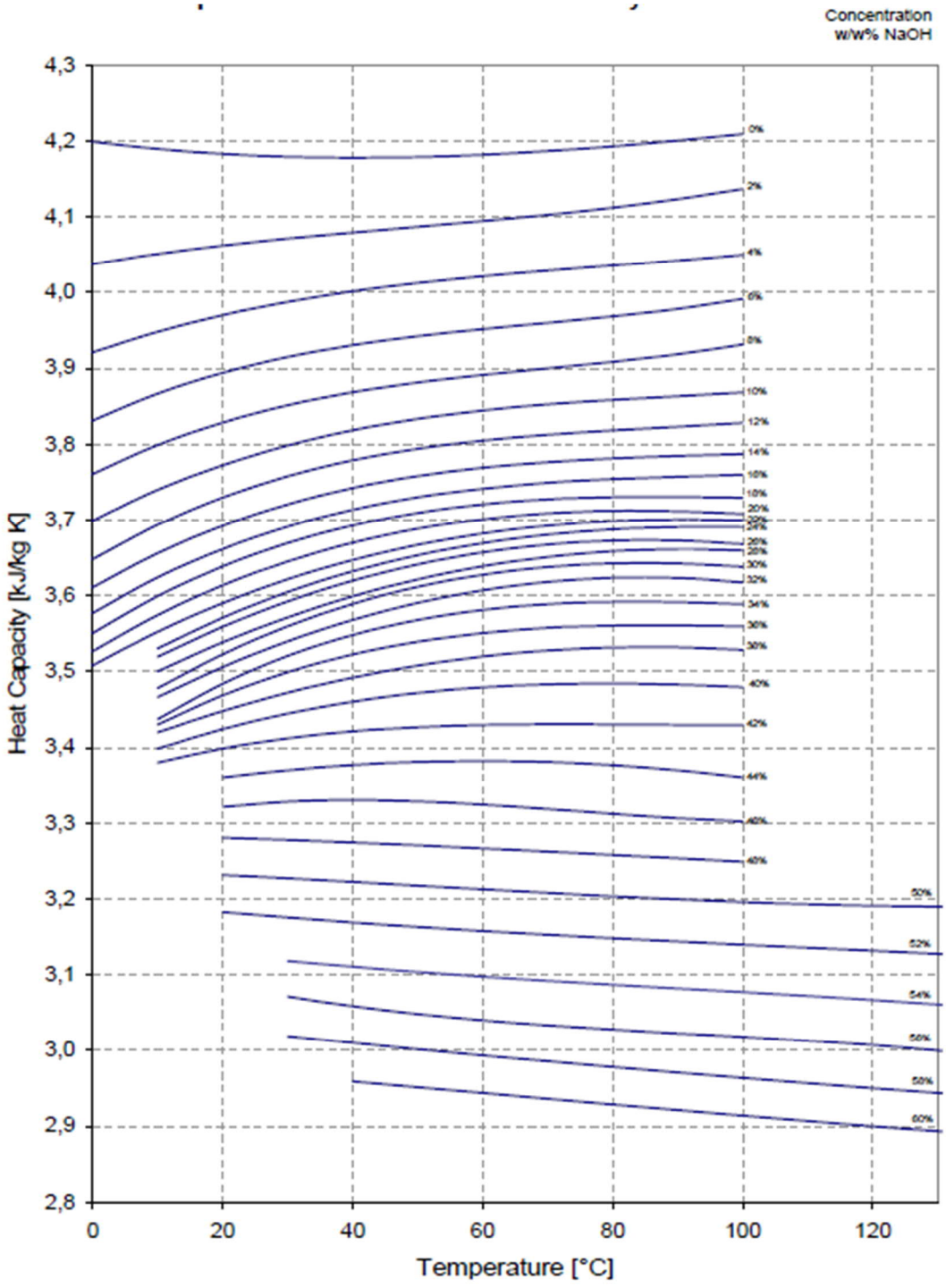
From the figure follows that the concentrations of sodium hydroxide supplied by Nouryon crystallizes at the following temperatures:

25 w/w% NaOH at ~-18°C
32 w/w% NaOH at ~+ 8°C
50 w/w% NaOH at ~+ 12°C

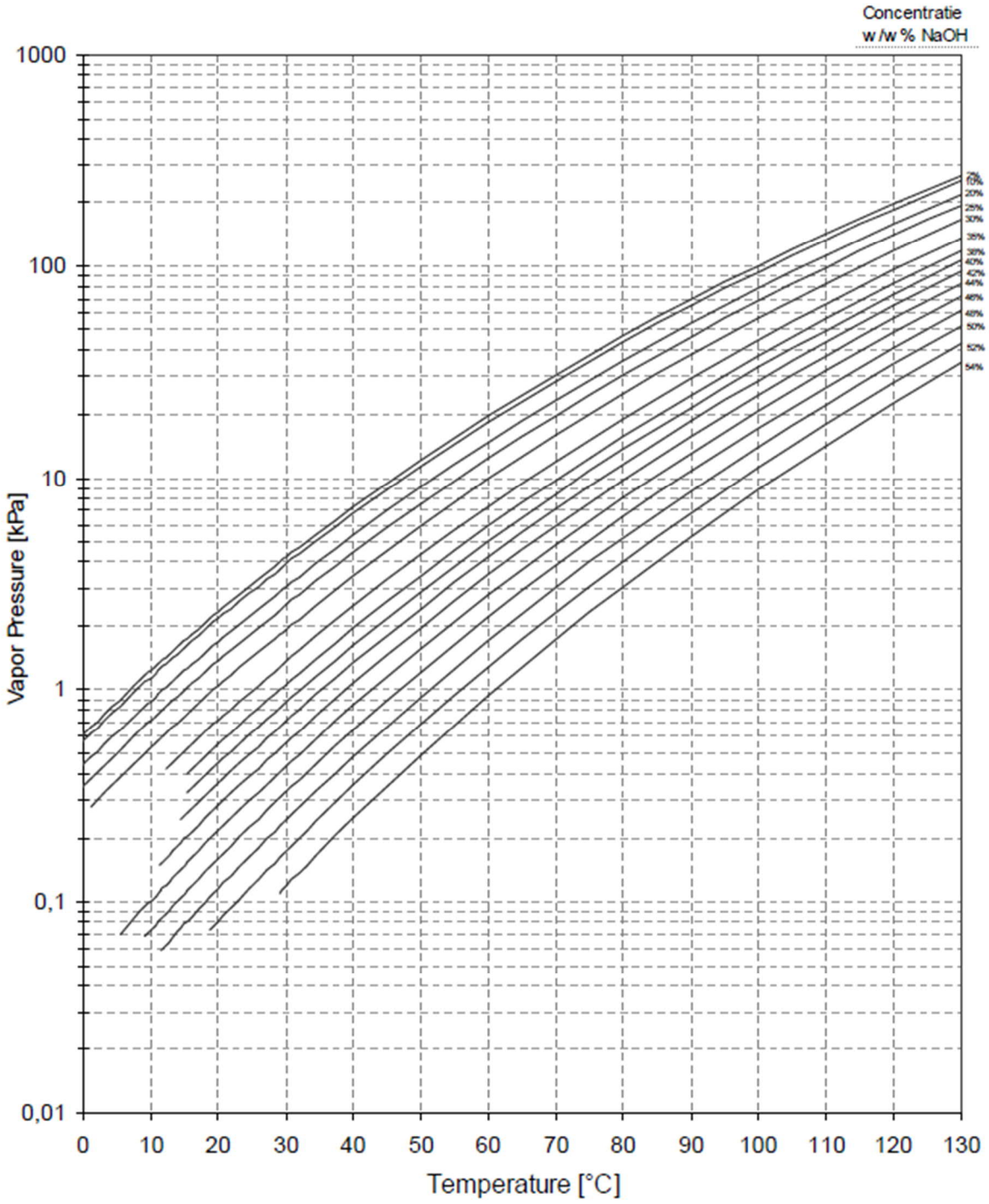
At further cooling down the caustic soda lye will become completely solid.



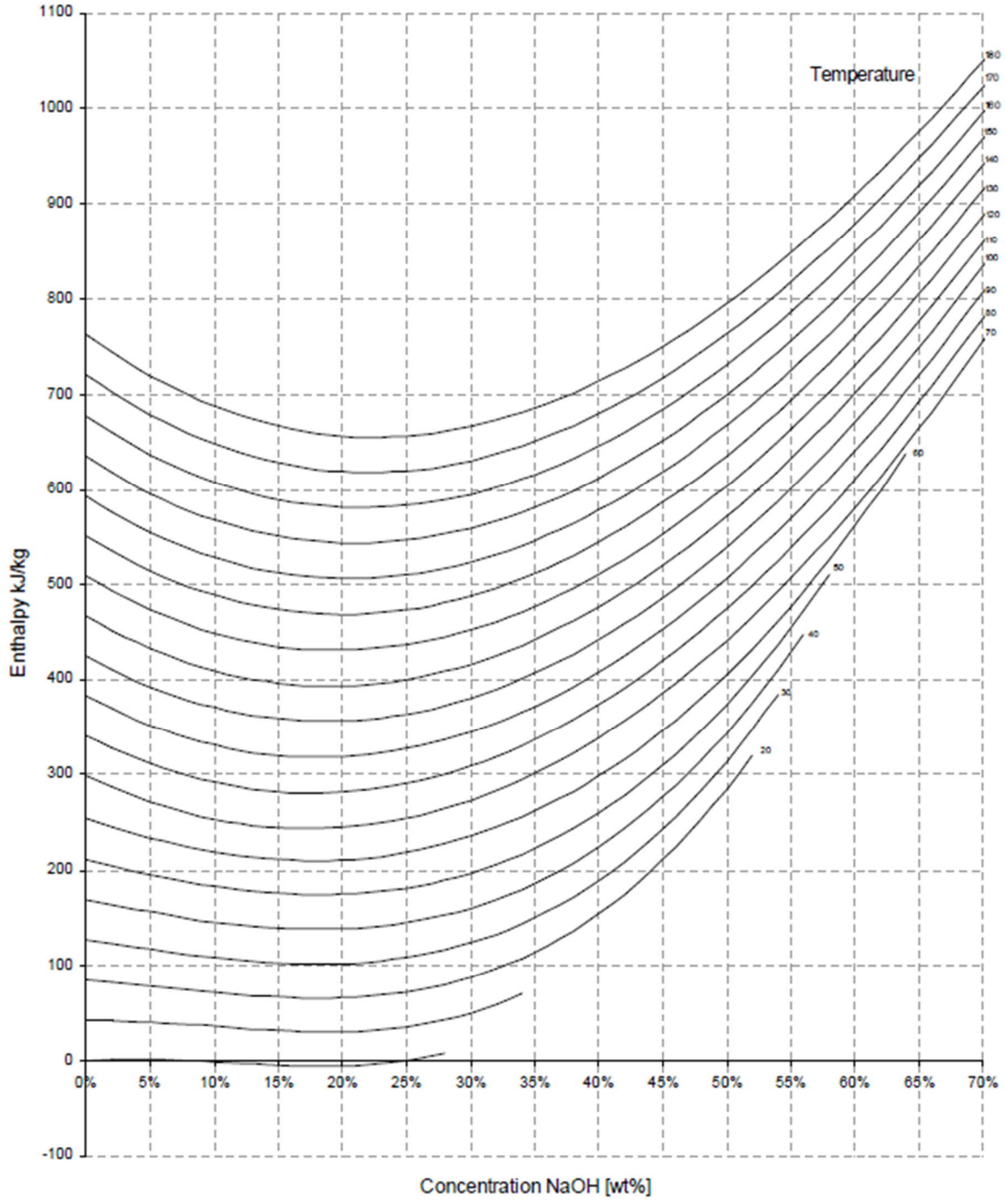
The Specific Heat of Caustic Soda Lye as a function of the temperature and concentration



The Vapor pressure of Caustic Soda Lye as a function of the temperature and concentration



The Enthalpy of Caustic Soda Lye as a function of the temperature and concentration



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