Tyfocor® L

Technical Information

® = Registered Trademark

Concentrate for long-term antifreeze and corrosion protection of heating and cooling circuits, solar and heat pump systems

Heat-transfer fluid - free of nitrites -

Glycol-based medium especially for the food and beverage industry

Edition: January 2004

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Tyfocor L

Properties

Appearance	clear, colourless liquid	
Boiling point	> 150 °C	ASTM D 1120
Pour point	< -50 °C	DIN ISO 3016
Density (20 °C)	1.054 - 1.058 g/cm³	DIN 51757/ASTM D 4052
Viscosity (20 °C)	68 - 72 mm²/s	DIN 51562
Refractive index nD20	1.435 - 1.437	DIN 51423
pH of concentrate	6.5 - 8.0	ASTM D 1287
pH of 1:2 dilution with neutral distilled water	7.5 - 8.5	ASTM D 1287
Water content	< 4 % w/w	ASTM D 1123/DIN 51777
Flash point	> 100 °C	DIN 51758
Alkali reserve	> 10-13 ml 0.1 n HCl	ASTM D 1121

Quality control

The above data represent average values that were valid at the time when this Technical Information Bulletin went into print. They do not have the status of a product specification. Specified values are the sub-ject of a special leaflet.

Properties

Tyfocor L is a non-toxic, virtually odourless, hygroscopic liquid. It is based on 1,2-propylene glycol, which poses no hazard to health and which may be used as a coolant or heat-transfer fluid in food processing and water purification applications.

The corrosion inhibitors contained in Tyfocor L reliably protect the metals normally used in solar installations and other heating equipment against corrosion, ageing and deposits over long periods. Tyfocor L prevents the surfaces of heat exchangers from becoming fouled, and ensures consistently high thermal efficiency.

Tyfocor L is miscible with water in all proportions. Its mixtures with water protect against frost at temperatures of down to -50 °C, depending on their concentration. Its performance is not impaired by hard water, and there is no danger of precipitation.

Mixtures of Tyfocor L and water do not remix.

Tyfocor L does not contain any nitrites, phosphates or amines.

Miscibility

Tyfocor L is miscible with all commercial antifreezes based on 1,2-propylene glycol.

Application

Tyfocor L / water mixtures are utilised as brines for cooling and heating circuits in the food and beverage industry, as heat-transfer fluids for solar and heat pump installations, and as antifreezes for sprinkler systems.

Tyfocor L has to be diluted with at least 25 % v/v and no more than 75 % v/v of water when it is used in heating or cooling circuits. Potable water (100 mg/kg Cl^- max.) or demineralised water must be used.

In order to prevent corrosion, the following minimum and maximum concentrations of Tyfocor L should be observed.

In solar heating equipment:	40-75 % vol. Tyfocor L
In other equipment:	25-75 % vol. Tyfocor L

Temperature stability in solar installations

Sustained temperatures higher than 170 °C cause premature ageing of the Tyfocor L. We would therefore recommend that the expansion tanks should be sufficient to ensure that all of the heat-transfer fluid can drain out of the solar collectors when the maximum static temperature is reached. Tyfocor L begins to undergo irreversible chemical changes at temperatures higher than 200 °C, with the result that the reliability of the equipment may be endangered.

Anticorrosion effect

The anticorrosion effect of a Tyfocor L/water mixture is evident from the following table:

Corrosion test acc. ASTM D 1384 (American Society for Testing and Materials). Average change in weight in g/m².

Material	Tyfocor L / ASTM-water 1 : 2
Copper (SF Cu)	– 0.2
Soft solder (L Sn 30)	– 0.1
Brass (MS 63)	– 0.3
Cast iron (GG26)	± 0.0
Steel (HI)	+ 0.7
Cast aluminium (G AlSi6Cu4)	– 0.5

Compatibility with sealing materials

Mixtures of Tyfocor L and water do not attack the sealants normally used in heating systems. The following list of sealants, elastomers and plastics that are resistant to Tyfocor L / water mixtures has been compiled from experimental results, experience, and the literature.

Examples of sealants are Fermit®, Fermitol® (registered trademarks of Nissen & Volk GmbH, Hamburg), and hemp

Butyl rubber	IIR
Chloroprene	CR
Ethylene-propylene-diene-rubber	EPDM
Fluorocarbon elastomers	FPM
Natural rubber below 80 °C	NR
Nitrile rubber	NBR
Polyacetal	POM
Polyamides below 115°C	PA
Polybutene	PB
Polyethylene, soft, hard	PE-LD, PE-HD
Polyethylene, crosslinked	PE-X
Polypropylene	PP
Polytetrafluoroethylene	PTFE
Polyvinylchloride, rigid	PVC h
Silicone rubber	Si
Styrene butadiene rubber below 100 °C	SBR
Unsaturated polyester resins	UP

Phenolic and urea resins, plasticised PVC, and polyurethane elastomers are not resistant.

An important point to note is that the performance of elastomers such as EPDM is determined by the nature and amount of the constituent additives and the vulcanisation conditions, as well as the properties of the rubber itself. For this reason, we would recommend testing the resistance of these elastomers to mixtures of Tyfocor L and water before they are put into service for the first time. This applies particularly to elastomers intended as membranes for expansion tanks as described in DIN 4807.

Gaskets that have proved to be resistant to hot Tyfocor L/ water mixtures are: up to 160 °C: elastomer gaskets made from 70 EPDM 281*, and up to 200 °C: flat gaskets such as REINZ-AFM 34** or Centellen 3820***, basing on aramide / special-NBR.

* *Carl Freudenberg Dichtungs- u. Schwingungstechnik, Pf 100363, D-69465 Weinheim*
** *REINZ-Dichtungs-GmbH, Postfach 1909, D-89229 Neu-Ulm*
*** *Hecker Werke GmbH & Co, D-71093 Weil im Schönbuch*

Application guidelines

In view of the specific properties of Tyfocor L, the following instructions must be adhered to for ensuring long-term protection.

1. Solar heating equipment must be designed as closed circuits, because the entry of atmospheric oxygen causes the inhibitors in Tyfocor L to be consumed more rapidly.
2. Equipment must not be fitted with galvanised heat exchangers, heat reservoirs, tanks or pipes, because zinc is detached by 1,2-propylene glycol / water mixtures.
3. Flexible-membrane expansion tanks must conform to DIN 4807.
4. Silver or copper brazing solders are to be utilised preferably on joints. Fluxes used in combination with soft solder usually contain chlorides. Their residues must be removed by thorough flushing of the system, because otherwise increased chloride concentration in the heat-transfer fluid may lead to corrosion.
5. Chemically speaking, aqueous solutions of Tyfocor L are largely inert, but it is important to ensure that the manufacturer's recommendations state that all the seals and connectors used in solar heating equipment are resistant to temperatures up to the maximum static temperature.
6. The only flexible connections that are permissible are hoses, preferably metal, that do not permit the diffusion of oxygen.
7. Scaling on copper or copper alloys must be removed, because it can be detached by hot propylene glycol / water mixtures.
8. It must be ensured that no external voltages are applied between parts of the equipment that come into contact with the Tyfocor L solution, as otherwise corrosion may occur. At most, an external voltage of no more than 1.5 volts may be applied to components made of copper or copper alloys.
9. The layout of the tubes must ensure that circulation cannot be disturbed by gas pockets or deposits.
10. The level of the heat-transfer liquid must never be allowed to fall below the highest point in the system. A closed vessel fitted with a bleed valve must be provided at the highest point in the circuit in order to bleed gases from the system.
11. Only automatic bleed valves should be used in order to ensure that no air is entrained.
12. Dirt and water must not be allowed to enter the installation or its components during assembly and before filling. After assembly has been completed and the connections have been soldered, the system must be flushed to remove any foreign matter (swarf, fluxes, packaging residues, sawdust, etc.) and material used in assembly.

    After the installation is complete, the system must be cleaned and tested for leaks acc. DIN 18380. The system should then be completely drained and filled with Tyfocor L solution, even if the plant is not put into operation immediately, in order to prevent corrosion.
13. It must be ensured that no air pockets remain in the installation after it has been filled. It is essential to eliminate gas pockets, because a vacuum would be formed if they collapsed following a drop in temperature, and this would cause air to be sucked into the system.
14. In order to ensure that there are no obstructions to the flow of the heat-transfer liquid, the in-circuit filters must be cleaned within 14 days, at the latest, after the equipment has been filled with heat-transfer fluid and put into operation for the first time.

15. If losses occur due to evaporation, the system can be topped up with neutral potable water. If leakages or other losses occur, the heat-transfer liquid in the system must be replenished with an aqueous Tyfocor L solution of the same concentration. In cases of doubt, the Tyfocor L content must be determined. It can be checked by measuring the density of the mixture with a hydrometer (see den-sity / concentration diagram).

The Tyfocor L content can also be determined by measuring the refractive index with a refractometer. Values for the density and refractive index of Tyfocor L / water mixtures are presented in the following table.

% vol. Tyfocor L	Density at 20 °C g/cm^3	Refractive index nD20	Frost protection °C
25	1.023	1.3627	–10
30	1.029	1.3690	–14
35	1.033	1.3747	–17
40	1.037	1.3801	–21
45	1.042	1.3855	–26
50	1.045	1.3910	–32
55	1.048	1.3966	–40

Storage stability

Tyfocor L has a shelf life of at least three years in airtight containers. It should not be stored in galvanised containers, because zinc can be detached by propylene glycol / water mixtures.

Packaging

Tyfocor L is delivered in road tankers, 215 kgs non-returnable drums and in 31 kgs, 21 kgs, and 11 kgs plastics non-returnable cans.

Safety

Tyfocor L contains 1,2-propanediol (1,2-propylene glycol) The German Gefahrstoffverordnung of 26.10.1993 does not require it to be labelled.

EEC-Safety Data Sheet

A Safety Data Sheet has been drawn up for Tyfocor L in accordance with EEC Directives 91/155/EEC and RL 2001/EG, resp.

Handling

The usual safety and industrial hygiene measures relating to chemicals must be observed in handling Tyfocor L. The information and instructions given in our EEC-Safety Data Sheet must be strictly observed.

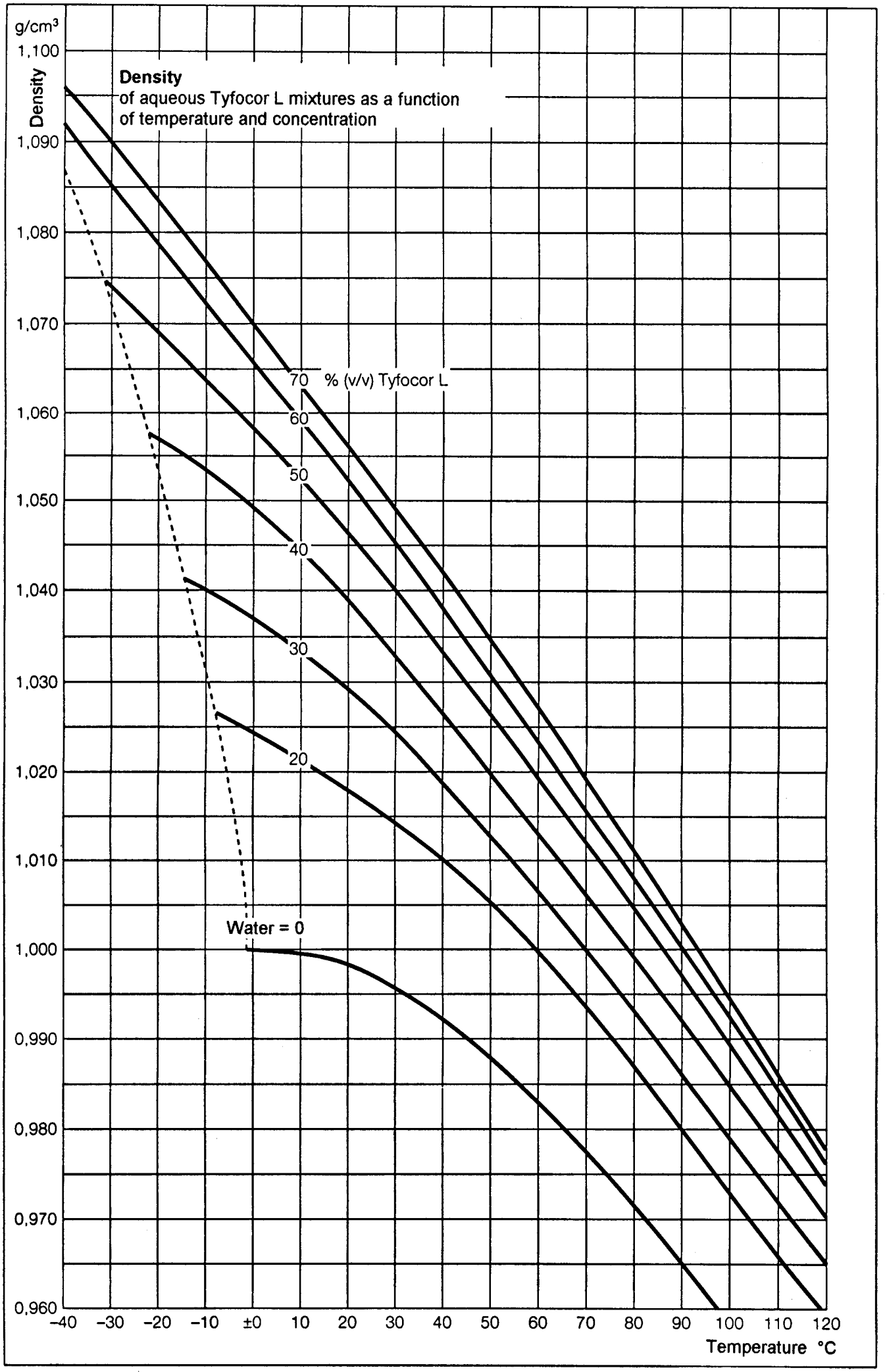
Disposal

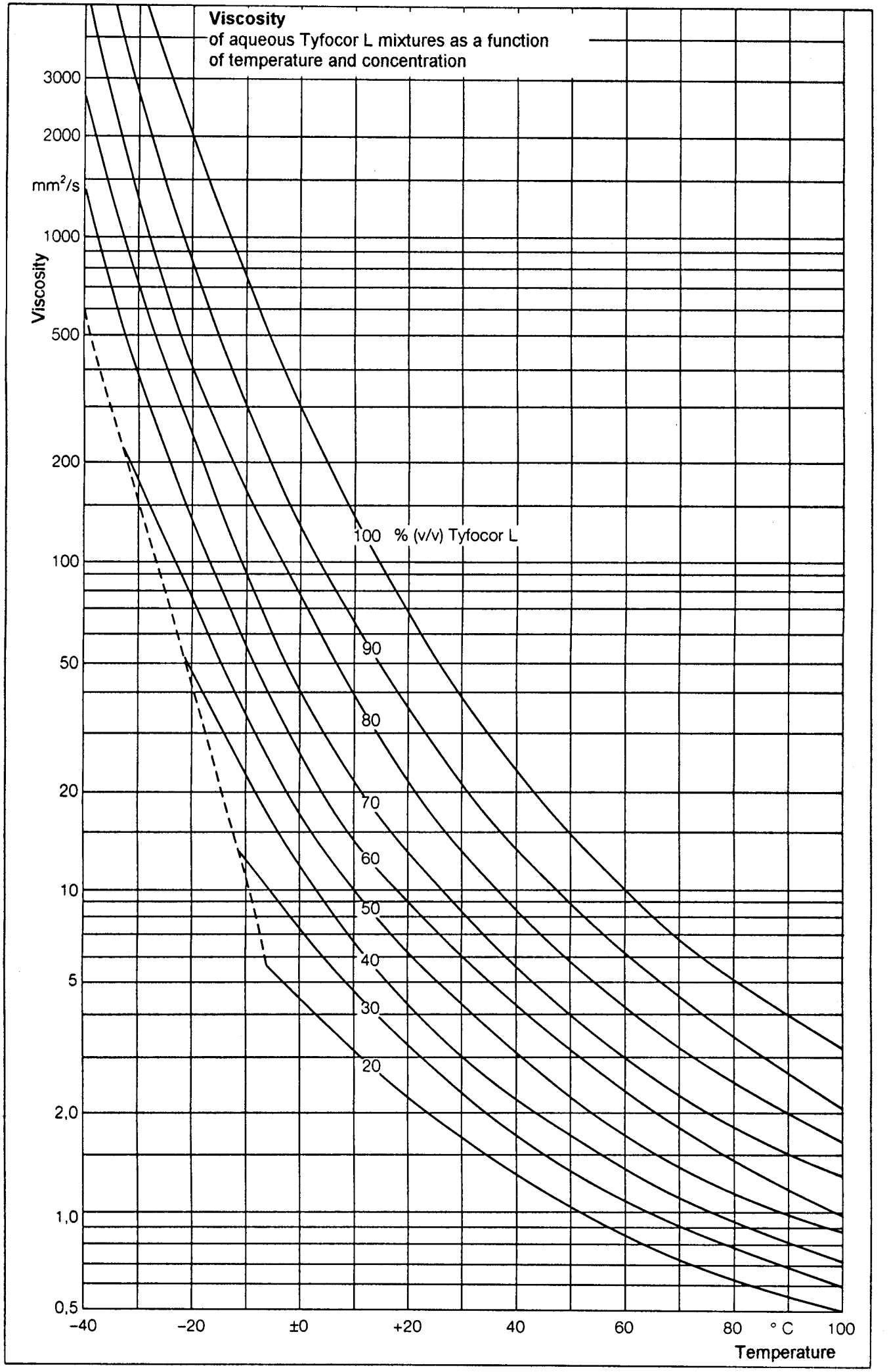
Tyfocor L spills must be taken up in an absorbent binder and disposed of in accordance with regulations. If the pertinent local regulations are observed, Tyfocor L can be disposed of by special treatment, e. g. combustion in an authorised incinerator. For further information, please refer to the EEC-Safety Data Sheet.

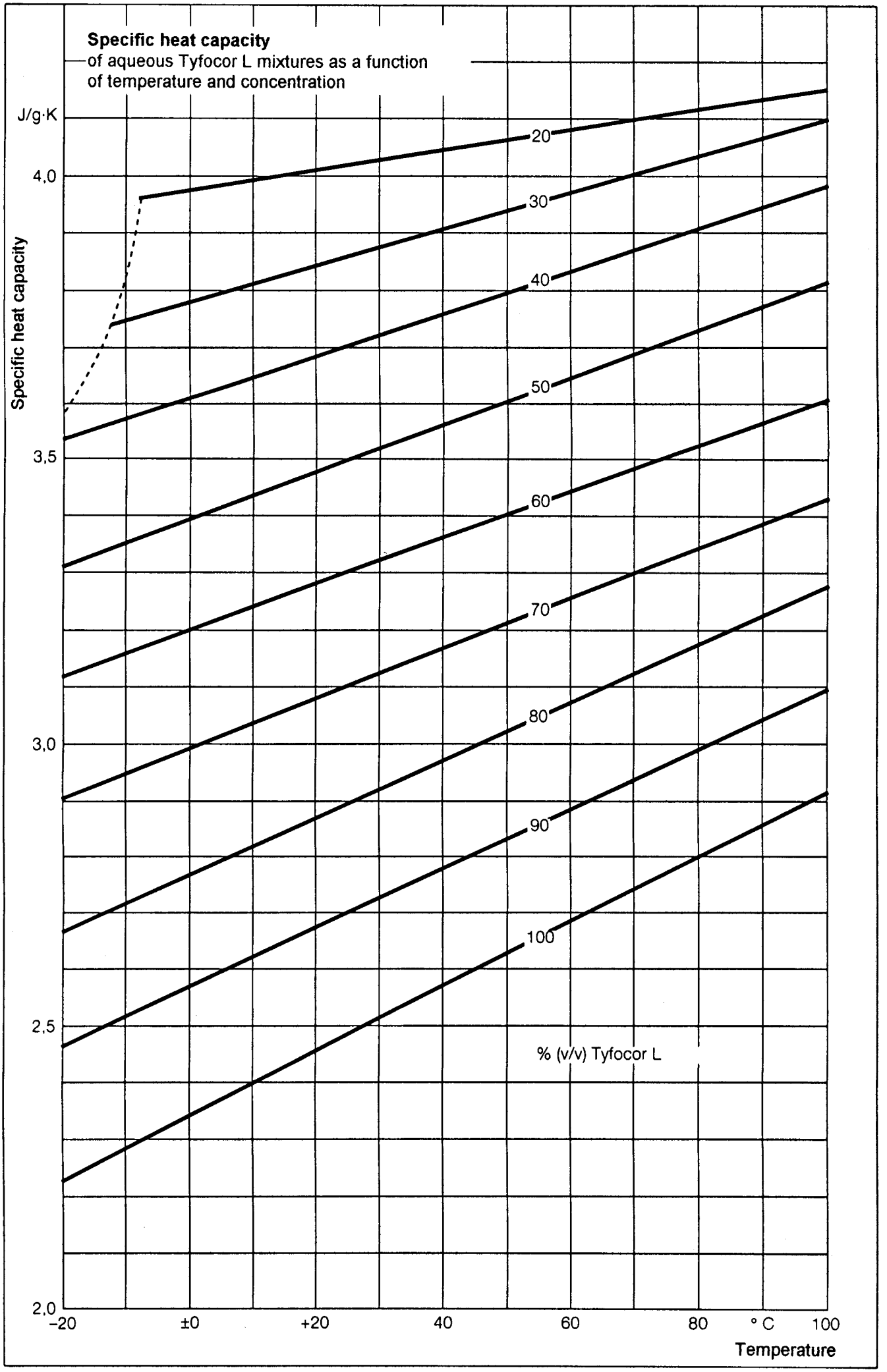
Ecology

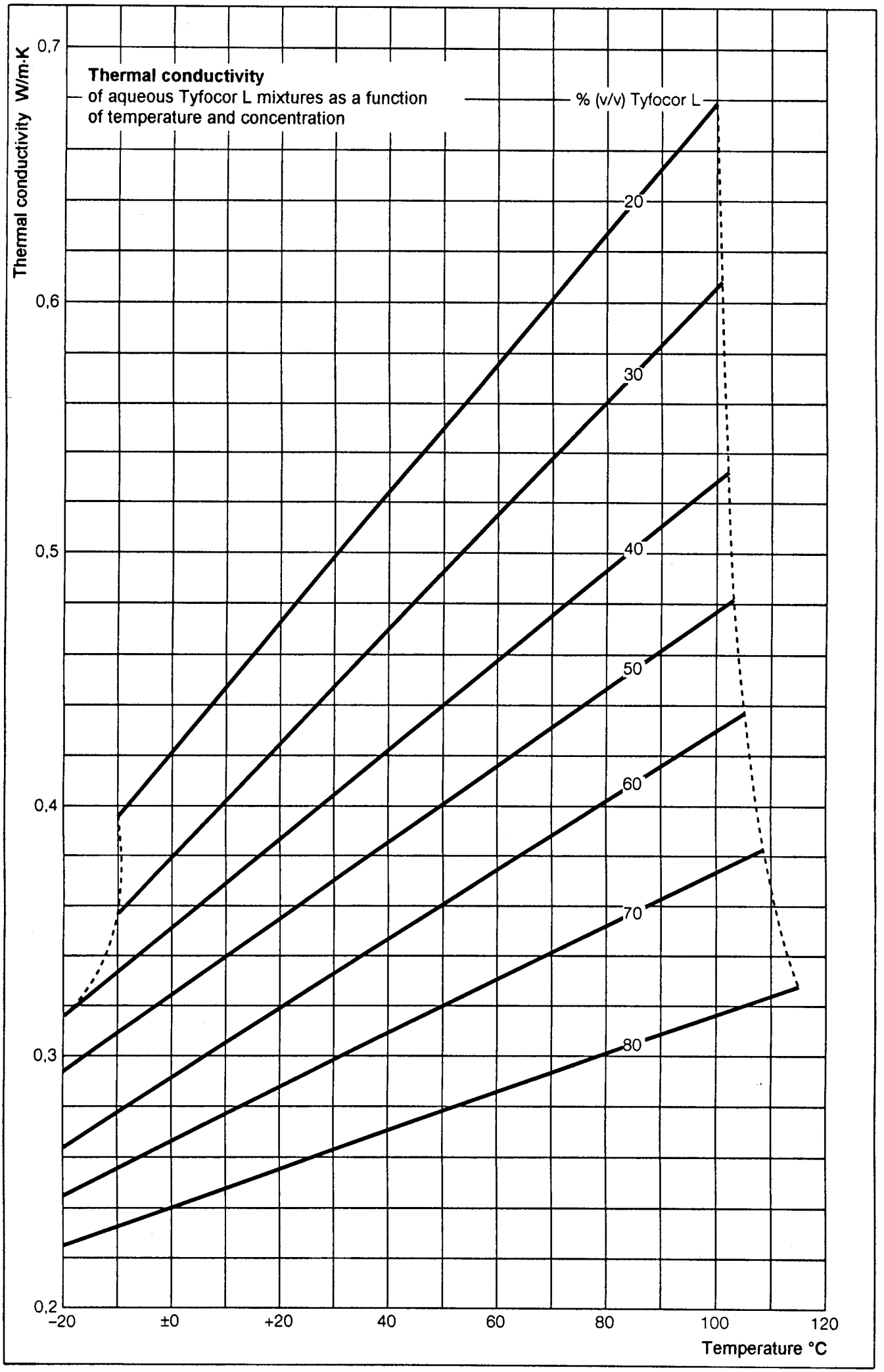
Tyfocor L is classified in water hazard class 1, (low-rate endangering, Germany), according to VwVwS of 17 May 1999.

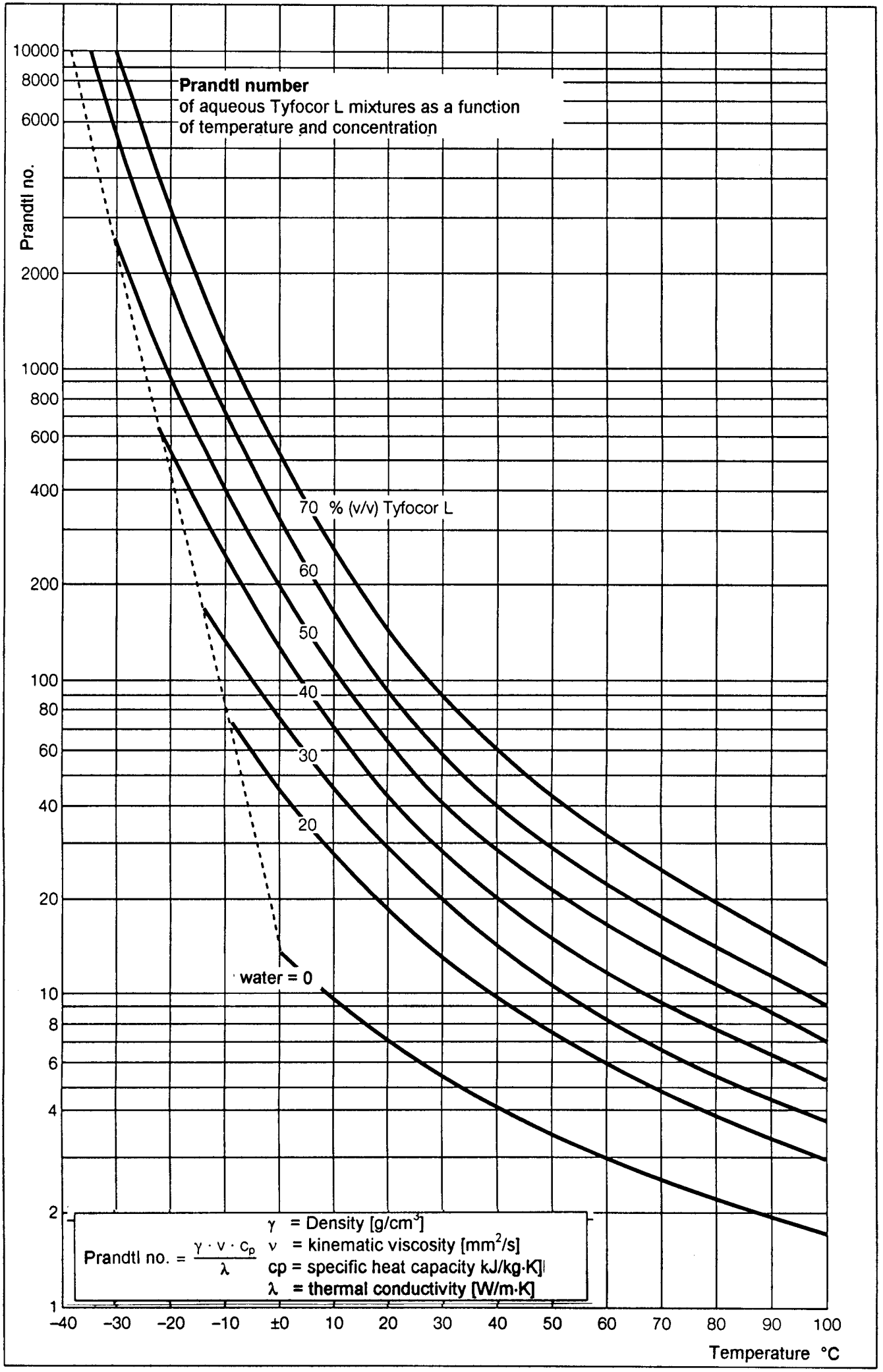
Tyfocor L is biodegradable. If it is run with the appropriate care into an acclimated water treatment plant, it will not impair the efficiency of the activated sludge.

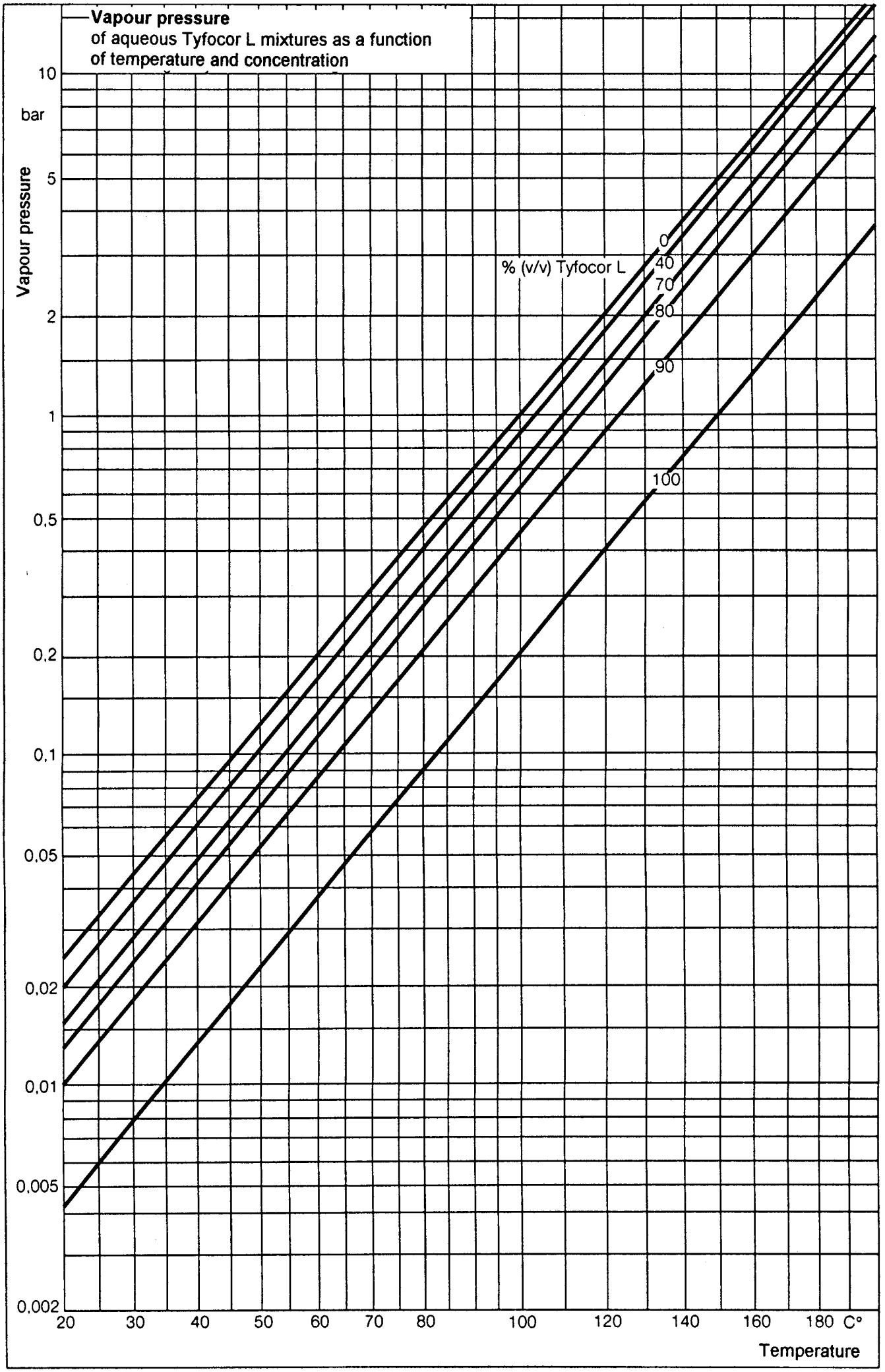

g/cm³
1,100
Density
1,090
1,080
1,070
1,060
1,050
1,040
1,030
1,020
1,010
1,000
0,990
0,980
0,970
0,960
Density
of aqueous Tyfocor L mixtures as a function
of temperature and concentration
70 % (v/v) Tyfocor L
60
50
40
30
20
Water = 0
–40 –30 –20 –10 ±0 10 20 30 40 50 60 70 80 90 100 110 120
Temperature °C

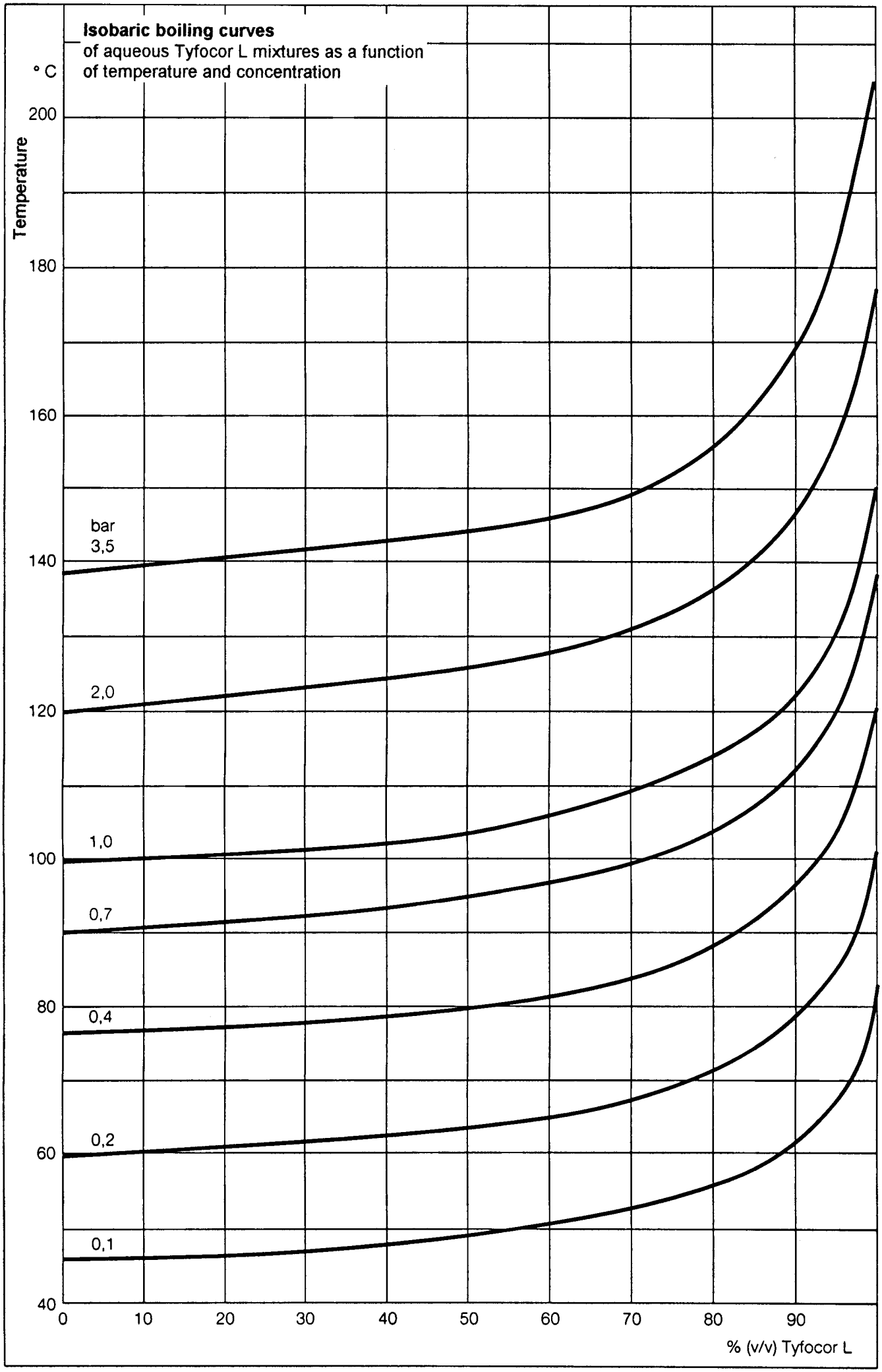

Viscosity
of aqueous Tyfocor L mixtures as a function
of temperature and concentration
Viscosity
mm²/s
3000
2000
1000
500
200
100
50
20
10
5
2,0
1,0
0,5
100 % (v/v) Tyfocor L
90
80
70
60
50
40
30
20
-40
-20
±0
+20
40
60
80
° C
100
Temperature

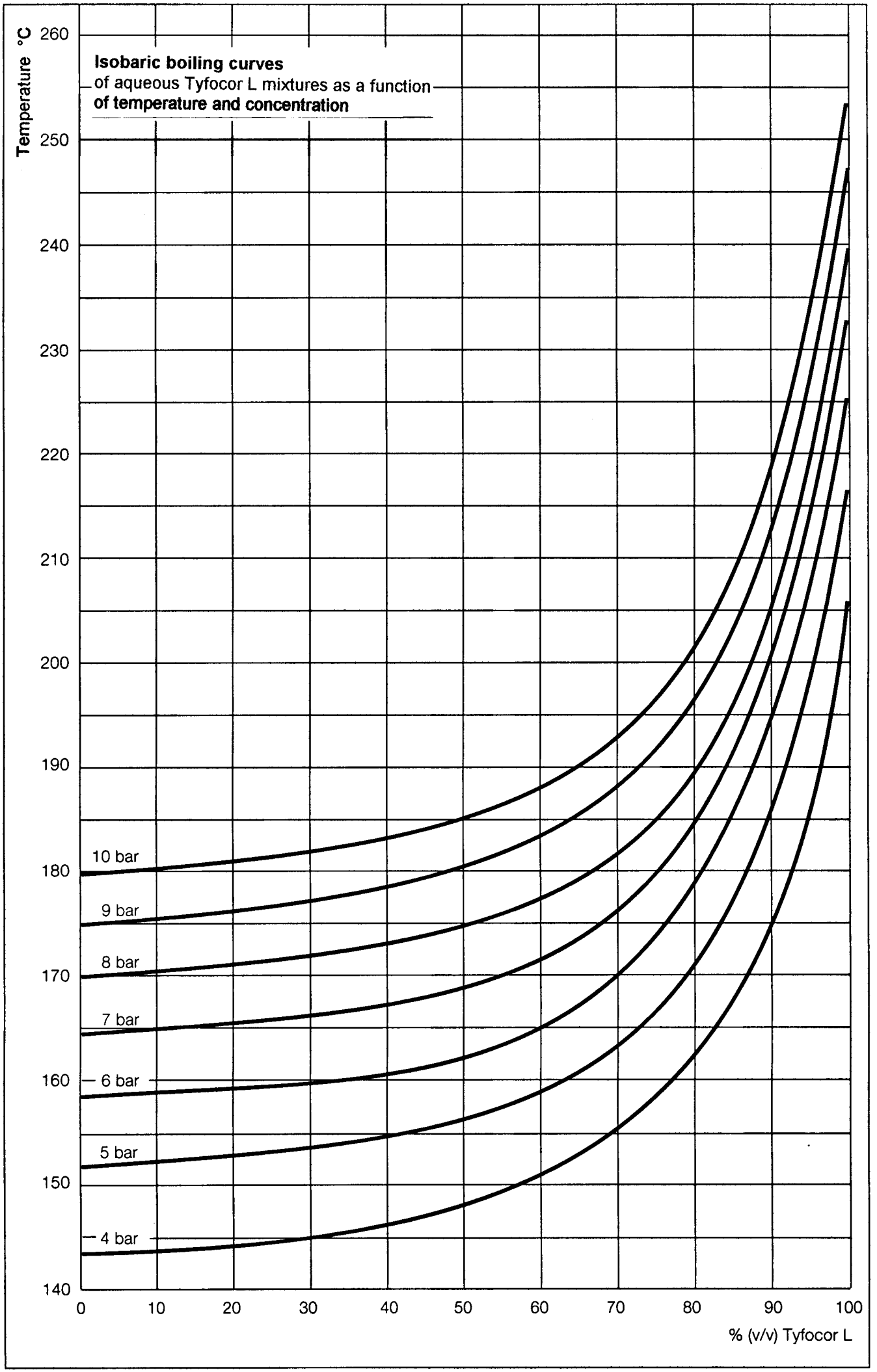

Specific heat capacity
of aqueous Tyfocor L mixtures as a function
of temperature and concentration
J/g·K
Specific heat capacity
4,0
3,5
3,0
2,5
2,0
20
30
40
50
60
70
80
90
100
% (v/v) Tyfocor L
-20
±0
+20
40
60
80
° C
100
Temperature

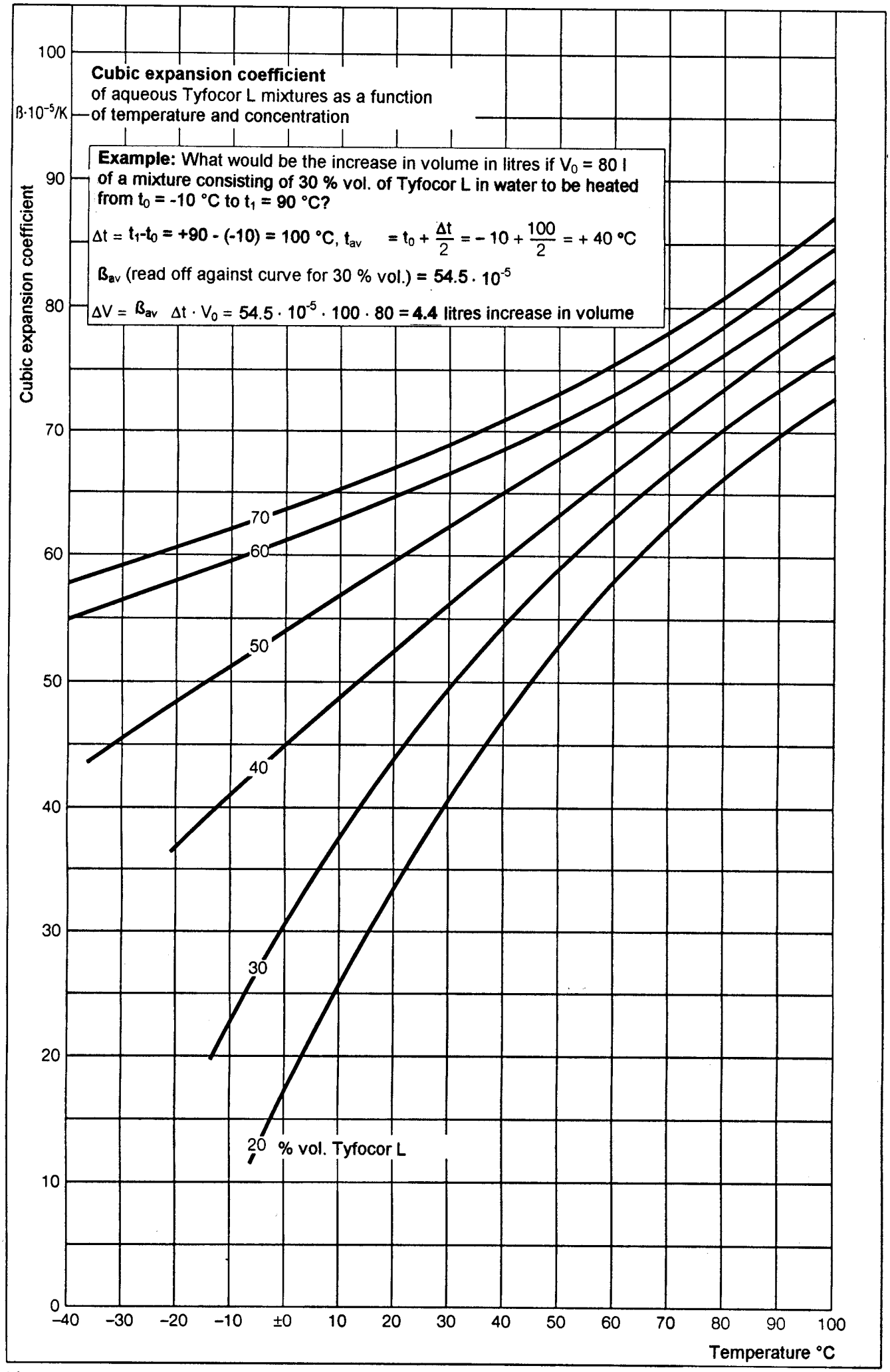

Thermal conductivity
of aqueous Tyfocor L mixtures as a function
of temperature and concentration
% (v/v) Tyfocor L
20
30
40
50
60
70
80
Thermal conductivity W/m·K
0,7
0,6
0,5
0,4
0,3
0,2
–20
±0
+20
40
60
80
100
120
Temperature °C

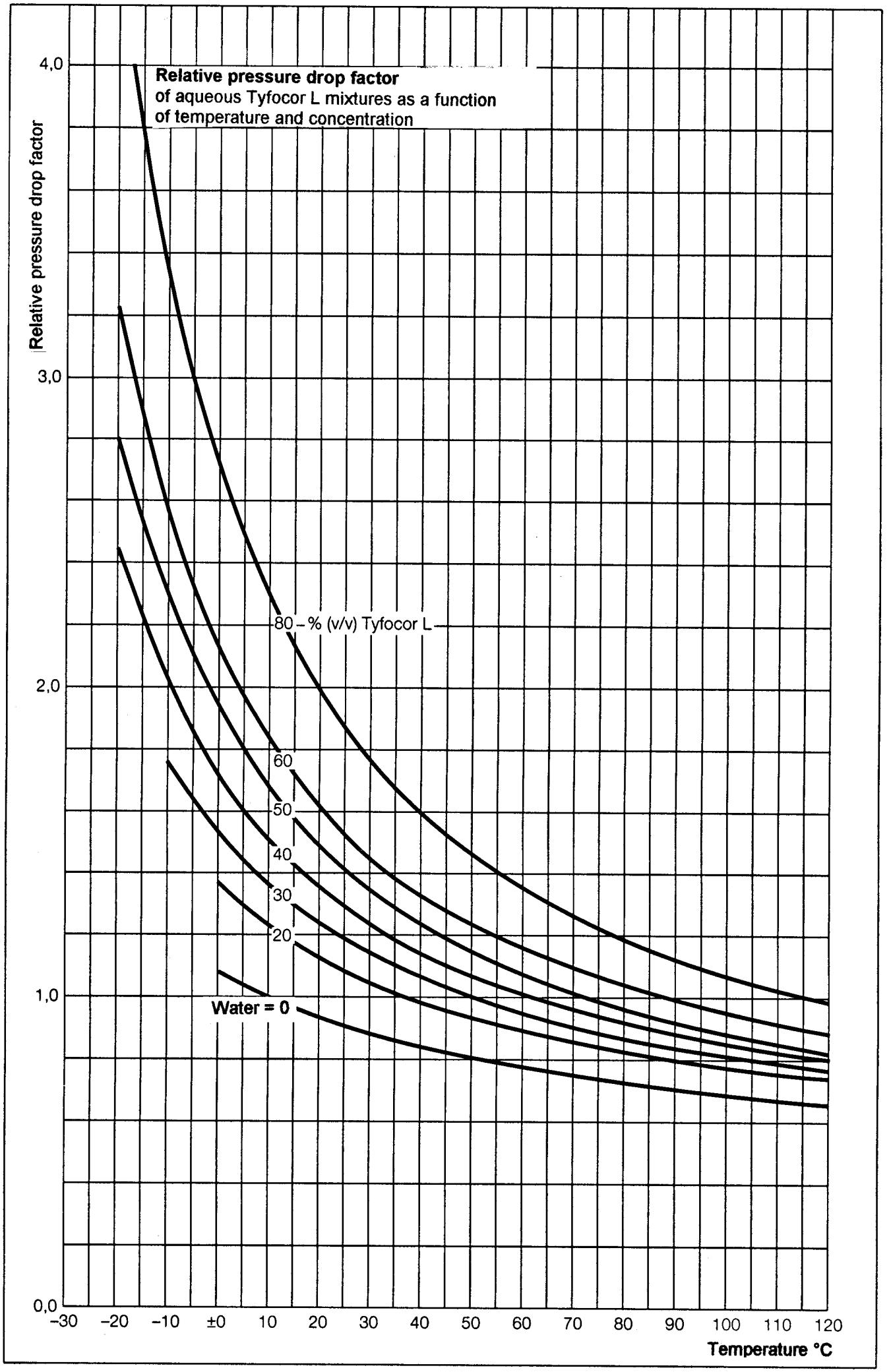

Prandtl number
of aqueous Tyfocor L mixtures as a function
of temperature and concentration
Prandtl no.
10000
8000
6000
2000
1000
800
600
400
200
100
80
60
40
20
10
8
6
4
2
1
70 % (v/v) Tyfocor L
60
50
40
30
20
water = 0
Prandtl no. = γ · v · cp / λ
γ = Density [g/cm³]
v = kinematic viscosity [mm²/s]
cp = specific heat capacity kJ/kg·K]
λ = thermal conductivity [W/m·K]
−40 −30 −20 −10 ±0 10 20 30 40 50 60 70 80 90 100
Temperature °C

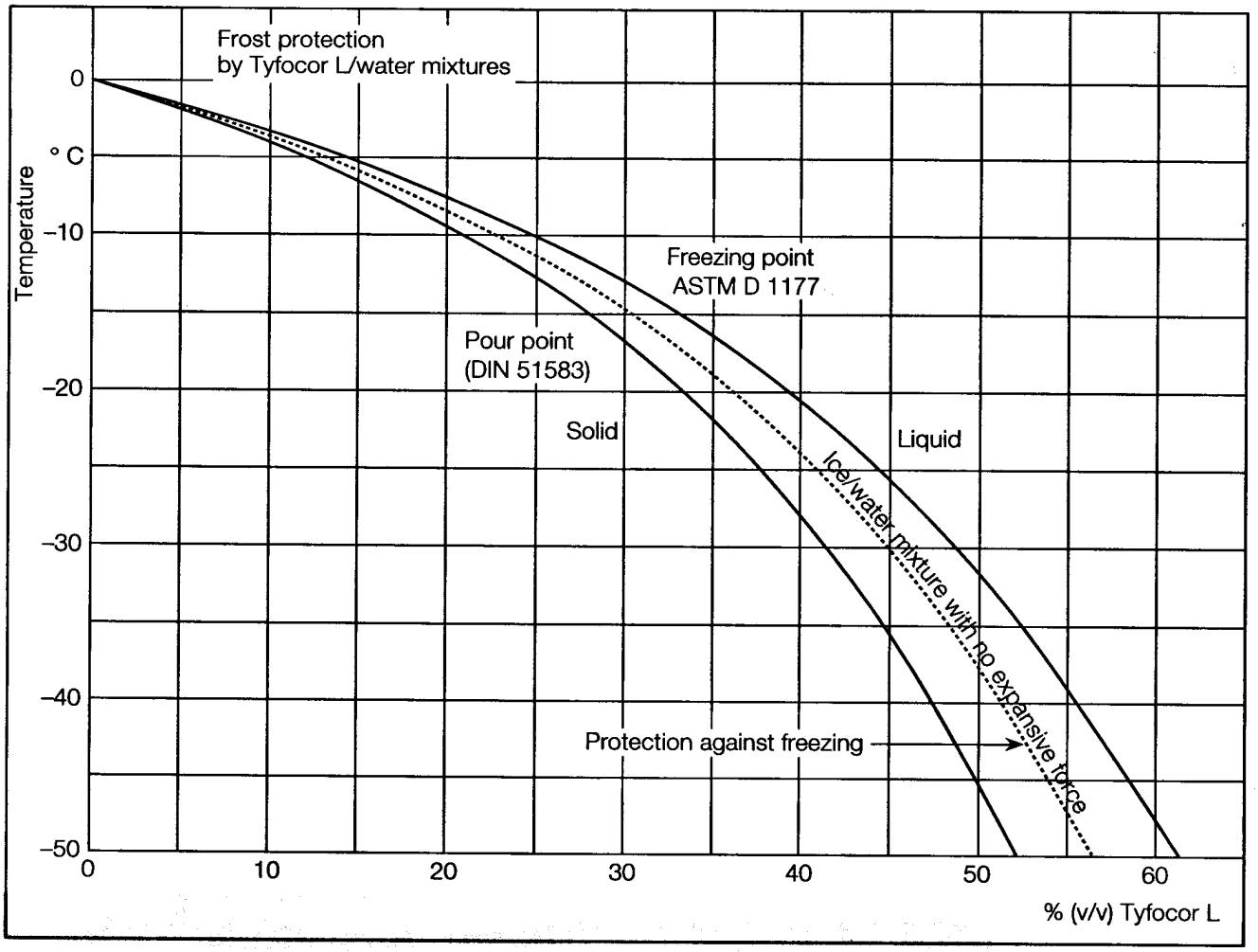

Vapour pressure
of aqueous Tyfocor L mixtures as a function
of temperature and concentration
Vapour pressure
bar
10
5
2
1
0,5
0,2
0,1
0,05
0,02
0,01
0,005
0,002
% (v/v) Tyfocor L
0
40
70
80
90
100
20
30
40
50
60
70
80
100
120
140
160
180 C°
Temperature


Isobaric boiling curves
of aqueous Tyfocor L mixtures as a function
of temperature and concentration
° C
Temperature
200
180
160
140
120
100
80
60
40
bar
3,5
2,0
1,0
0,7
0,4
0,2
0,1
0
10
20
30
40
50
60
70
80
90
% (v/v) Tyfocor L


Isobaric boiling curves
of aqueous Tyfocor L mixtures as a function
of temperature and concentration
Temperature °C
260
250
240
230
220
210
200
190
180
170
160
150
140
10 bar
9 bar
8 bar
7 bar
6 bar
5 bar
4 bar
0
10
20
30
40
50
60
70
80
90
100
% (v/v) Tyfocor L


Cubic expansion coefficient
of aqueous Tyfocor L mixtures as a function
of temperature and concentration
ß·10⁻⁵/K
Example: What would be the increase in volume in litres if V0 = 80 l
of a mixture consisting of 30 % vol. of Tyfocor L in water to be heated
from t0 = -10 °C to t1 = 90 °C?
Δt = t1-t0 = +90 - (-10) = 100 °C, tav = t0 + Δt/2 = - 10 + 100/2 = + 40 °C
ßav (read off against curve for 30 % vol.) = 54.5 · 10⁻⁵
ΔV = ßav Δt · V0 = 54.5 · 10⁻⁵ · 100 · 80 = 4.4 litres increase in volume
Cubic expansion coefficient
100
90
80
70
60
50
40
30
20
10
0
70
60
50
40
30
20 % vol. Tyfocor L
–40 –30 –20 –10 ±0 10 20 30 40 50 60 70 80 90 100
Temperature °C


Relative pressure drop factor
of aqueous Tyfocor L mixtures as a function
of temperature and concentration
Relative pressure drop factor
4,0
3,0
2,0
1,0
0,0
80 – % (v/v) Tyfocor L
60
50
40
30
20
Water = 0
-30 -20 -10 ±0 10 20 30 40 50 60 70 80 90 100 110 120
Temperature °C



Note

The information submitted in this publication is based on our current knowledge and experience. In view of the many factors that may affect processing and application these data do not relieve processors of the responsibility of carrying out their own tests and experiments, neither do they imply any legally binding assurance of certain properties or of suitability for a specific purpose. It is the responsibility of those to whom we supply our products to ensure that any proprietary rights and existing laws and legislations are observed.

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