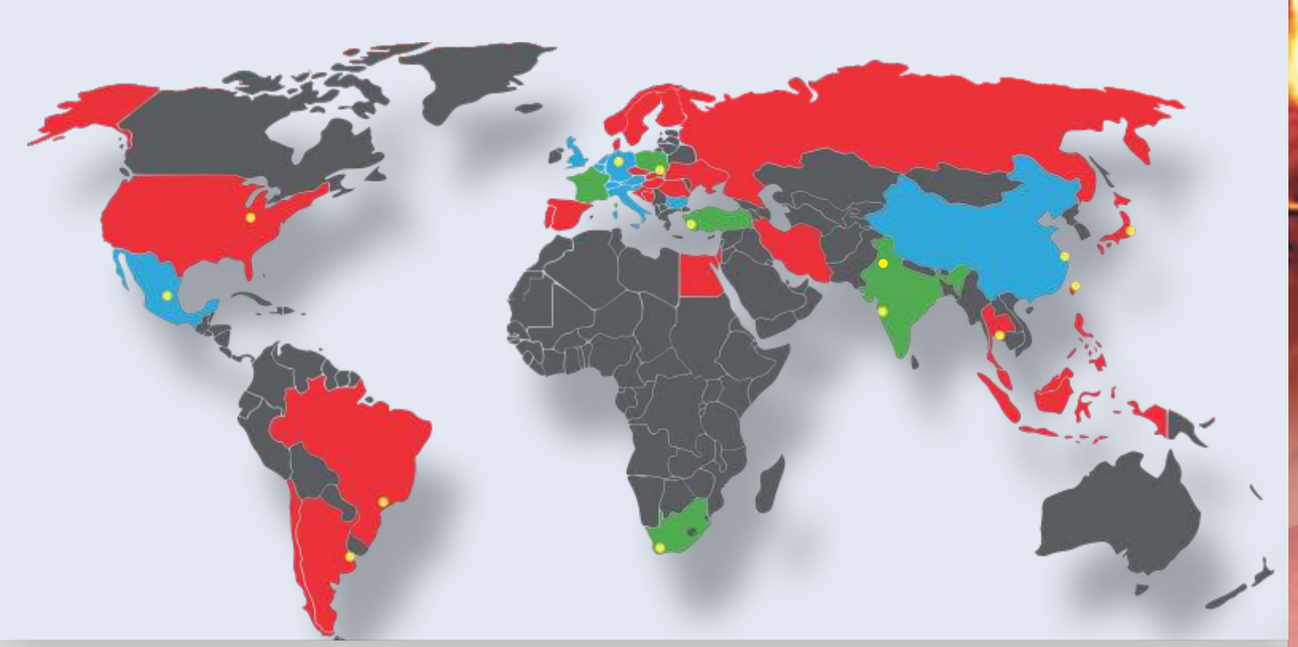

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HARDCASTLE PETROFER
industrial oils and chemicals

Quenchants

For the heat-treatment of steel,
cast iron and aluminium alloys

HARDCASTLE PETROFER
industrial oils and chemicals

Solutions for Metal Processing

An Introduction .....

Welcome to Hardcastle Petrofer Private Ltd. (HARDCASTLE PETROFER), a joint Venture between the Jatias of HARDCASTLE group and the world renowned PETROFER Germany.

About the Partners.....

HARDCASTLE has made pioneering efforts during its long market presence in the Indian Metal Processing Chemicals field.

HARDCASTLE was the first to introduce advanced technology products such as Polymer Quenchant and Fire Resistant Hydraulic Fluids to the Indian Industry by indigenously manufacturing and supporting the performance through unmatched service back-up.

HARDCASTLE is an approved supplier to an entire spectrum of leading industrial organizations in the Private and Public sectors in India. Many products of HARDCASTLE are already being used by some leading industries on an exclusive basis.

On the other hand, from its origin in Central Europe, PETROFER has developed a worldwide network of associates and distributors to ensure that the needs of its international customers are met completely. PETROFER's commitment to quality assurance and the environment is reflected in it's accreditation to the DIN EN ISO 9001, QS 9000, VDA 6.1 and DIN EN ISO 14001 standards.

The excellence of PETROFER's product range is the result of the Company's philosophy of continuous improvement and the dedication of its personnel at its development centre in Hildesheim, Germany.

About us.....

Thus, HARDCASTLE PETROFER is an unparalleled combine of an Indian Company AND a German Company both having served their respective industries for over half a century. They have come together to complement each other's expertise and serve the Indian industry with their combined strength. The objective - to exceed the highly specialised expectations of varied customer needs.

HARDCASTLE PETROFER's Indian manufacturing facility is located at Sarigam (near Vapi), Gujarat. You can always depend on HARDCASTLE PETROFER's team of qualified and experienced chemists and engineers, who will work with you to find the optimum solution to your needs.

HARDCASTLE PETROFER offers products which play a vital role in a wide variety of industrial applications.

Table of Contents

1. General Information on quenchants

1.1 HARDCASTLE PETROFER and quenching

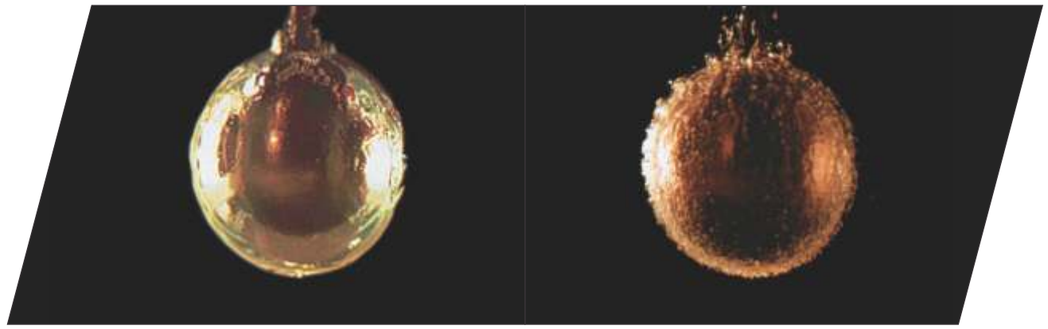
The metallurgical properties of heat-treated steel components are primarily dependent upon the austenitizing conditions, the hardenability of the steel and the quenching process used.

Modern heat-treatment processes are continually making new demands on quenching fluids and HARDCASTLE PETROFER's extensive development programmes ensure that our product technology is more than capable of meeting these new requirements. These programmes are designed not only to improve the technical properties of our quenchants, but also to provide economic and environmental benefits.

We are constantly screening new raw materials for their suitability for use in quenchants and our existing product range is reviewed continually to ensure that the best available technology is used.

We also collaborate with equipment manufacturers & our valued costumers for developing new products according to their specific needs. By using this approach backed by our in house capability & knowhow, we are able to offer the most comprehensive range of quenchants available today:

MEDIUM SPEED QUENCHING OILS
ACCELERATED QUENCHING OILS
BRIGHT QUENCHING OILS
HOT QUENCHING OILS
VACUUM QUENCHING OILS
WATER-BASED POLYMER QUENCHANTS
MOLTEN SALT BATHS
CUSTOMISED QUENCHING OILS



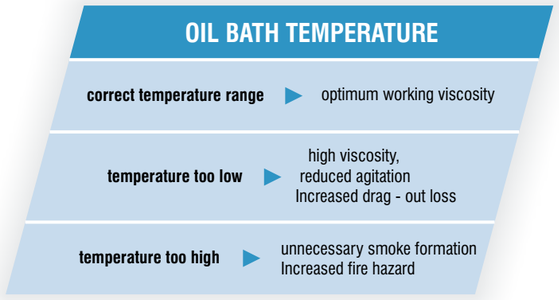
By having our own extensive development facilities and a complete range of products we can ensure that the best solution to suit customers needs is achieved. Many factors are important in choosing the most suitable quenchant:

- hardenability of steel
- component details (component geometry)
- metallurgical properties required
- furnace equipment
- operator safety
- post-treatment
- environmental issues

As many variables often have to be considered, it is important that a comprehensive knowledge of the quenchant is available i.e.

- physical and chemical data
- quenching properties
- thermal and ageing stability
- physiological and ecological properties

This brochure provides a general overview of quenching and details of various quenchants in our range and their potential applications.



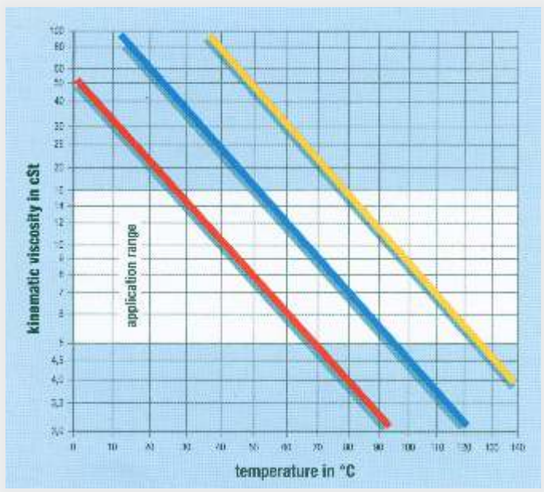
1.2
Physical and Chemical data

Important data used for identifying petroleum products are typically: viscosity, flashpoint and specific gravity. However, unfortunately these properties do not determine the suitability of an oil for use in quenching.

Figure 1 below shows that using quench oils within the recommended working temperature range ensures optimum viscosity for minimal drag out and low product consumption.

Flash-point is, however, especially important since it limits the application temperature range of an oil. Typically the upper temperature limit should be approximately 60°C below the oil's flash point.

Specific gravity of a pure mineral oil can give an indication of its origin. However, it can be significantly modified by additives and therefore the quality of a quenching oil cannot be determined on the basis of its specific gravity.



Low viscosity accelerated quenching oil
accelerated quenching oil, high vaporization stability
hot quenching oils.

Figure 1:
Application temperature range as a function of oil viscosity for various types of quenching oils.

1.3
The quenching process

A quenchant is characterized primarily by its quenching properties and these are difficult to describe in words. Descriptions such as "severe" or "mild" are of little use in technological era. The quenching process can however be studied using test probes such as:

- nickel and nickel alloy probes: cylinders 12,5 mm Ø (ISO 9950) or a ball (GM-test)
- steel probes, 3-80 mm Ø (Meinhardt-method)
- a silver ball, 20 mm Ø (MPI-silver ball method)
- silver cylinders 8 or 16mm (Cetim method AFNOR NFT 60178)

Usually the cooling effect of a quenchant is shown by charting temperature vs time or rate of cooling vs time. Figure 2 shows the relationship between these two methods. For all quenchants whose boiling range is below the component temperature there are 3 phases in the cooling process as shown in Figure 3 on the following page. Their importance in the quenching process is described in the following pages:

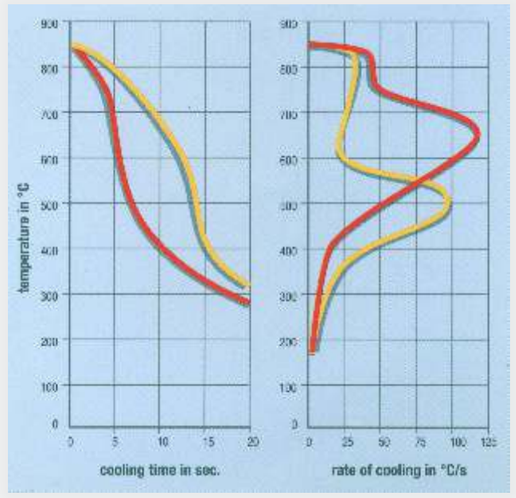


Figure 2:
Various ways of showing the cooling characteristic of a quenchant

1.3.1
Vapour blanket phase:

A vapour “blanket” is formed on the component immediately after immersion in the quenchant. This vapour layer acts as an insulator because of its low thermal conductivity and therefore the cooling rate in this phase is low.

The duration of this phase depends essentially upon the quenchants composition. Our accelerated quenching oils have a very short vapour blanket phase and, in this respect, are superior to most other quenching oils.

A short vapour blanket phase is not only necessary to avoid undesirable pretransformation microstructures, but it also ensures a steady lowering of temperature on the total surface of the component, thus minimizing thermal stress and distortions.

INFLUENCE OF THE COOLING PHASES

short vapour phase	▶	fast, homogeneous cooling of the entire work piece surface
wide boiling phase	▶	good heat extraction from larger diameters
cooling properties in the convection phase	▶	can be influenced strongly by agitation

1.3.2
Boiling Phase

After a period of time, depending upon the quenchant and component geometry, the vapour blanket starts to break down and the boiling phase begins.

Heat is conducted away at an increasing rate by evaporation of the quenchant at the component’s surface. The rate of cooling reaches its maximum, and as the surface temperature falls, boiling becomes weaker and finally ceases.

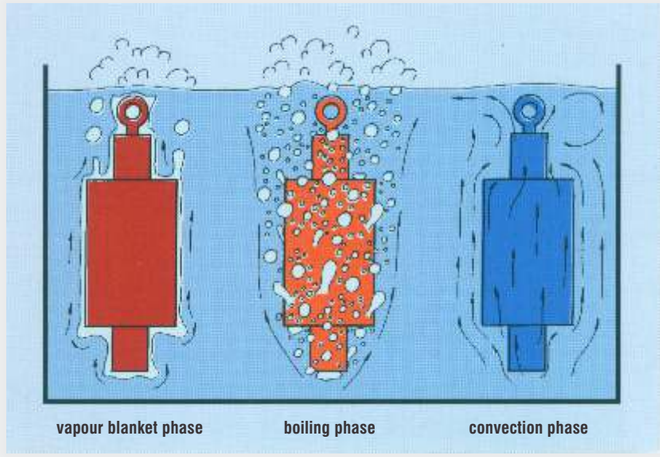


Figure 3:
The phases of the cooling process of quenchants having a boiling temperature below the quenching temperature.

1.3.3
Convection phase

In the last phase of cooling, heat is conducted away only by convection. Consequently cooling in this phase can be significantly affected by circulation of the quenchant.

A high degree of cooling in the convection phase will result in deeper hardening of the component.

For evaluation of the cooling curves shown in Figure 2 (page 7), the following points are therefore important:

- duration of the vapour blanket phase
- temperature range of the boiling phase
- the cooling rate during the convection phase and the temperature at which it begins.

The maximum cooling rate cannot be used to compare quenchants as it only shows the steepest slope of the temperature/time curve, and not the position of the curve in relation to the TTT diagram.

The TTT diagram in Figure 4 shows that the duration of the vapour blanket phase is of considerable importance in the selection of a quenchant. A short vapour blanket phase is necessary when quenching low alloy or plain carbon steels as only a few seconds (or, in extreme cases, fractions of a second) are available for the temperature to fall below the critical temperature range of approx. 600-500°C. If this requirement is not met, undesirable soft structures such as bainite, pearlite, troostite and possibly ferrite occur.

For the hardening of alloy steels, where the TTT curve lies further to the right, the duration of the vapour phase is less critical, but the comments made in section 1.3.1 regarding uniform cooling of the surface to reduce thermal stress and distortion, should be considered.

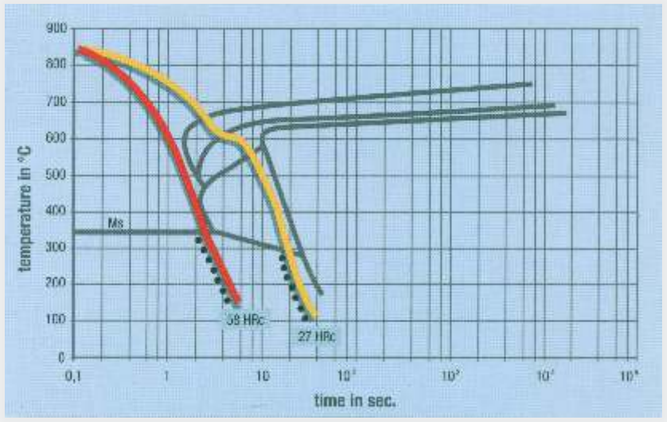
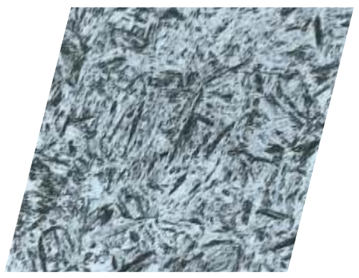
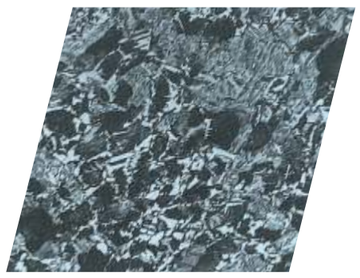


Figure 4:
Effect of various cooling characteristic relative to achievable hardness.
(TTT- diagram C 45, unalloyed steel 0.45% C)



58 HRC



27 HRC

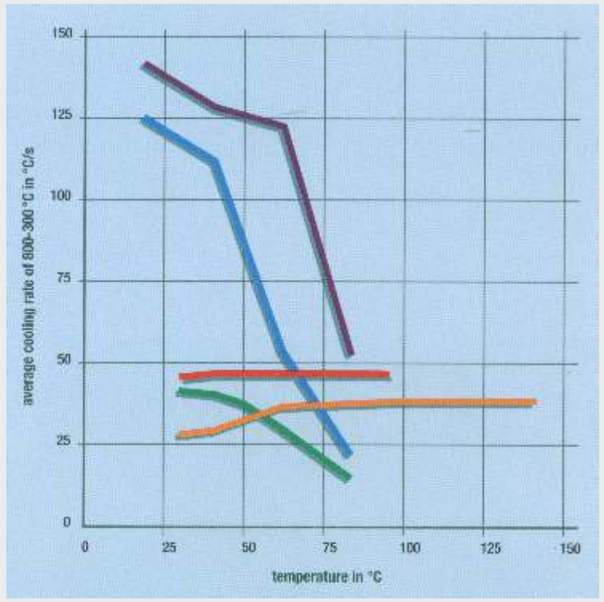
1.4

The effect of bath temperature on the quenching process

Quenching oils do not, for all practical purpose, change their cooling characteristics when their bath temperature remains within the recommended working range.

Only extremely low or greatly elevated temperatures lead to lengthening of the vapour phase, and thus a change in the performance of the oil.

However, aqueous quenchants are affected considerably more by bath temperature. This is caused by the much smaller difference between the working temperature range and the boiling range of aqueous solutions in comparison with oils (water boils at about 100°C, whereas oils boil from about 300°C upward). Consequently, when aqueous media are being used, bath temperatures must be kept constant within relatively narrow limits. Figure 5 shows the influence of bath temperature on the quenching performance of several fluids.



Water additive salt
Water
Low viscosity accelerated quenching oil
Hot quenching oil
Up - Concentration type Polymer quenchant

Figure 5:
Change in quenching speed in relation to bath temperature (shown schematically)

INFLUENCE OF THE BATH TEMPERATURE ON THE QUENCHING PROPERTIES	
quenching oils ▶	insignificant when the oil is within its working viscosity range
polymer solutions ▶	considerable, depending on the type of polymer, may be used advantageously to achieve special quenching properties
water ▶	very distinctive

The increase in bath temperature of the quenchant can be calculated using the following equation:

Mass (metal) X Specific heat (metal) X Fall in Temperature (metal) = Mass (quenchant) X Specific heat (quenchant) X Increase in Temperature (quenchant)

The temperature of the quenching oil must be maintained within recommended range as it can significantly influence the life of the oil, drag out loss & distortion of components. Various types of Heat Exchangers viz. Shell & Tube, Plate Type, Forced Air Cooled can be used for control of temperature.

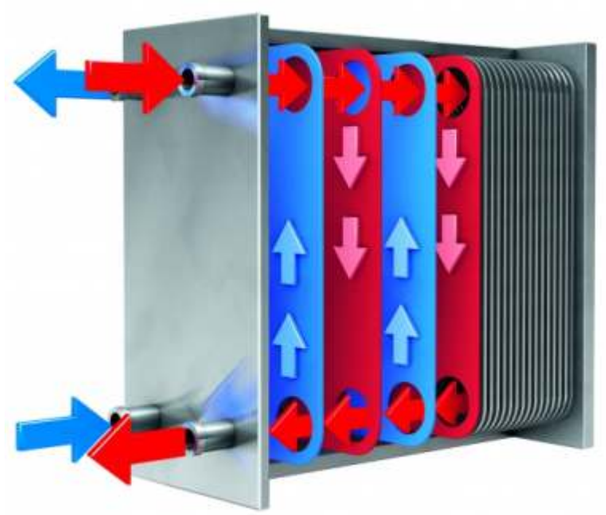


Plate Type Heat Exchanger

STABILITY OF QUENCHANTS	
high evaporation stability of oils ▶	helps reducing troublesome smoke formation, reduces consumption
good oxidation stability ▶	long service life, prevents formation of oil sludge
thermal stability ▶	insignificant smoke formation no change in the basic properties

1.5
Ageing resistance, service life and consumption

Resistance to evaporation has a considerable effect on consumption and thus on oil bath economics. Experience has shown that, on batch quenching, probably more oil is lost through evaporation than through “drag-out” by the components.

Ageing resistance is, however, of the greatest importance in determining the economics of any oil bath. Oils having poor oxidation resistance will form a sludge, after a short period in use, and this normally results in deposits on the cooler, the coldest place in the quenching bath.

Ultimately, discoloration appears on the surface of the treated components which is either difficult, or impossible, to remove. At this stage replacement of the oils is unavoidable.

During the development of our quenching oils we have placed great emphasis on their resistance to oxidation (ageing) by using highly stable base oils and, in many cases, sophisticated proprietary additive packages.

Several important points need to be observed, when using an oil bath, in order to achieve the optimum operating conditions.

Quenching oil with good ageing resistance after an oxidation ageing test.

Quenching oil with poor ageing resistance after an oxidation test.

In order to keep the thermal loading within limits, and also to avoid severe variations in the working temperature of the bath, a relationship between the weight of the batch (or hourly throughput of the furnace) and the volume of quenchant must be maintained.

This relationship depends upon the conditions of use of the oil and upon the size of the components. Larger components which take longer to cool cause a lower thermal loading to the oil bath than tightly packed batches of small components which give off their heat rapidly.

Consequently the following values can be used as a guide to the relationship between the weight of quenching oil and the gross weight of the batch to be quenched.

– open oil baths: 10:1

– sealed furnaces: 10:1 to 7:1

– hot quenching oils used at their highest temperatures 10:1 to 15:1

These values can also be used where quenching of small batches at short intervals takes place and the hourly throughput of steel is then used in the calculation.

The following points must be observed, in particular when operating open hot oil baths:

- the cooling and the heating elements should not be made of copper as this acts as a catalyst in the oxidation of all mineral oil product.

- the level of agitation in the system must not be excessive such that air is drawn into the oil. This condition will result in foaming and increased oxidation of the oil.

- the heating area loading of the heating elements should be limited to about 1 W/cm^2. If a higher loading is used, good movement of oil in the area of the elements must be maintained to avoid overheating.

The life of water-miscible quenchants is usually limited by several factors. In the case of surface hardening operations the solution often has to be replaced because of the effects of contamination from previous processes.

The thermal loading can also take its toll in the long term. In view of this, and the need to control the concentration of solution, monitoring is required for these products.

1.6
Safety precautions

Quenching oils are combustible liquids and in the quenching process the temperature of the components being treated is usually well above the flash point of the oil. However, if simple precautions are taken, there are no fire hazards in practice.

Ingress of water into quenching oil bath (typically through a leaking cooler or as condensate) does, however, create a special hazard. As little as 0, 1-0, 3% water-contamination can considerably increase the fire hazard as well as significantly change the quenching characteristics of the oil.

Immersing the charge completely in the quenching oil is essential to avoid fire hazard. Maintaining the quench oil level to ensure sufficient head of quenching oil above the surface of the components is also recommended.

It is advisable to turn on the agitation of quenching oil before start & during the quenching cycle.

NEGATIVE FACTORS WHEN WORKING WITH QUENCHING OILS

contamination with water	▶	change of the quenching properties, high fire hazard
bath temperature too close to the flash point	▶	increased fire hazard
Immersion speed of the batch is too low	▶	strong flame formation, increased fire hazard, greater soot and smoke formation
contamination with fire extinguishing medium	▶	certain extinguishing powders as well as all foams change the quenching characteristic and other properties
drag-in of soot	▶	may lead to stains on the work pieces

1.7
Maintenance and monitoring

Aqueous quenchants must be carefully monitored with respect to both the operating temperature and the concentration of the solution. Relevant instructions have to be carefully followed to ensure successful result.

Under normal operating conditions quenching oils do not require regular monitoring. Attention should, however, be paid to ensuring the working temperature of the oil is maintained and that the temperature never exceeds one which is at least 60°C below the oil's flashpoint before quenching a batch. The oil should also be regularly checked for water contamination .

We recommend checking oil baths at least annually and water-miscible quenchants at shorter intervals depending upon the operating conditions.

1.8
Cleaning heat-treated components

When water – miscible quenchants are used, post cleaning of the heat-treated components is often unnecessary, even before tempering. However, when high concentrations are being used, rinsing of the components is recommended.

HARDCASTLE PETROFER's quenching oils will produce hardened components with a bright finish, providing of course there was no prior surface oxidation. The components are suitable for further treatment, such as electroplating, without problems. Oil residues do not burn into the surface of the metal and therefore can be easily removed.

Removal of quenching oil generally requires the use of hot aqueous cleaners, or use of water washable quenching oil. Degreasing with solvents in a soak tank or in vapour is also possible.

The hot cleaner chosen should be formulated to provide rapid release of the quenching oil so that it can be easily removed from the wash tank.

HARDCASTLE PETROFER has developed "HICLEAN" for this purpose, thus enabling wash water to be used for longer periods with savings in disposal costs. For removal of separated oil the use of weir systems or oil skimmers is recommended.

Even emulsions from water washable quenching oils are destabilized when small quantities of HICLEAN (0.5 – 2%) are added to the washing water.

Centrifuges also enable very good oil separation from the wash and can be used for both conventional and water washable quenching oils.

In the following pages our range of quenchants is presented. Individual product information is available for all the products listed, on request.

NEGATIVE INFLUENCES ON THE CLEANING PROCESS		
insufficient agitation in the cleaning bath	▶	remaining oil residues, especially, in tightly packed batches
insufficient oil separation from the washing bath, insufficient washing properties of the cleaner	▶	oil residues remain on the parts, trouble some smoke formation during tempering
insufficient skimming, oil floating on top of the washing bath	▶	washed batch may pick up oil when being withdrawn

2. Quenching oils

2.1
Medium Speed Quenching Oils

Medium speed quenching oils are recommended for general purpose applications. These oils are formulated with high quality base oils, additives for high oxidation stability & speed improvers. They offer normal quench severity which makes them suitable for hardening of low & high alloy steel grades.

They are normally used in open quench tanks due to their higher oxidation stability characteristics

Typical Applications of Medium Speed Quenching Oils are:

- Hardening of Automobile Forgings
- Hardening of Heavy Forgings
- Hardening of Bearing Races
- Quench Hardening of Tool Steels
- Hardening of Martensitic Grades of Stainless Steel

Product	Viscosity at 40°C (cSt)	Flash Point (°C) Min	Normal Operating Temperature Range°C
HIQUENCH N	27	160	30-80
HIQUENCH 42(M)	22	190	30-80
HIQUENCH M	28	190	30-80
HIQUENCH 311	30	206	30-80

2.2

Medium Fast Speed Quenching Oils

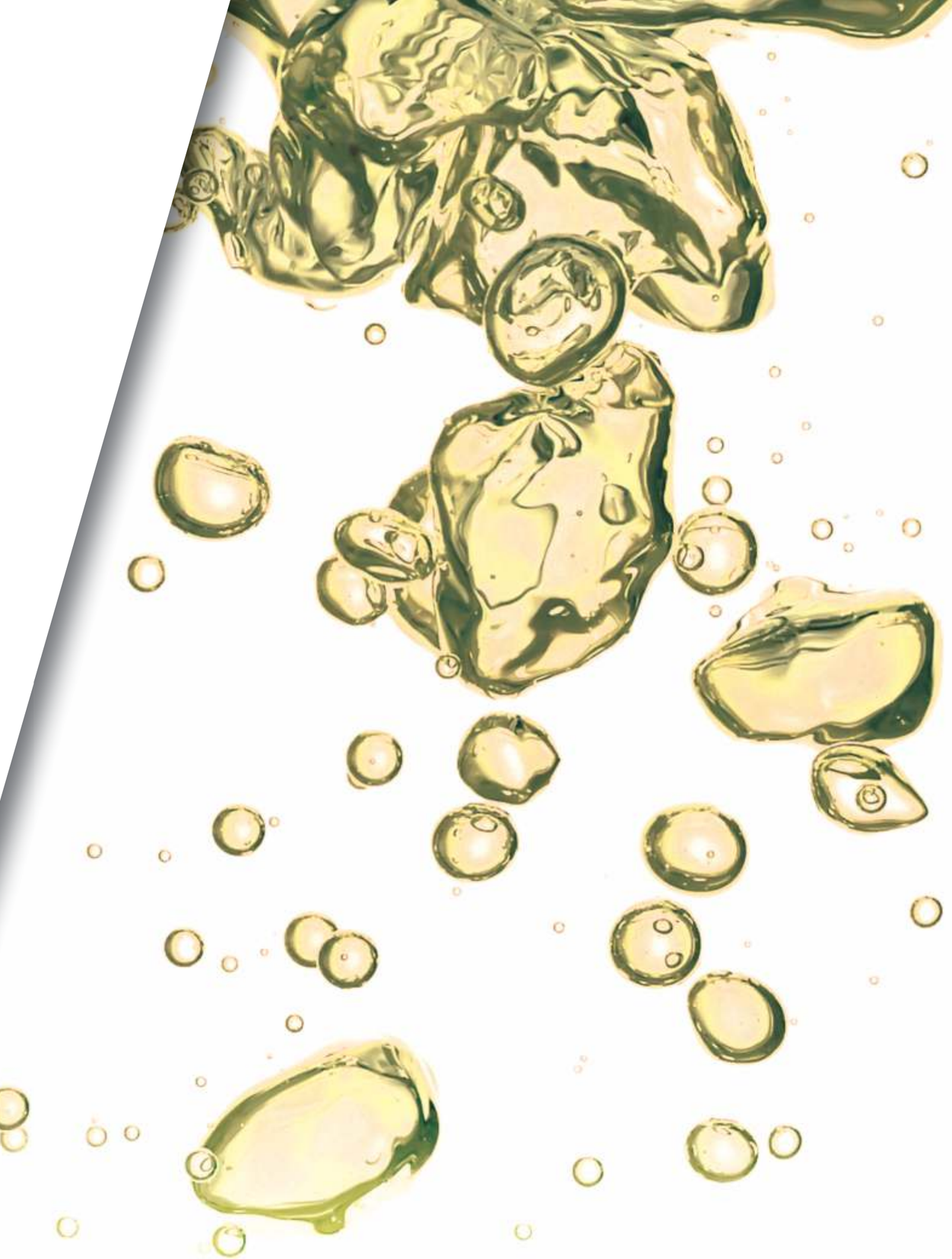
Medium Fast Speed Quenching Oils are formulated to enhance quenching performance. These oils are used mainly in hardening of plain carbon & alloyed steels.

These oils are normally used in continuous furnaces & sealed quench furnaces

Some typical applications are:

- hardening of high tensile bolts, screws, nuts, washers, etc
- hardening of hand tools
- heat treatment of steel bars & sections
- hardening of leaf & coil springs
- hardening of case carburized parts including transmission gears & shafts
- hardening of bearing races
- hardening of automobile forgings

Product	Viscosity at 40°C (cSt)	Flash Point (°C) Min	Normal Operating Temperature Range°C
HIQUENCH MF	22	178	30-80
HIQUENCH MF(A)	20	190	30-80
HIQUENCH MF PLUS	22	180	30-80



2.3
Fast Speed Quenching Oils

Fast Speed Quenching Oils have been especially formulated for use in sealed quench furnaces. They exhibit short vapour phase and high quench severity. Hence the quenched parts in the batch are uniformly and rapidly cooled.

These oils are therefore used successfully for low distortion hardening of large diameter & heavy transmission gears & parts where high core hardness is required, hardening of components of low/lean alloys steels.

Product	Viscosity at 40°C (cSt)	Flash Point (°C) Min	Normal Operating Temperature Range°C
HIQUENCH ISX	16	160	40-70
HIQUENCH SF	17	174	40-80
HIQUENCH S(A)	26	180	40-80
HIQUENCH SF 195	27	190	50-80

2.4
Marquenching Oils

Marquenching Oils are also popularly known as Hot Quenching Oils. Following the development of new additives these oils can now offer better cooling properties & high oxidation resistance at higher operating temperatures. This allows new standards to be set for the operation of hot oil with respect to:

- quenching speed
- distortion control
- service life

Optimum hardness and lowest distortion can be achieved because of the extremely short vapour blanket phase and the slow cooling rate during martensite transformation.

Product	Viscosity at 40°C (cSt)	Flash Point (°C) Min	Normal Operating Temperature Range°C
HIQUENCH MT 650	65	226	80-120
HIQUENCH MT 780	78	228	60-150
HIQUENCH MT 1115	112	245	80-180
HIQUENCH MT 400	40	210	50-150
HIQUENCH MT 1800	175	250	120-190

2.5

Special Quenching Oils

Due to our wide experience and technical expertise we are capable of developing customised quenching oils to meet specific customer requirements

Hot & Cold Quenching Oils

These are versatile quenching oils which have a wide operating temperature range and can be used alternately for marquenching as well as cold quenching applications. Hence these oils offer flexibility of operation and are most suitable for commercial heat treaters having a limited number of furnaces.

Product	Viscosity at 40°C (cSt)	Flash Point (°C) Min	Normal Operating Temperature Range°C
HIQUENCH MT 500 HC	50	222	50-150
HIQUENCH MT 780	78	228	60-150

Bright Quenching Oils

Our Medium Speed Quenching Oils & Hot Quenching Oils are also available with Bright quench additives which improve the surface finish of quenched components by preventing the soot deposits from sticking on the surface of the quenched parts. Typical applications are:

- carburized components such as automobile gears & shafts in sealed quench furnaces
- continuous furnaces for bearing races, fasteners

Water Washable Oils

These oils contain specially designed additives to enable the oil film after quenching to be rinsed off with plain water

Tempering Oils

Tempering oils are mainly used for:

- stress relieving and tempering of hardened parts
- heating parts for shrink fitting

Quenching Oils for vacuum furnaces

Vacuum quenching oils have been developed with the following special properties in order to achieve spotlessly clean surfaces:

- extremely high resistance to vaporization
- low gas absorption capacity
- rapid degassing capability
- extremely high degree of purity

3. Water-miscible Quenching Media

3.1
Polymer Quenchants

As has been shown, quenching oils cover a wide range of cooling performance, yet there is still a significant gap between the maximum achievable cooling rate of a low viscosity accelerated oil and that achievable with ordinary cold water.

Water-miscible quenchant which fill this gap are thus an ideal complement to the quenching oil range. Heat-treatment operation can be carried out with these water-based quenchants which would either be impossible or extremely difficult with an oil. This particularly relates to spray-quenching in induction and flame-hardening processes, where a high degree of fire risk exists when using an oil.

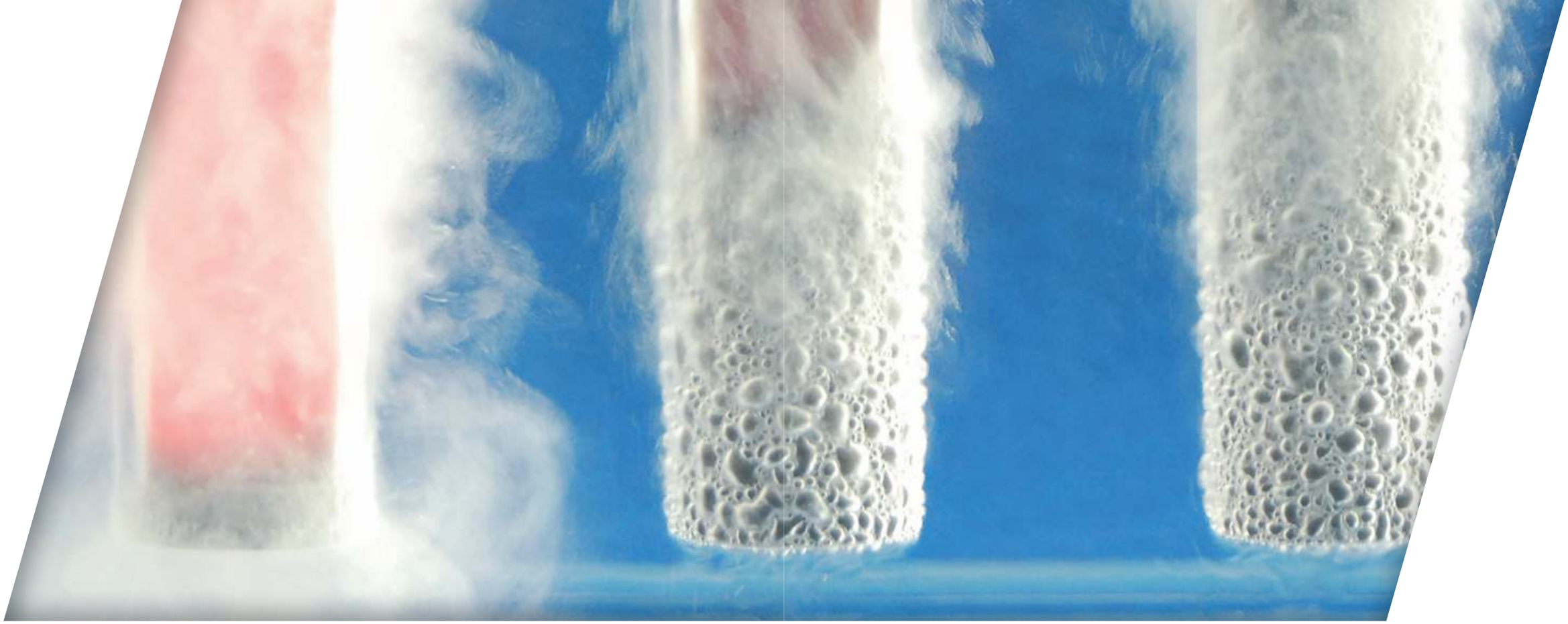
Emulsions have historically been employed in these applications instead of oil, but unfortunately they do not give the low cooling rates in the temperature range for martensite transformation necessary to reduce, or eliminate, the danger of cracking. These cooling characteristics can only be achieved with polymer quenchants.

As a result of our continuous development programmes, we are today able to offer users a complete range of water miscible quenchants which successfully covers the whole spectrum from oil-to-water quenching.

Accelerated quenching oils can already be replaced in a wide range of applications as polymer solutions are available which give comparable cooling characteristics. These solutions are therefore suitable for hardening alloyed quench and tempering steels and some tool steels, as well as for quenching components directly from forging.

Water miscible quenching media are today used to a high extent as a substitute fro quenching oils. It must be realised that these products contain from 60 to 98% of water in the ready-to-use condition, the level depending on the concentration to be used for a given application.

Due to high water content in polymer quenchant solutions the cooling rates in the boiling phase are usually higher than the rates in quenching oils.



All water-miscible quenchants are of course incombustible, and, in contrast to oil quenching, helps avoiding the risk from fume and fire. This is particularly useful when hardening forged parts directly from forging temperature and for interrupted quenching (time quenching) of components.

Our range of water-miscible quenchants is distinguished by high thermal stability. The products are low foaming, provide excellent corrosion protection and are not susceptible to attack by micro-organisms.

The use of water-miscible products can often be a new venture for customers and therefore it is advisable to discuss applications thoroughly. This is obviously not so important with induction and flame-hardening operations where the use of water-miscible quenchants has been established for many years.

However, for other applications, we recommend consultation with our Technical Service Representative to make use of our extensive experience in this field. This is particularly important if a quenching oil is being replaced.

In the following section our range of water-miscible quenchants is described, including emulsions and salt solutions.

3.1.1
Inverse Solubility Type Polymer Quenchants

Inverse Solubility Polymers exhibit inverse solubility in water i.e. they are soluble in water at room temperature, but insoluble above the inverse solubility temperature (normally 65 ^{o}C -70 ^{o}C) These polymer solutions reduce the quenching effect of water by virtue of the polymer in solution becoming insoluble at the inverse solubility temperature during the quenching process and plating out onto the hot surface of the component. The thickness of the insulating film formed varies with the concentration of the polymer in the original solution.

When the component cools to below the inverse solubility temperature of the polymer solution, the film starts to re dissolve completely, thus ensuring the drag out of the polymer to remain low. Hence these polymer quenching solutions are very economical in use.

Inverse Solubility Polymer Quenchants are used in quenching baths mainly for hardening low alloy, quench and tempering steels which are difficult to harden with quenching oil, but which are prone to cracking with water quenching. They can also be used for induction and flame hardening processes.

Inverse Solubility Polymer Quenchants can be used for a wide range of applications:

- quenching of forgings of low alloy and plain carbon steels for automobiles e.g. crankshafts, connecting rods, camshafts, etc
- quenching of steel castings
- quenching of bars & sections of low alloy and carbon steels
- hardening of hand tools, spanners, wrenches, tongs
- hardening of high pressure cylinders & seamless tubes
- hardening of carburised or carbo -nitrided small parts in continuous furnaces (chain & bicycle components)
- induction hardening of crankshafts, camshafts, gears, splines on shafts, slewing rings, axle shafts, velocity joints, etc

Product	Viscosity at 40^{o}C (cSt)	Application Temperature Range^{o}C
HIQUENCH P11	290	25-55
HIQUENCH P12	1450	25-55
HIQUENCH P122	435	25-55
HIQUENCH P21	71	25-55

Inverse Solubility Polymer Quenchants are also used for solution heat treatment of Aluminum.
Typical applications for Aluminum are:

- Sheet panels and sections in the aerospace industry
- Castings & Forgings used in automobile industry e.g. Cylinder heads, engine blocks, alloy wheels

3.1.2
Up-Concentration Type Polymer Quenchants

The New Generation Up-concentration type Polymer Quenchants provide an even more significant reduction (compared to Inverse Solubility Polymer Quenchants) in quenching speed when added to water at various proportions. Concentrations of 8-20% give cooling curves practically equal to those of quenching oils.

Reduction of the quenching rate, compared to that of water, is achieved by the formation of a polymer film on the part's surface during cooling. In the beginning of the cooling process a thin polymer film ensures uniform collapse of the vapour blanket and the start of the boiling phase.

With further cooling, an insulating film develops and the thickness of the film varies with concentration. Its insulating effect ensures a controlled heat flow from the component into the quenchant.

These Polymer quenchants are used to treat steels of higher hardenability e.g. for quenching alloyed, tempering and case-hardening steels and for hardening tool steels. Interrupted quenching of components is possible at any desired surface temperature.

These Polymer quenchants can be used for wide range of applications as listed below:

- Quenching of Open Die Forged Components like Turbine shafts, Seamless Rolled Rings, Valve Bodies
- Quenching of Bars, coils of Martensitic Stainless Steels
- Quenching of Die Steels, tool steels

4. Heat Treatment Salts

A range of quenchants is not complete without a selection of molten salts. These are used for austenising, quenching & tempering

4.1
Marquenching Salts

The various types of marquenching salts available are classified depending on their melting point and thereby their lowest application temperature. The maximum possible bath temperature for these products is 550 ^{o}C. At higher temperature thermal decomposition of the salt increases rapidly.

The quenching rate of these salts is reduced by carry over from hardening or carburizing salt baths, contaminants or by carbonate formation at higher temperatures. These contaminants have to be removed by desludging the bath periodically.

However the quenching action can be enhanced by adding water in quantities up to 2%

4.2
Hardening Salts

These are normally used for heating the components to austenising or hardening temperature. The salts can be selected depending on the operating temperature range required (from 500 to1300^{o}C)

4.3
Water additive Salts

Water and salt combinations have unique ability to shorten the vapour blanket phase. Consequently they can be used at temperatures of about 50^{o}C where as the quenching action of plain water decreases significantly above temperatures of 20 ^{o}C.

Water additive salts are used for hardening of plain carbon or free machinable carbon steels to attain maximum hardness.

Our range of water additive salts consists of HISALT WQA (nitrite free) & HISALT WQS (nitrite containing).

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Marquenching Salts

Product	Melting Point (^{o}C)	Application Temperature Range(^{o}C)	Application
HISALT 1150	135	160-530	Marquenching, Austempering
HISALT 1220	220	260-540	Austempering
HISALT 2460	460	500-900	Quenching of High Speed Steel

Hardening Salts

Product	Melting Point (^{o}C)	Application Temperature Range(^{o}C)	Application
HISALT 2550	550	575-900	Hardening
HISALT 660	640	700-900	Hardening
HISALT 2670	670	730-900	Hardening
HISALT 2840	845	900-1300	High Temperature Hardening

INTERNATIONALLY ACCLAIMED PETROFER BRAND PRODUCTS ARE ALSO AVAILABLE IN INDIA!!!

HEAT TREATING QUENCHANTS

Accelerated high performance quenching oils ISOMAX
Accelerated quenching oils with high evaporation stability ISORAPID; FASTQUENCH; SYNTHERM
Hot quenching oils MARQUENCH
Quenching oils for vacuum furnaces VACUQUENCH
Normal speed quenching oils ISODUR
Tempering oils and synthetic tempering fluids ISOTEMP; SYNTHERM
Water-washable quenching oils E-OILS
Polymer Quenchants AQUATENSID; AQUACOOL; FEROQUENCH
Quenching emulsion AQUANOL; BLACKYNOL WL
Water additive salts for accelerated quenching AQUARAPID

HEAT TREATING SALT BATH AGENTS

Hardening and high-speed steel bath HS; NEUTROSAL; SINOXAL
Carburizing and nitriding salt baths CARBOGEN; CARBORAPID; CARBOMAX; CARBOTECT; NITROGEN
Hot Quenching salt baths AS; GS
Blackening and black-finishing baths SFS; BLACKENING BATH
Special salt baths REINIGUNGSSALZ RS; HEAT TRANSFER SALTS
Carburization protection and anti-nitriding pastes SURFATECT

DIECASTING AND FORGING

Forging lubricants DIE FORGENT
Diecasting release agents and piston lubricants DIE-LUBRIC; PISTON-LUBRICANT; PISTON-POWDER
Special products for the diecasting industry TRANSTHERM; TEMPLUBRIC

FIRE-RESISTANT HYDRAULIC FLUID

ULTRA-SAFE 620; ULTRA-SAFE 1120;
HYDRO-COOL; ENVOLUBRIC HE

METAL CUTTING WATER-MISCIBLE PRODUCTS

High mineral –oil based coolants EMULCUT
Semi-synthetic coolant ISOPAL
Mineral-oil-free coolants ISOCOOL
Mineral-oil-free grinding fluids ISOGRIND; ISOGRIND G (Glass Grinding and Polishing)

METAL CUTTING NEAT OILS

General-purpose cutting oils, including biodegradable types ISOCUT VG; ISOCUT E
High performance cutting oils ISOCUT; ISOCUT R;
Honing and lapping oils SUPERFIN; ISOLAP
High-performance cutting concentrates PINGINOL

METAL FORMING, DRAWING, ROLLING

Drawing oils, pastes and emulsions DRAWLUB; ISOLUBE

INDUSTRIAL LUBRICANTS

Hydraulic Oils H, HL HLP, HLP-D ISOLUBRIC VG
Biodegradable hydraulic fluids TRIBOLUBRIC; SYNTOLUBRIC; ENVOLUBRIC
Gear Oils GEARLUBRIC; MOLYGEAR
Adhesion oils and slide-way lubricant WAYLUBRIC
Spindle oils SPEEDLUBRIC
Special grease GREASE; HAFTOL

RUST PREVENTIVES

Corrosion protection oils ISOTECT
Water-miscible rust preventives ISOTECT E; AQUAPLUS
Dewatering fluids DEWATER
Specialized products BLACKYNOL

CLEANING AND MAINTENANCE

Industrial cleaners water-miscible FEROCLEAN S, A and N
Industrial cleaners solvent-based FEROCLEAN L
Maintenance of water-miscible coolants FEROSEPT; CLEANSEPT; CONTRAFUM; SABOCLED

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