

BREOX QUENCHANTS

BREOX QUENCHANT A
BREOX QUENCHANT NF-18
BREOX QUENCHANT HT
BREOX QUENCHANT HQA

INTRODUCTION

BREOX QUENCHANTS are a series of non-flammable polymeric quenchants manufactured by Cognis Performance Chemicals. The products are comprised from an aqueous solution of polyalkylene glycol and corrosion inhibitor. These are further diluted to a working concentration prior to use.

ADVANTAGES

- Eliminates fire risks due to the relatively high concentration of water
- Eliminates smoke, soot and oil quenchant residues, making a cleaner working environment and easier equipment maintenance.
- A high degree of flexibility since optimum quenching conditions for a specific material or component may be determined by control of concentration, bath temperature, and/or agitation.
- Minimises the replacement and control requirements common to PVA and soluble oil quenchants due to deterioration and/or oxidation.
- Minimises the residual stress, distortion and soft spotting associated with water quenching of Aluminium based materials.
- Produces clean components ready for further processing – drag out losses are reduced compared to oil and no degreasing is necessary.
- The quenchant is fully soluble in water (below it's cloud point) and easily mixed to the operating concentration.
- Good anti-corrosion properties, protecting the quenching system.
- Extended life time due to low levels of drag out and bath deterioration.

PRODUCTS

The **BREOX QUENCHANTS** range is comprised of four products:

BREOX Quenchant A – An established product encompassing a nitrite based corrosion inhibition system.

BREOX Quenchant NF-18 – A similar product to BREOX Quenchant A, Quenchant NF-18 encompasses a nitrite free formulation.

BREOX Quenchant HT – For use in integral furnace/bath systems or where the quench volume is reduced. BREOX Quenchant HT has a higher cloud point thus minimising the risk of bulk inversion of the polymer.

BREOX Quenchant HQA – A concentrate designed to be transported over long distances, the low water volume making the product more cost effective. Once at it's destination BREOX Quenchant HQA can be diluted to manufacture Quenchant A either for resale or into a useable product.

PHYSICAL PROPERTIES

	Quenchant A	Quenchant NF-18	Quenchant HT
Density @ 20°C (kg/m ³)	1098	1082	1101
Refractive Index @ 20°C	1.41	1.43	1.41
Viscosity @ 40°C (mm ² /sec)	450	530	560
Flash Point	None	None	None
Fire Point	None	None	None
Pour Point		-32°C	-20°C
pH	Slightly Alkaline	Slightly Alkaline	Slightly Alkaline
Cloud Point	74°C	76°C	88°C

APPLICATIONS

Aluminium Quenching

The solution heat treatment procedures for aluminium alloys, in either the cast, forged or wrought form, has traditionally incorporated a water quench. The use of **BREOX QUENCHANTS** can minimise the residual stress, and therefore distortion levels, produced during the quenching phase of thermal treatment without sacrifice of mechanical or intergranular corrosion properties. Age-hardening of the components then proceeds as for water quenched items irrespective of whether natural or artificial aging procedures are used.

Ferrous Quenching

For ferrous heat treatment **BREOX QUENCHANTS** have been successfully used for the induction and flame hardening of components such as gears, shafts, steering racks and

other items of variable geometry and steel composition. **BREOX QUENCHANTS** have also found application during the quenching of a wide variety of component size/chemistry combinations from shaker, pit, integral quench or continuous furnaces employing either oxidising or protective atmospheres.

QUENCHING ACTION

The quenching action of a **BREOX QUENCHANT** solution depends upon the characteristic of inverse solubility. At ambient temperatures the liquid organic polymer is fully soluble in water. Above the separation temperature, however, the polymer becomes insoluble and will precipitate out of solution. Once cooled below the separation temperature the polymer will once more dissolve. This solubility variation results in a three stage cooling cycle similar to the behaviour noted for water or oil quenchants. See below.

When a hot metal component is either immersed in, or flooded with, a **BREOX QUENCHANT** solution a thin film of polymer is deposited upon the component surface because the inversion temperature has been locally exceeded. The presence of this film slows down the initial rate of cooling – analogous to the vapour blanket stage in water or oil quenching.

After a short period of time the polymer film becomes active and a period of rapid cooling ensues – equivalent to the nucleate boiling phase in conventional liquid quenching. During this period the presence of the even polymer film ensures uniform surface heat extraction characteristics thereby reducing the thermal stresses and distortion associated with the quenching process.

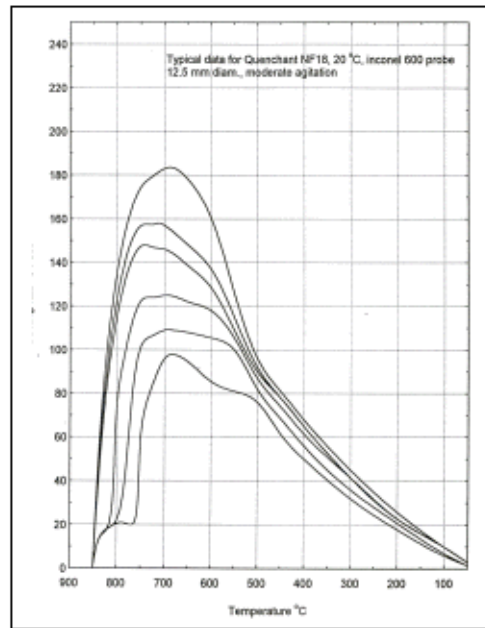
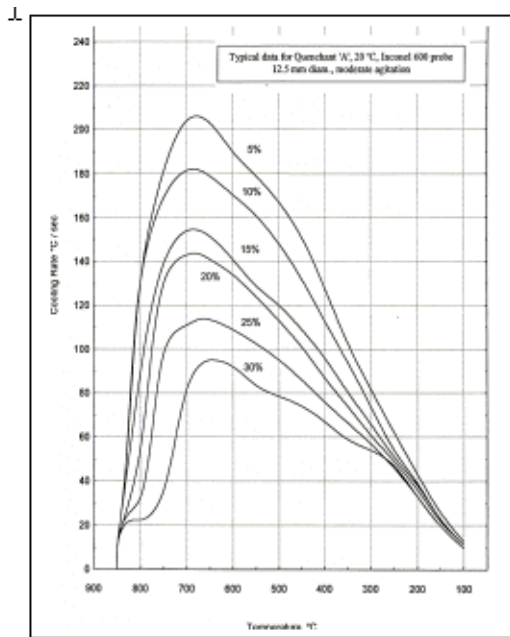
Finally, when the temperature falls below the separation temperature, the polymer layer re-dissolves and heat transfer is by convection/conduction as with other quenching fluids at these temperatures.

Separation Temperatures

Quenchant A: 74°C
Quenchant NF-18: 78°C
Quenchant HT: 88°C

CONTROL OF COOLING CHARACTERISTICS

The cooling rates of **BREOX QUENCHANTS** may be varied to suit particular metallurgical conditions by varying the solution concentration. The variation in quench performance with concentration arises from the increase in liquid polymer layer thickness, at the component surface, with increase in concentration.

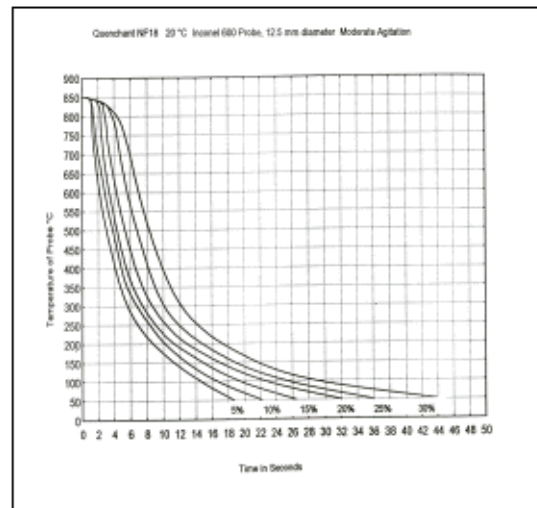
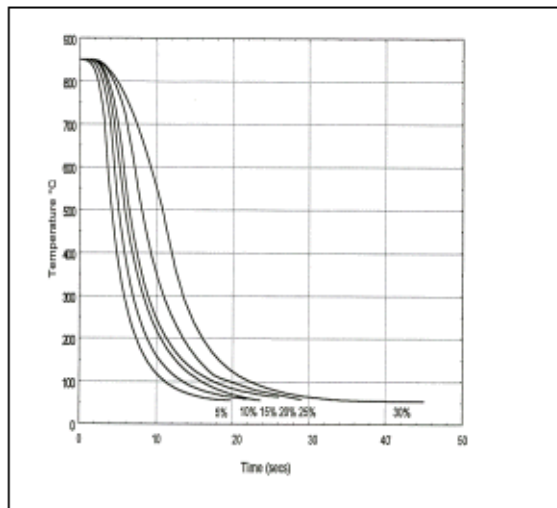


At a dilution of 3 – 5% the solution has improved wettability compared to water and quench properties equivalent to a well agitated water, or even brine, quench may be achieved.

Concentrations around 15% achieve cooling rates similar to, or slightly in excess of, those for fast mineral oil quenchants and are thus suitable for low hardenability materials.

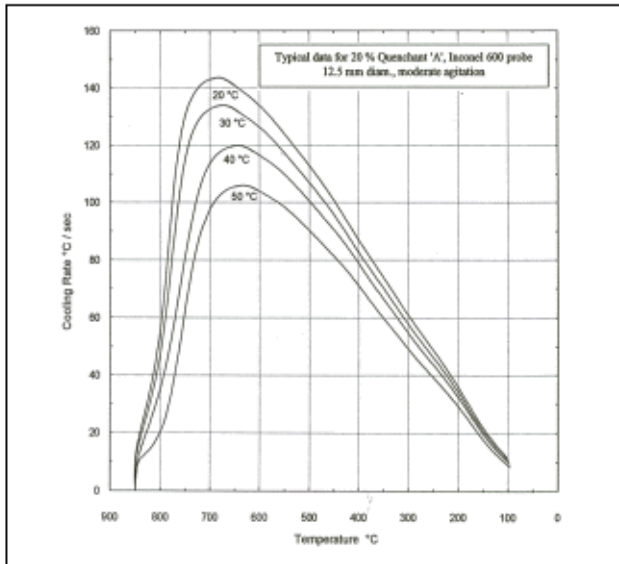
Increasing the solution concentration to 30 – 35% reduces cooling rates to those of the medium/slow speed quench oils producing conditions suitable for a range of direct hardening and case/hardening steels.

Solutions of 40% and above have been used in aluminium heat treatment when replacing hot water quenches.



The range of bath operating temperature is normally limited between ambient and 50°C since higher temperatures may promote bulk tank inversion (as a result of the inverse solubility effect) which must be avoided.

Variation in bath temperature will also modify the cooling behaviour of the quenchant, the diagram below illustrates this effect. Thus close control of the desired bath temperature should be maintained.



Agitation must always be incorporated into a polymer quenching system design to ensure that local overheating and polymer starvation do not occur. Additional variation of the quench performance may however be accomplished by suitable agitation control.

- Optimum rate 43m³ per minute
- Directed up through the load
- Liquid volume recirculated once every 2- 5 minutes

USE OF BREOX QUENCHANTS

To obtain the noted advantages for these products it is essential that the quenching characteristics of both the specific material/component combination and the furnace equipment are appreciated so that appropriate quenchant conditions may be achieved. Further, appropriate jigging and spacing procedures must be applied; in this respect the following points should be noted:

- Quenchant must have free access to all component surfaces and wet them simultaneously in order to develop an even polymer film with consequent uniform surface heat extraction properties.
- Depending on component size and geometry parts should be suspended either vertically or horizontally with spacers used where necessary to ensure free quenchant access.
- Equipment mechanisation is advisable to ensure satisfactory and repeatable quench transfer characteristics with large or heavy components.
- Polymer quenchants require closer temperature control than other quench systems therefore it should be noted that:
 - The associated temperature rise in oil is approximately halved when using polymers.
 - It is recommended that the quenchant system be fitted with an appropriate heat exchanger.
- In order to maximise the benefits of polymer quenching and to minimise risk of bulk tank inversion it is recommended that a Load(Kg)/Quench volume (L) of 1:12.5 be employed, if this is not achievable then a minimum of 1:10 is acceptable.

MANUFACTURE OF BREOX QUENCHANT A FROM BREOX QUENCHANT HQA

By manufacturing **BREOX QUENCHANT A** from **BREOX QUENCHANT HQA**, the customer utilises a cost effective way of transportation, since the water level within **QUENCHANT HQA** is kept to a minimum.

Formulation of Quenchant A in this manner is relatively simple, the procedure can be carried out at an ambient temperature (above 15°C) with only a stirred tank. Due to the relatively high viscosities of **BREOX QUENCHANT** and HQA good agitation is essential.

Furthermore, in order, to minimise the risk of precipitation and to maintain the performance characteristics of **BREOX QUENCHANT A**, distilled or deionised water should be used.

In order to formulate **BREOX QUENCHANT A** the following should be observed:

BREOX QUENCHANT HQA	61.5 wt%
Deionised Water	37.0 wt%
Sodium Nitrite	1.48 wt%

Place the required quantity of **BREOX QUENCHANT HQA** into the blend vessel. Commence agitation. Add the required quantity of deionised water, stir until a homogeneous solution is formed, or for a minimum of 3 hours. Add Sodium Nitrite (a solution can be added as long as the necessary water adjustment has been made) and stir until homogeneous or for a minimum of 2 hours. If heating of the tank is preferred, care should be taken not to heat above 40°C.

CONVERSION PROCEDURES

When a **BREOX QUENCHANT** is introduced into an existing system it will, in all likelihood, be replacing one of the following classes of fluid:

Water

No special conversion procedures are required unless surfaces are painted – see section on compatible coatings.

Brine

Salt residues should be removed by flushing system with fresh water.

Polyvinyl Alcohol (PVA)

Residual polyvinyl alcohol should be flushed with fresh water. Insoluble films of PVA should be cleaned from the equipment as completely as possible prior to introducing a **BREOX QUENCHANT**.

Soluble Oil

Residual soluble oil should be removed by flushing the system with warm water or the application of a steam cleaning technique. This is critical since the soluble oil will emulsify in **BREOX QUENCHANT** and reduce quenching speed.

Petroleum Oil

This quenchant should be drenched from the system, following which sludge and varnish should be removed from the tank and heat exchanger surfaces.

Unless the degree of agitation within the system is high, petroleum oils will not emulsify in **BREOX QUENCHANTS** and thus, because of their lower density, will move to the bath surface. Significant volumes should be skimmed off to reduce the potential fire hazard. Minimal amounts may be allowed safely to burn off.

BREOX QUENCHANTS have a solvent action on petroleum oil degradation products, consequently heat exchanger surfaces will be cleaned and made more efficient. Similarly these products will be removed from the packing glands of pumps and system seals. Thus periodic checks for leaks resultant from the removal of these films are recommended.

Other Polymer Quenchants

Residual quenchant should be flushed from the system with fresh water as completely as possible prior to introducing a **BREOX QUENCHANT**.

BREOX QUENCHANT NF-18 SHOULD NOT BE MIXED WITH NITRITE CONTAINING MATERIALS. See Note after section on precautions.

The water content of **BREOX QUENCHANTS** will swell cork or leather gaskets and seals which may result in leakage. On conversion to a **BREOX QUENCHANT** these materials should be replaced with natural or synthetic rubber.

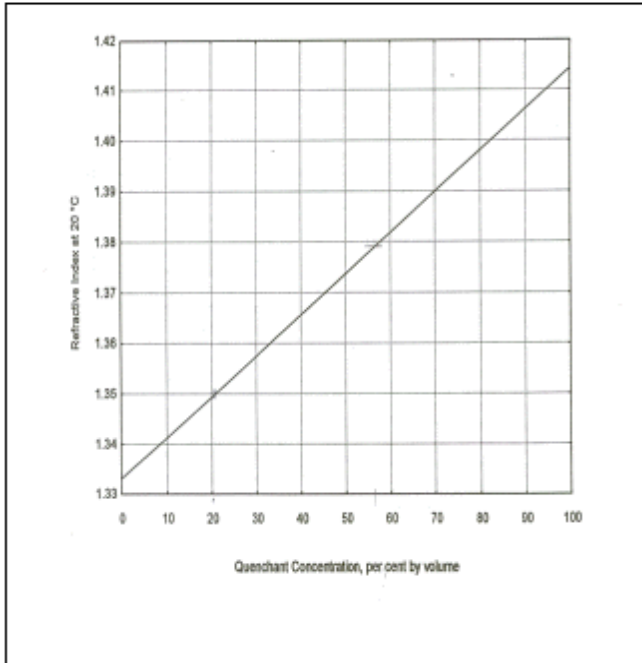
MAINTENANCE OF QUENCHING SYSTEMS CONTAINING BREOX QUENCHANTS.

Determining Fluid Concentration

To retain optimum bath performance the appropriate concentration of **BREOX QUENCHANT** in water must be regularly monitored and maintained. There are a number of different procedures available to do this.

Refractive Index

Concentration may be readily determined by measurement of refractive index, the direct relationship being shown below.



Adjustment of concentration.

Where the concentration has fallen, the chart below enables the user to calculate the BREOX Quenchant top up to bring the concentration to the required level.

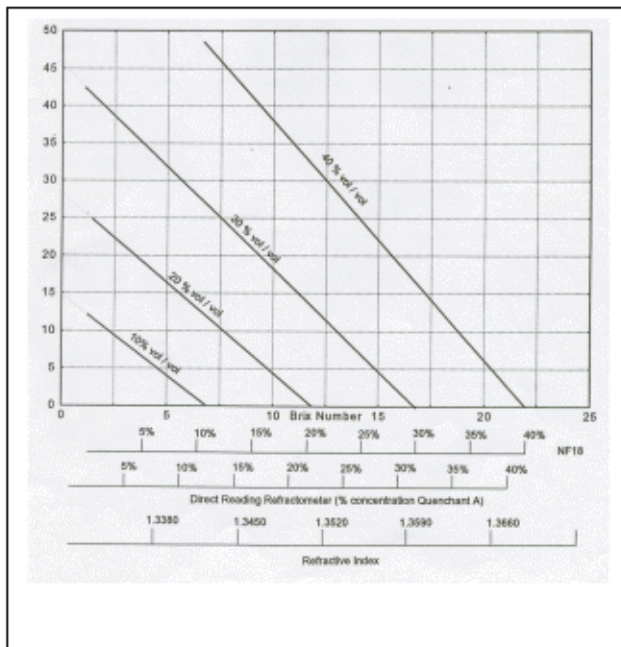
The equation below is for use where the concentration of BREOX Quenchant has increased, and therefore a water top-up is necessary:

$$\text{Water Top Up} = C - \left[Q + \frac{(100-R)}{R} \right]$$

Where

- C = System capacity
- Q = Original volume of undiluted BREOX quenchant in the system
- R = Refractometer reading of % BREOX quenchant in the system

Where a direct reading refractometer is not used, the Brix Number or refractive index reading can be converted to % **BREOX QUENCHANT** by using the chart below. The direct reading refractometer is available from Bellingham and Stanley Limited, Polyfract Works, Lonfield Road, Tunbridge Wells, Kent, TN2 3EY, UK.

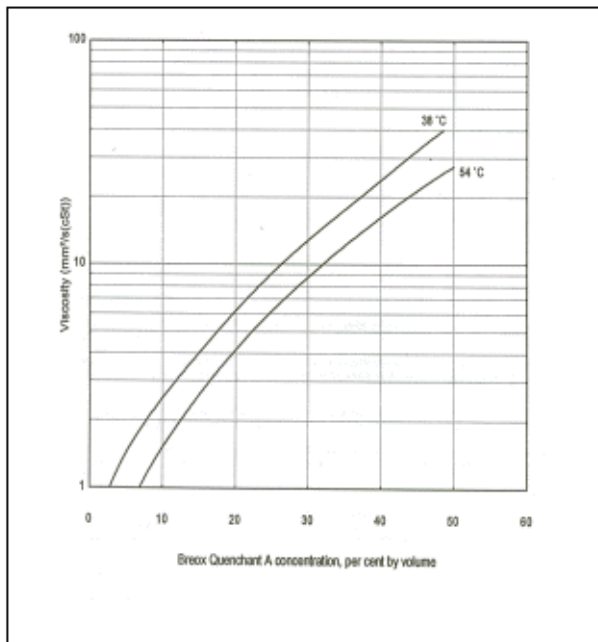


Example:

Brix No: 10. Required concentration of BREOX Quenchant– 20% vol/vol; system capacity 5000 litre; additional BREOX Quenchant to be added to system:

$$5 \times \frac{5000}{100} = 250 \text{ litre}$$

VISCOSITY



A useful double check on concentration may be achieved by the measurement of Kinematic viscosity. The diagram over indicates the direct relationship between viscosity and quenchant concentration. It should be noted that accurate temperature control is essential when making determinations. A viscosity check every two or three months is recommended.

CORROSION INHIBITION

BREOX QUENCHANTS contain a corrosion inhibitor package at a level suitable for the protection of copper, aluminium, cast iron, steel and brass. However, incompatibility may be encountered with copper and its alloys in the presence of furnace atmospheres containing ammonia.

The inhibitor package is not designed to overcome problems associated with the use of hard water or water with a high dissolved salt content. Under these circumstances **BREOX QUENCHANTS** should be diluted to the working concentration with deionised or distilled water, the use of additional corrosion inhibitor is not recommended. It should be noted that the corrosion inhibitor may be depleted in service. Advice on the methods for periodic checking of inhibitor level to ensure its maintenance at the correct operating level are available from your local CPC Sales Office.

BREOX QUENCHANTS do not confer corrosion protection to the surface of the heat treated components. After removal from the quench tank aluminium components should be given an agitated water rinse of appropriate duration to remove any residual quenchant. With a salt bath installation this procedure will give the additional benefit of removing any adherent salt deposits.

COMPATIBLE COATINGS

In view of the corrosion protection offered by **BREOX QUENCHANT** solutions, coatings should rarely be necessary. However, if they are to be employed it is important to ensure that they are compatible with the product.

BREOX QUENCHANTS will soften and lift most phenolic coatings and, whilst filters may be used to remove the paint particles, it is recommended that questionable coatings be removed prior to initial system fill. Generally a two-pack epoxy based or polyurethane paint system

will be satisfactory for use up to 65°C.

CONTAMINATION AND FLUID LIFE

Salt Bath Heating

Salt carry-over between the salt bath solution treatment furnace and the quench tank is unavoidable. Therefore **BREOX QUENCHANT NF-18** is NOT suitable for use for use in conjunction with nitrite/nitrate salt mixtures. Under these conditions the use of **BREOX QUENCHANT A** is recommended.

Salt contamination will increase the quench speed of **BREOX QUENCHANTS**. This is not detrimental to material properties providing it is kept within established limits. A further effect of salt is to distort refractometer readings, therefore bath maintenance should be performed with care. If a sufficient concentration is achieved, the organic polymer in **BREOX QUENCHANTS** may be salted out of solution.

In production systems with salt bath heating the salt content of a **BREOX QUENCHANT** will have to be periodically measured and the refractometer readings adjusted accordingly. When the bath becomes heavily contaminated or exceeds established limits, **BREOX QUENCHANT** may be recovered by the following procedure.

Heat the fluid above the cloud point, it will separate into two phases, the salt being preferentially contained in the water phase. The contaminated water phase can then be drawn off and replaced with fresh water. The inhibitor level should also be checked and adjusted as necessary.

A more detailed explanation of the use of **BREOX QUENCHANTS** in conjunction with salt bath heating is available as a Customer Service Report from your local CPC Sales Office.

Other Contaminants

Table 1 identifies the effect of a number of other contaminants the quench speed of **BREOX QUENCHANT A** as indicated by GM Quenchometer results of an 11.2 volume per cent **BREOX QUENCHANT A** solution.

Contaminant	Quenchometer Time (Seconds)
None	8.1
1% synthetic cutting fluid	8.5
1% general purpose cutting oil	12.6
1% soluble oil	18.7
1% petroleum oil	17.9
1% general purpose grease	20.1
1% inorganic washing machine compound	5.2

Foaming

Under conditions of high agitation **BREOX QUENCHANTS** may be subject to slight foaming which is of no consequence in the heat treatment operation. However, when air is entrained, foaming will be aggravated particularly when drawn in through circulating pumps. Therefore, inlet ports of pumps should be covered in fluid at all times.

If the system cannot be operated without air entrainment the addition of a suitable antifoam agent can often be of benefit. Consult your local CPC Sales Office for advice.

STORAGE AND HANDLING

The solution of organic polymer in water constituting a **BREOX QUENCHANT** is stable and non-flammable. The corrosion inhibitor package employed makes it safe for use with common metallic materials of construction.

These products are normally shipped, stored and used in steel containers and associated equipment. **BREOX QUENCHANTS** freeze at around 0°C and become highly viscous below around 20°C, room temperature storage is recommended.

A centrifugal pump will be satisfactory for handling viscosities up to about 500 centistokes. For higher viscosities a positive displacement pump is suggested. The pump motor and piping diameter must be sized adequately for the maximum viscosity expected to be handled. For intermittent service, full-bore ball valves will minimise pressure drops in the piping system.

Since **BREOX QUENCHANTS** are safe to store and handle, bulk storage tanks may be located inside a building. If outside storage is planned, and underground tank, or a heated and insulated tank, should be considered in cold climates. The storage tank may be vented directly to the atmosphere.

In prolonged and quiescent storage, evaporation and condensation of moisture may cause a layer of diluted solution to form at the liquid surface. Thus samples should be taken from the bulk of the stored product and not from the surface region, or the liquid should be circulated prior to sampling to ensure homogeneity.

HEALTH AND SAFETY

Material Safety Data Sheets have been issued describing the health safety and environmental characteristics of these products together with advice on handling precautions and emergency procedures. This must be consulted and fully understood before handling, storage and use of these products.

PRECAUTIONS

BREOX QUENCHANT NF-18 must not be used in conjunction with other nitrite containing quenching fluids. When converting an existing, nitrite containing, polymer quench system it is important to ensure that all traces of nitrite have been removed, e.g. by the use of test papers or a colourimetric technique, prior to the introduction of **BREOX QUENCHANT NF-18**.

PACKAGES

BREOX QUENCHANTS are available in bulk or barrels.

DISPOSAL

In the unlikely event that a quench charge of **BREOX QUENCHANT** requires disposal, two main techniques are available:

- Incinerate the neat polymer, with support fuel after it has been recovered by heating the charge above the inverse solubility temperature.
- With the agreement of the appropriate local authorities the charge may be used as land fill at an approved site.

Remarks

Handling & Safety:

Storage:

Revision-No.

1.3-08.2004 Effective August 17, 2004

The product can be stored for at least 2 years at ambient storage conditions and temperature without any deterioration.

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