

A large iceberg floats in the ocean. The tip of the iceberg is visible above the water surface, while the much larger, jagged base is submerged underwater. The sky is blue with scattered white clouds. The water is a deep blue, and the overall scene is serene and clean.

Antifrogen® Heat Transfer Fluids

EMATEM Summer School 2023

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Industrial & Consumer Specialties
Industrial Applications
18.08.2023

what is precious to you?



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- HTFs - Overview, Requirements and Production Process

Clariant and Gendorf Site



Clariant at a glance – history



1995 Clariant Swiss parent company created in a spin-off and subsequent IPO of the Sandoz Chemicals Division	2000 Acquisition of British BTP	2006 Acquisition of Ciba Masterbatches	2012 Clariant rebranding Introduction of new corporate mission and vision	2015 Establishment of Global Business Services Clariant celebrates its 20th birthday	2018 SABIC becomes Clariant's biggest shareholder by acquiring the stake of White Tale Holdings	2021 Establishment of JV Clariant IGL Specialty Chemicals Private Limited (CISC)
1997 Acquisition of Hoechst AG specialty chemicals business	2001 – 2007 Divestment of several bigger businesses due to financial difficulties resulting from BTP acquisition	Divestment of Pharmaceutical Fine Chemicals	2013 Opening Clariant Innovation Center in Frankfurt, Germany	2016 Acquisition of Kel-Tech and X-Chem in the U.S.	Clariant and SABIC sign memorandum of understanding and governance agreement	Acquisition of remaining 70% in Brazilian Beraca
		2008 Change in management	2013 – 2014 Divestment of five businesses	2017 Announcement of planned merger with Huntsman	Clariant and SABIC sign memorandum of understanding and governance agreement	2022 Divestment of Pigments business
		2009 Launch of Clariant Excellence	2014 Sustainability becomes strategic pillar	White Tale Holdings steps in	2019 Divestment of Healthcare Packaging business	Executive Committee replaced by Executive Steering Committee
		2009 – 2010 Restructuring phase		Termination of merger Strategy update started	2020 Divestment of Masterbatches business	2023 Reorganization in three global business units instead of five
		2011 Acquisition of Süd-Chemie				
		Roll-out of new Clariant Corporate Values				

1995

2000

2006

2012

2015

2018

2020

2023



Clariant at a glance – a globally leading company in specialty chemicals

5 198

Sales 2022¹ (CHF m)

810

EBITDA 2022¹ (CHF m)

15.6%

EBITDA margin 2022¹

3

Business Units

11 148

Total staff 2022¹ (FTEs)

70

Production sites 2022¹

0.64

Scope 1 & 2 GHG emissions 2022^{1,2}
(m t CO₂e)

2.58

Scope 3 (category 1) GHG emissions 2022^{1,3}
(m t CO₂e)

¹ Continuing operations

² This includes 0.02 m t of biogenic CO₂ emissions.

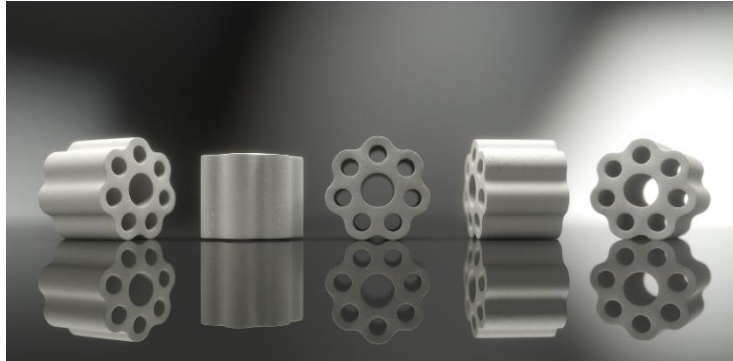
³ Category 1 = emissions from purchased goods and services

Three business units – our portfolio for long-term sustainable growth



Care Chemicals

The Business Unit Care Chemicals consists of the business segments Personal & Home Care, Crop Solutions, Industrial Applications, Base Chemicals, Oil Services and Mining Solutions. The business unit has a clear focus on highly attractive, high-margin, and low-cyclicality segments with a large share of the business being consumer-facing in Consumer Care and Industrial Applications.



Catalysts

The Business Unit Catalysts includes the business segments Propylene, Specialties, Syngas & Fuels, Ethylene, Biofuels & Derivatives and Applied Catalyst Technology. The business unit contributes significantly to value creation in our customers' operations, ensuring that finite raw materials and energy are used efficiently and, in turn, ensuring the quality and yield of processes.



Adsorbents & Additives

The Business Unit Adsorbents¹ & Additives comprises the business segments Purification, Foundry & Specialties, and Cargo & Device Protection in the regions EMEA, APAC and Americas on the Adsorbents side, as well as Coatings & Adhesives, Plastics and E-Mobility & Electronics in Additives. The business unit creates value through enhanced sustainability benefits, for example by enabling material circularity and by reducing customers' dependency on fossil resources to reduce CO₂ emissions.

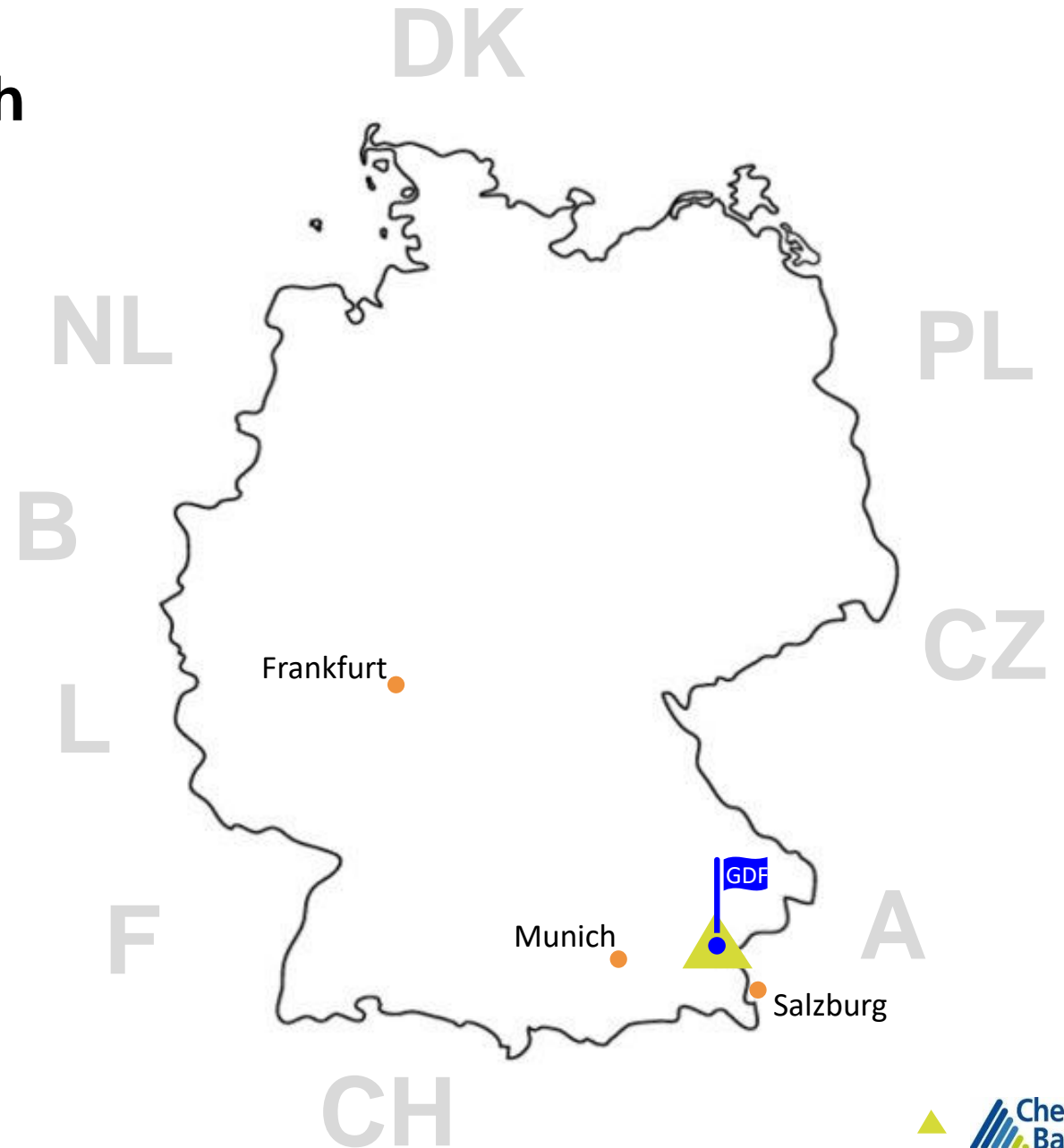
¹ The Adsorbents business is primarily divided into the EMEA, APAC and Americas regions, with local representatives for Purification, Foundry & Specialties, and Cargo & Device Protection.

Gendorf Site: 100 km from Munich and 60 km from Salzburg



Chemical Park Gendorf

Operated by InfraServ Gendorf
approx. 4.000 employees



Applications of Clariant Products made in Gendorf



HTFs - Overview, Requirements and Production Process

Basic requirements and chemistry of Clariant HTFs

Desired characteristics of HTFs include:

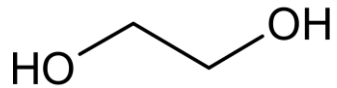
- Effective heat transfer
 - High heat capacity
 - High thermal conductivity
 - Low viscosity
- Frost protection
- Corrosion protection
- Compatibility with sealings
- Non-flammable / Non-toxic
- Low cost

Norms? In general, heat transfer fluids do not need to fulfill any norms!

Components of Clariant HTFs

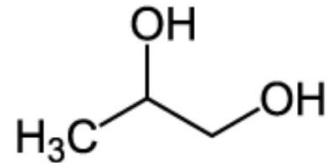
- Water
- Freezing point depressant
 - Monoethylene glycol (MEG)
 - Monopropylene glycol (MPG)
 - Higher boiling glycols
 - Potassium formate (KF)
- Corrosion inhibitors (based on OAT technology)
- pH buffer
- Scale inhibitors
- Defoamers
- Colorants

Different freezing point depressants?



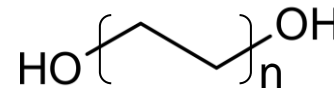
**Monoethylene glycol
(MEG)**

- Toxic if swallowed
- Lower price
- Effective antifreeze
- Medium viscosity at low temperatures
- up to +150 °C



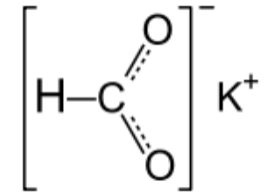
**Monopropylene glycol
(MPG)**

- Non-toxic
- Higher price
- Less effective antifreeze
- High viscosity at low temperatures
- up to +150 °C



**Higher boiling glycols
(Tri/Tetraethylene glycols)**

- Non-toxic
- Higher price
- Less effective antifreeze
- High viscosity at low temperatures
- up to +200 °C / +270°C



**Potassium Formate
(KF)**

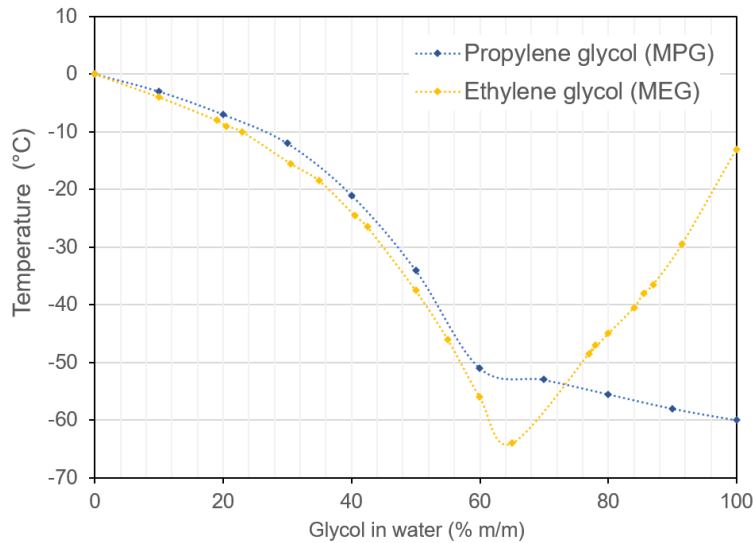
- Non-toxic
- Higher price
- Effective antifreeze
- Very low viscosity at low temperatures
- up to +80 °C



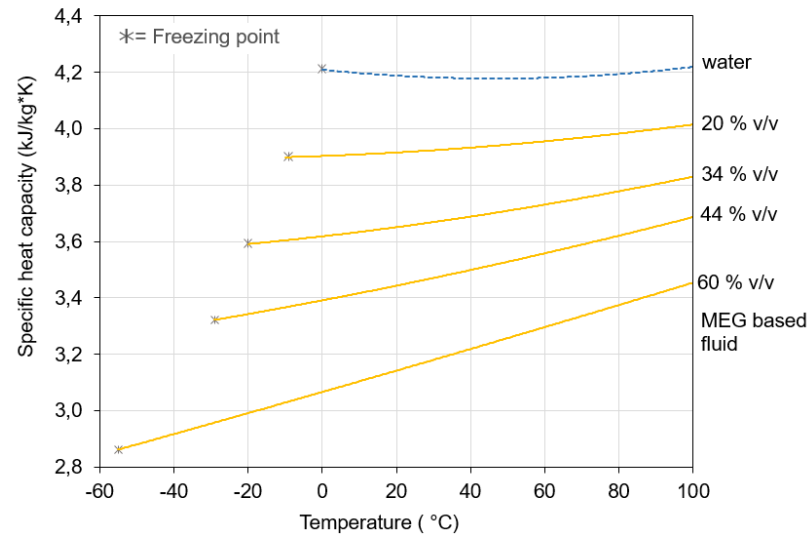
Various Antifreezes - Physical Properties

The physical properties of available heat transfer fluids on the market are quite similar and are mainly a result of which **type** and **amount** of the **freezing point depressant** is used. Examples:

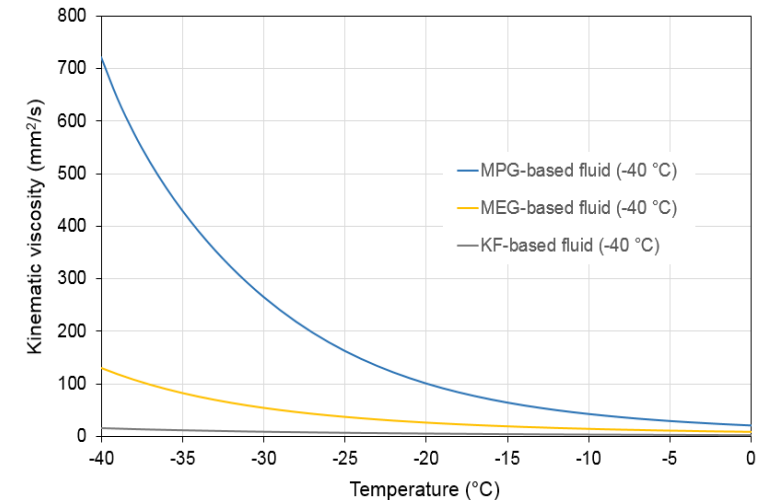
Freezing point



Specific heat capacity

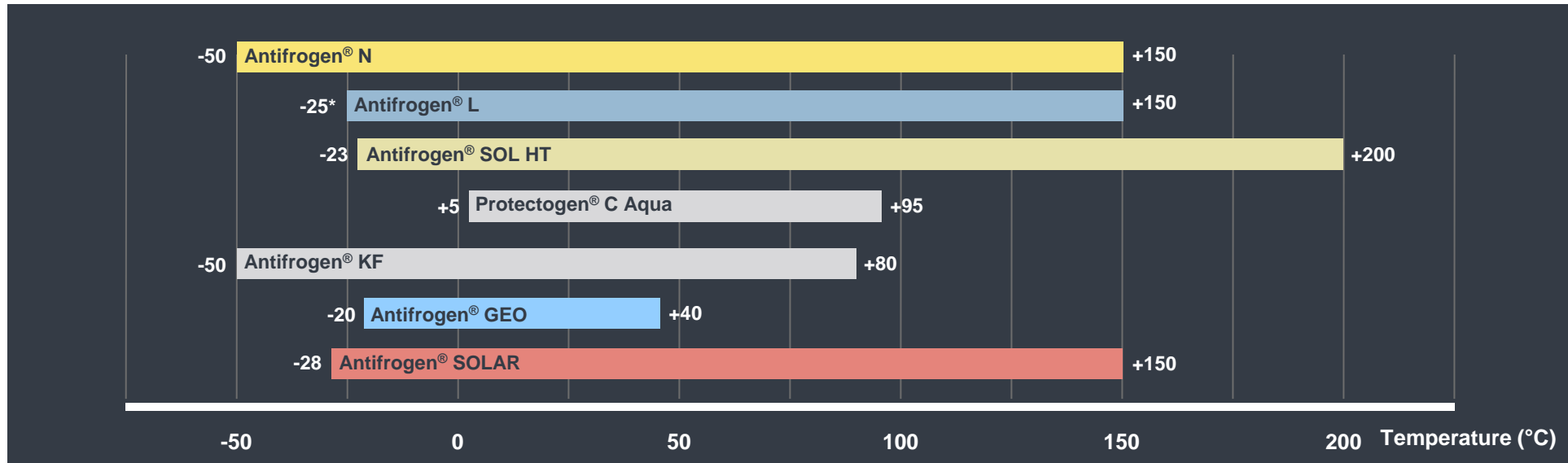


Kinematic viscosity (at given frost resistance of -40 °C)





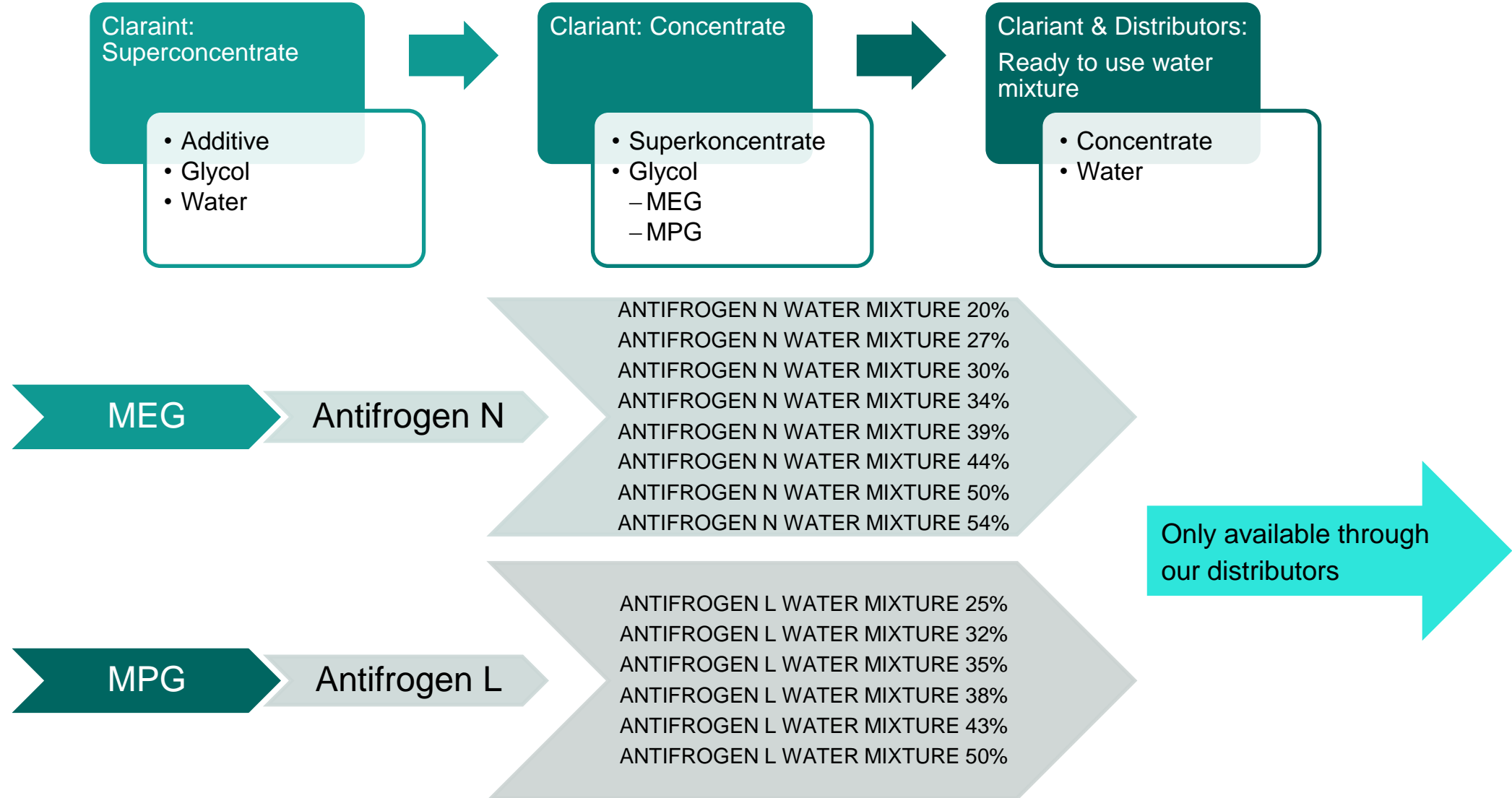
Which product is needed?



- | | |
|--|---------------------------------------|
| Standard requirements?..... | Antifrogen® N |
| Physiological harmless brine necessary?..... | Antifrogen® L, Antifrogen® KF |
| Solarthermal application?..... | Antifrogen® SOL HT, Antifrogen® SOLAR |
| Geothermal application?..... | Antifrogen® GEO |
| Low viscosity at low temperature?..... | Antifrogen® KF |
| No frost Protection necessary?..... | Antifrogen® C Aqua |



Production Process





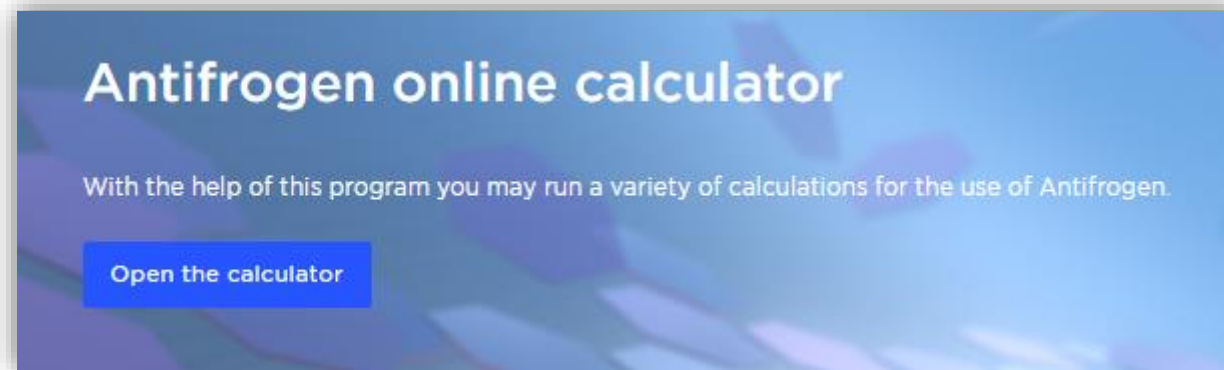
Example: Antifrogen L Water Mixture 35%

Analysis	Result	Unit	Method
Color at 20°C visual	blue		Clariant
Consistence at 20°C visual	liquid		Clariant
pH	8.0 - 9.5		DIN EN 1262
Density at 20°C	1,030 +/- 0,0015	g/cm ³	DIN 51757
Refractive index at 20°C	1.3720 +/- 0,001		DIN 51423-2
Reserve alkalinity	min. 1.3	ml 0.1M HCl	ASTM D 1121

Further information about our products

Homepage: <http://www.antifrogen.com/>

- Technical data sheets, SDS, Certificates
- Overview about our distributors
- Antifrogen Service
- Contact data
- Antifrogen online calculator



Available Data for Antifrogen

Antifrogen calculator

Please select a product

- Antifrogen® N
- Antifrogen® L
- Antifrogen® SOL HT
- Antifrogen® KF
- Antifrogen® SOLAR
- Antifrogen® GEO

Physical data at constant

Concentration

Temperature

Conversion Table

Concentration - Freezing point - Brix

Increase / decrease concentration in your system

Calculate volume of concentrate / water



Antifrogen calculator

Parameters

Concentration of **Antifrogen® N** in Water %v/v ⓘ

Temperature step °C

Results

Physical Data of 20 %v/v **Antifrogen® N** in Water

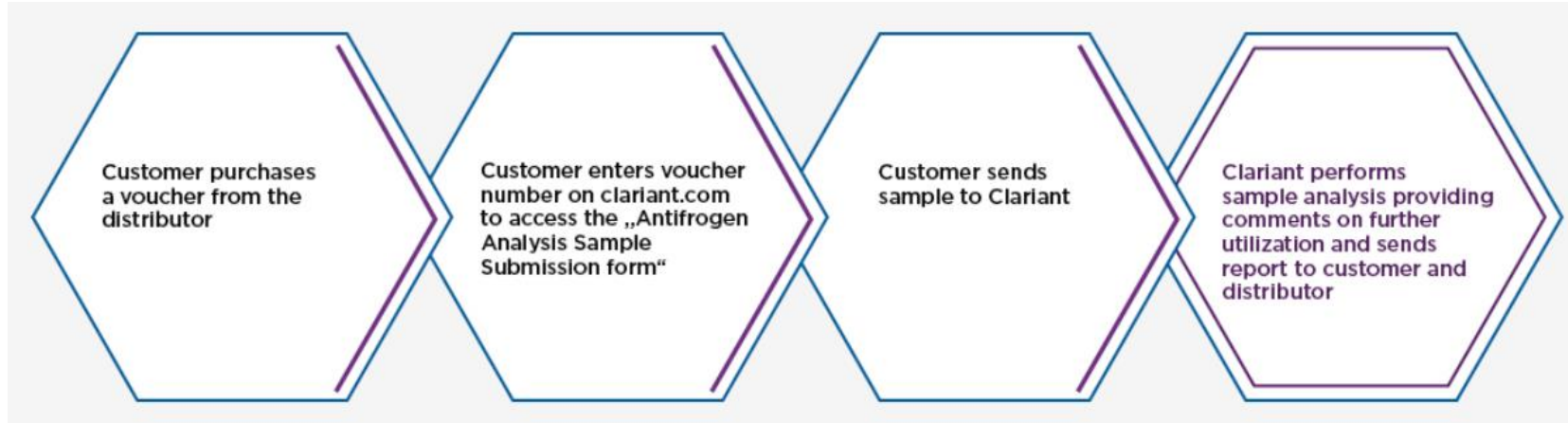
Freezing point: -9 °C

Boiling point (1 bar): 103 °C

	Temperature (°C)	Kinematic Viscosity (mm ² /s)	Density (g/cm ³)	Specific Heat Capacity (kJ/kg·K)	Thermal Conductivity (W/m·K)	Vapour Pressure (bar)
<input type="checkbox"/>	-9	4,80	1,037	3,89	0,494	-
<input type="checkbox"/>	31	1,29	1,022	3,93	0,524	-
<input type="checkbox"/>	71	0,63	1,000	3,98	0,550	0,32
<input type="checkbox"/>	111	0,40	0,971	4,04	0,574	1,47

Display only selected items

Antifrogen® Analytical Service



Samples	Per Year
Sum:	> 3000
Quality ok	~ 82 %
Limited use	~ 18 %
Replacement necessary	~ 5 %

Effects on Physical Properties

Composition

- Glycol
- Water
- **Additives (ca. 4-6 %)**

Age:

- pH
- Reserve alkalinity
- Acids, degradation products
- State of the facility
 - Rust, particles, entry of air
- Date of manufacturing
 - Borat / OAT
 - since 2013 all Antifrogenes are borate free
(but partly still in use in the facilities!)


Materials of the system:

- Flux, Metal compounds

Solubility of gases? ⁽¹⁾

- Temperature and pressure dependance

(1) Felix Panitz, Löslichkeit von Gasen in Wasser-Glykol-Kreisläufen energietechnischer Anlagen, Technischen Universität Dresden, 23.01.2020



Thank you for your attention!