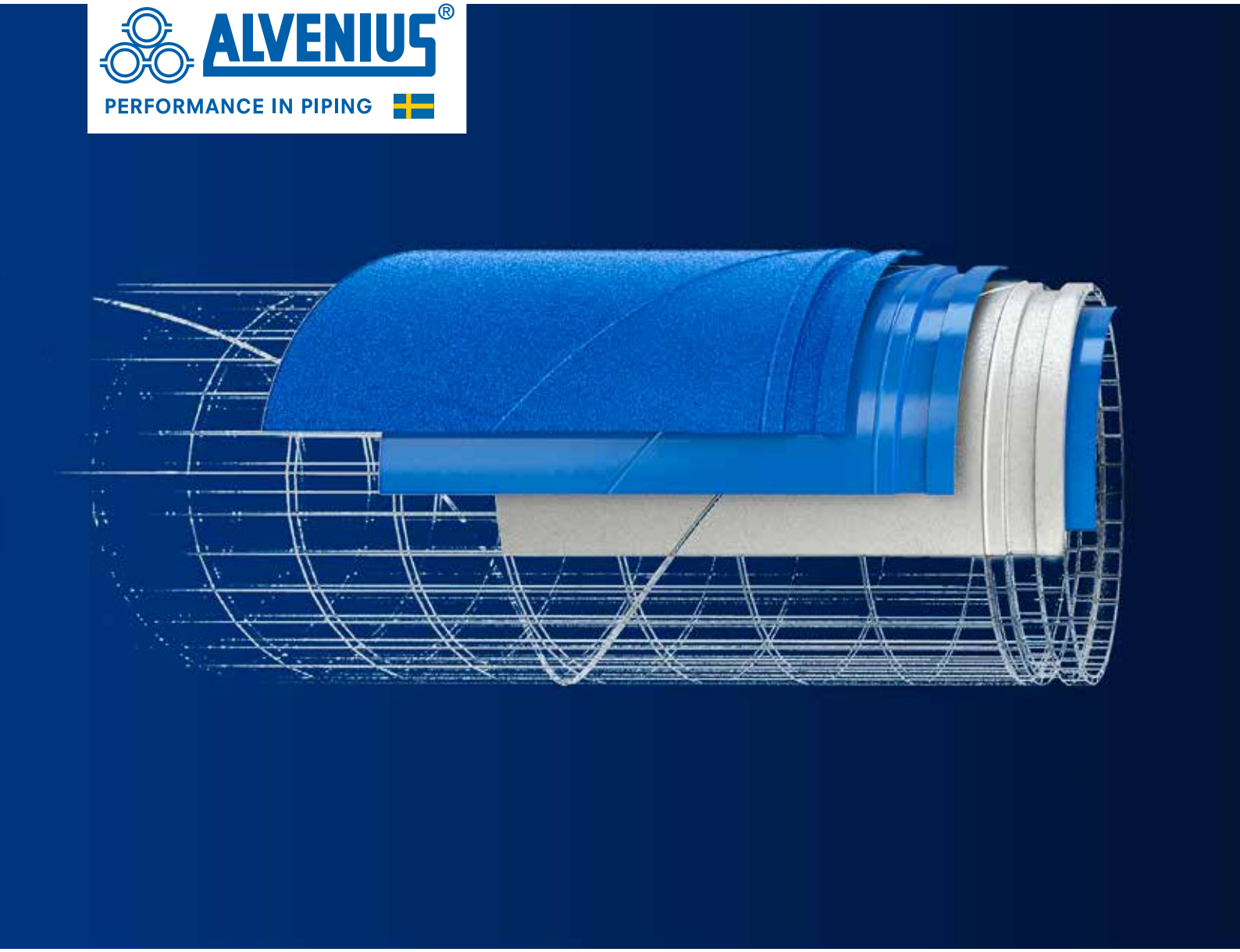
ALVENIUS®
PERFORMANCE IN PIPING



Alvenius Surface Coatings

Better protection, higher performance and lower costs

Surface coatings for all conditions and needs

Demanding conditions, aggressive or abrasive media, strict hygiene requirements, the need for a cost-effective pipe system. No problem. Alvenius offers surface coatings to meet all needs and requirements and we guide you to the right solution.

Typical applications for pipe systems from Alvenius include:

- Mining industry and mineral processing
- Tunnelling applications
- Chemical industry
- Municipal water & wastewater
- Pulp and paper industry
- Food industry
- Offshore
- Construction and civil engineering
- District cooling
- Artificial snowmaking
- Fire protection
- Automotive industry

HDG

HDG (Hot-Dip Galvanized) is an ideal surface coating for pipes that may need to be dismantled and reassembled as it provides a highly robust surface layer.

Such pipes are highly resistant to impact, wear and harsh weather conditions. What's more, the zinc layer "heals" if damaged..

CorroFlo®

Alvenius FlowMax® pipes are coated both internally and externally with CorroFlo®. These pipes are ideal for environments and applications where, for example, acidic water and aggressive chemicals are a problem.

Tests show that CorroFlo® meets the requirements for the extremely demanding corrosion class SS-EN ISO 12944, which applies to marine environments (C5-M) and underground (Im3).

Independent tests show that pipes coated with CorroFlo® offer a service life of more than 50 years.

RocShield®

For extra-durable wear and impact protection, the external surface of the pipes can be treated with RocShield® on top of the CorroFlo® coating.

RocShield® is a 500 µm LDPE layer that offers extreme resistance, making it suitable for pipes used in exposed environments.

The surface structure with its good gripping properties also offers easier and safer handling.

Internal surface coating advantages

- Improved life cycle cost – extremely low flow resistance means lower energy consumption and lower overall costs
- Very good resistance to corrosion and chemicals
- Optimal hygiene properties – the smooth coating prevents the build-up of deposits inside the pipes
- Free from Bisphenol A

External surface coating advantages

- Resistance to external impact on the pipes
- Superior service life – proven by independent tests in extreme environments
- Ideal in aggressive environments thanks to the high resistance to acidic and alkaline liquids
- Very good resistance to corrosion
- The surface coating has an elongation at failure of up to 800%
- Flexible and easy to repair if damaged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The right coating is a good investment

Alvenius HDG, CorroFlo®, RocShield® – each coating has its special benefits and its special properties. Our task is to ensure that you get the right solution for your pipe system.

A pipe system without any coating has a considerably shorter service life and worse performance.

As HDG (Hot-Dip Galvanization) is a universal, well-known surface treatment, we will focus here on Alvenius' unique CorroFlo® (thermoplastic) coating.

CorroFlo® gives you a resistant system with high performance and both your investment and your lifecycle costs remain at the right level.

Resistance

Depending on the media you pump – acidic water, aggressive or wearing liquids – you will have excellent protection with CorroFlo® coating. The surface treatment also minimises the risk of the build-up of deposits on the inside of the pipe.

Anti-corrosion

The specially adapted CorroFlo® thermoplastic, a performance polymer alloy, effectively keeps corrosion away.

Ideal for drinking water

Alvenius CorroFlo® pipes are free from Bisphenol-A and ideal for drinking water.

CorroFlo® pipes are approved for use in food processing industry and drinking water – see page 7. CorroFlo® also eliminates the build-up of bacterial and harmful deposits on the inside of the pipes.

Low flow resistance means lower costs

CorroFlo® coating is extremely smooth. This means that the pipes have the lowest flow resistance on the market (system value k=0.05), which means lower investment costs, lower energy consumption and excellent cost efficiency overall.

As an extra benefit you can reduce the required pump power or the number of pumps in the system.

CorroFlo® gives you

- 500 µm thermoplastic layer for optimum service life
- Corrosion-tested, certified coating
- Very good UV resistance
- Resistance to wear and abrasion
- Resistance to salty air, salt water and UV exposure
- No Bisphenol-A
- Approval for contact with drinking water and food
- High dielectric strength
- In a fire, the coating has low smoke generation and toxicity
- Can be repaired on site

We protect the environment

As Alvenius works hard to reduce its environmental impact, it is natural for CorroFlo® to meet a number of requirements that focus on our environment.

REACH (Regulation, Evaluation and Authorisation of Chemicals, EC 1907/2006) defines a number of substances that should be avoided to minimise environmental impacts.

Consequently, CorroFlo® is free from:

- substances of Very High Concern (SVHC)
- substances classed as Persistent, Bioaccumulative, and/or Toxic (PBT)
- substances classed as very Persistent and very Bioaccumulative (vPvB)
- substances classed as carcinogenic category 1 or 2
- substances classed as mutagenic category 1 or 2
- substances classed as toxic for reproduction category 1 or 2
- substances classed as endocrine disruptors
- perfluorooctane sulfonates ('PFOS')

CorroFlo® does not contain any of the substances listed in BASTA/CPL. This means:

- no lead
- no mercury
- no cadmium
- no volatile organic compounds
- no substances known to be very toxic to aquatic life

Approved for drinking water and food

CorroFlo® is ideal for distribution of drinking water, and contains neither Bisphenol-A nor any other reactive ingredients.

CorroFlo®, in the color blue, has the following approvals: EU 10/2011 (EU), KTW / DVGW - document W270 (Germany) and WRAS BS 6920 (UK). For other approvals and colors please contact Alvenius for updated information.

Chemical resistance

Pipes coated with CorroFlo® are ideal in environments and applications in which substances such as salty or acidic water could occure.

CorroFlo® has very high resistance to chemical substances that a pipe system may come into contact with. Please see a full list of the chemical substances on pages 15-18.

Very safe fire properties

CorroFlo® thermoplastic consists of carbon, hydrogen and water. This means:

- no reactive ingredients
- no phthalates
- no Bisphenol-A
- no halogens
- no isocyanates
- no heavy metals

In the event of fire, this means that the smoke largely consists of carbon dioxide and water.

The toxicity of the smoke is therefore extremely low and complies with many strict standards by a good margin.

- NES 713 = 1.78. Complies with the Royal Navy's requirement for max. 5.
- BS 6853:1999 = 0.21. Complies with London Underground's requirement for max. 1.

The values for **smoke generation** and **smoke density** are also very low.

- Smoke index = 110 after 20 minutes' fire. Complies with US Railroad's requirement for max. 200 after 4 minutes.
- Smoke density in accordance with BS 6853:1999 =1.13 (AO(ON)). Complies with London Underground's requirement for max. 2.6.

In accordance with BS 476, CorroFlo® can be considered to correspond to Class 0, and thus meets the requirements for coatings in tunnels and enclosed buildings.

Tests and certificates for fire and smoke properties				
France	NF P 92-501	Fire Performance of Rigid Materials		Class M1
France	NF C20-453	Corrosiveness of smoke		pH = 4.46
France	NF C20-454	Gases evolved during pyrolysis		
			Detected	CO_2 (34%), CO (7.5%)
			Not detected	HCl, HBr, HCN, HF, SO_2
UK	BS 476 Pt.5	Test for ignitability		Class P
UK	BS 476 Pt.6	Fire propagation		I = 0.2
UK	BS 476 Pt.7	Spread of flame		Class 2
UK	NES 713	Toxicity of fume index		1.76
USA	NFPA 258	Smoke generation	Flaming mode	110.06
			Non-flaming mode	27.84

Excellent corrosion properties

CorroFlo® thermoplastic was developed to function and provide maximum protection in the toughest climates, environments, circumstances and applications.

Swedish Swerea Kimab carried out an eleven-year field test with pipes coated with CorroFlo® (reg. no. 80708), with the following results:

- Rust attack Zero
- Blistering Zero
- Cracking Zero
- Flaking Zero
- Defect spread from drilled hole Zero
- Adhesion 100%

Swerea Kimab's conclusion indicates that pipes coated with CorroFlo® have a service life of beyond 50 years.

The MPA (Materials Testing Institute University of Stuttgart) carried out tests at a test site on Helgoland (project 902 8085 000/BF) in which pipes and pipe fittings were exposed to a tough marine environment with very salty air for one year.

The conclusion of the test was that pipes coated with CorroFlo® very easily conform to the C5-M corrosion class under ISO 9223 and ISO 12944.

Tests and certificates for corrosion and salt spray		
ISO 9223, ISO 12944-2	C5-M Im3	Coastal and offshore areas with high salinity In soil
ISO 9227, NF 41-002		Salt spray testing
MPA 902 8085 000/BF		One-year test in a marine environment
Swerea Kimab 80 7087		Inspection and testing of pipes after eleven years in the soil
ASTM A926-94, SP P1 02658		Abrasion testing

Facts about CorroFlo®

Typical properties of the material		
Tensile Strength	ISO 527	14 Mpa
Elongation at Break	ISO 527	800%
Brittleness Temperature	ASTM D-746	-78˚C
Hardness	Shore A Shore D	95 44
Vicat Softening Point	ISO 306	70˚C
Melting Point		105˚C
Tear Strength	ASTM D1938	22 N.mm
Environmental Stress Cracking	ASTM D1693	Greater than 1000 hrs
Toxicity Index	NES 713	1.8
Flammability	UL94 3.2 mm moulding	Unrated (see also Properties of Coating)
Dielectric Strength	IEC 243 VDE 0303	47.8 KV/mm at 370 microns
Volume Resistivity	IEC 93	3 x 10^{17} Ohm.cm
Surface Resistivity	IEC 93	8 x 10^{17} Ohm at 350 microns
Water Absorption	ASTM D570-81	<0.03%

* These values may vary from colour to colour.

Typical properties of the coating			
Recommended Coating Thickness			Average 500 microns
Impact Strength	Gardner (drop weight) ISO 6272 Direct 23˚C (0.7mm plate) Reverse 0˚C (0.7mm plate) Reverse 0˚C (3mm plate) Direct 23˚C (3mm plate)		 Greater than 27 Joules Greater than 27 Joules 18.0 Joules 2.7 Joules
Abrasion	Taber ASTM D4060/84 H18, 500g load, 1000 cycles CS17, 500g load, 1000 cycles		 60 mg weight loss 25 mg weight loss
Salt Spray	ISO 9227 and NF 41-002		Results after 1000 hours
	Steel	Scribed	Loss of adhesion less than 10mm from scribe Under film corrosion 1mm
		Unscribed	No blistering or corrosion after 10,000 hours
	Aluminium	Scribed	No loss of adhesion
		Unscribed	No loss of adhesion
Chemical Resistance*	Dilute Acids 60˚C Dilute Alkali 60˚C Salts (except peroxides) 60˚C Solvents 23˚C		Good Good Good Poor
Corrosion	ISO 12944		C5-M, IM-3. 4 Mpa
Weathering	QUV ASTM G53-77 Florida 45˚ facing South		 2000 hrs - No significant change in colour or loss of gloss. 3 years - No significant change in colour or loss of gloss.
Burning Characteristics Ignitability	BS476: Pt5: 1979 500 micron coating		P - Not easily ignitable
Surface spread on flame	BS476: Pt7: 1979 500 micron coating		Class 1
Fire Propagation	BS476: Pt6: 1989 500 micron coating		I = 0.2
Flammability	UL94		V_o (see also Properties of Material)
Safe Working Temperature	(Continuous in air)		From -70˚C to max 60˚C

* The results given are for full immersion in the chemicals for a prolonged period of time.
The coating is resistant to splashes and short term contact of most chemicals.

Facts about RocShield®

For extra durable wear and impact protection, the outside of the pipes can be coated with RocShield® on top of the CorroFlo® coating.

RocShield® is a 500 µm LDPE layer and is primarily for buried pipes as the surface layer is very resistant.

Typical properties of the material		
Specific Gravity*		0.92 g/cm^3
Tensile Strength	ISO 527	10 Mpa
Elongation at Break	ISO 527	250%
Brittleness Temperature	ASTM D-746	-20˚C
Hardness	Shore A Shore D	95 41
Vicat Softening Point	ISO 306	84˚C
Melting Point		107˚C
Environmental Stress		
Crack Resistance	ASTM D1693	Greater than 100 hrs
Flammability	UL94 3.2 mm moulding	Unrated (see also Properties of Coating)
Dielectric Strength	IEC 243 VDE 0303	25 KV/mm at 350 microns

* These values may vary from colour to colour.

Typical properties of the coating		
Recommended Coating Thickness		300-1200 microns on flat plate 800-1200 microns on wire
Appearance		Smooth/Glossy
Gloss	ISO 2813	55
Impact Strength	Gardner (drop weight) ISO 6272 Direct 23˚C	2.0 Joules
Abrasion	Taber ASTM D4060/84 H18, 500g load, 1000 cycles CS17, 500g load, 1000 cycles	 80 mg weight loss 35 mg weight loss
Chemical Resistance	Dilute Acids 60˚C Dilute Alkali 60˚C Salts (except peroxides) 60˚C Solvents 23˚C	Fair Fair Fair Poor
Safe Working Temperature	(Continuous in air)	60˚C max


CorroFlo®
High-Strength Steel
CorroFlo®
RocShield®

CorroFlo® Chemical Resistance

Splash refers to situations where CorroFlo® is exposed to the respective Chemical for a very short time only through accidental contact.

Occasional Short Term Contact refers to situations where CorroFlo® is in contact with the respective Chemical - either once or for short periods of time.

Prolonged Contact refers to situations where CorroFlo® is in contact with the respective chemical - either constant, or for longer periods of time.

NR = NOT RECOMMENDED.

	Splash (˚C)	Occasional Short Term Contact (˚C)	Prolonged Contact (˚C)
Acetaldehyde (40%)	20	20	20
Acetamide	20	20	NR
Acetic Acid (30%)	60	20	20
Acetic Acid (80%)	60	20	NR
Acetic Acid (Glacial)	20	NR	NR
Acetic Anhydride	20	20	NR
Acetone	20	20	NR
Acetyl Chloride	20	20	NR
Adipic Acid (20%)	60	60	60
Alcohols	20	20	NR
Allyl Chloride	20	NR	NR
Aluminium Salts (15% soln.)	60	60	60
Ammonia (conc.soln.)	20	NR	NR
Ammonia (dilute soln. (10%)	20	20	20
Amyl Acetate	20	20	NR
Amyl Chloride	20	20	NR
Aniline	20	20	NR
Arklone	20	NR	NR
Aviation Fuel	20	NR	NR
Barium Salts (15% soln.)	60	60	60
Benzaldehyde	20	20	NR
Benzoic Acid (20%)	60	60	60
Bleach (Sodium Hypochlorite, 12%)	20	NR	NR
Borax	60	60	60
Boric Acid	60	60	60
Brine (5%)	60	60	60
Brine (15%)	60	60	60
Bromine Water	20	NR	NR
Butadiene	20	NR	NR
Butane	20	20	20
Butanediol	20	20	20
Butyl Acetate	20	20	20
Butyl Chloride	20	20	NR
Calcium Salts (15% soln.)	60	60	60
Calcium Hydroxide (30%)	20	20	NR
Calcium Hypochlorite (10%)	20	NR	NR
Carbon Disulphide	20	NR	NR
Carbonic Acid	60	60	60

Figures in table are maximum temperatures for contact.

	Splash (˚C)	Occasional Short Term Contact (˚C)	Prolonged Contact (˚C)
Glucose	60	60	60
Glycerol (Glycerine)	60	60	60
Genklene	20	NR	NR
Heptane	20	20	20
Hexane	20	20	20
Hydrobromic Acid (5%)	20	20	20
Hydrobromic Acid (30%)	20	20	NR
Hydrochloric Acid 5% (SG 1.03)	60	60	60
Hydrochloric Acid (10%)	20	20	20
Hydrochloric Acid (20%)	20	20	NR
Hydrochloric Acid 37% (SG 1.18)	20	20	NR
Hydrocyanic Acid (5%)	60	60	60
Hydrofluoric Acid (5%)	20	20	20
Hydrofluoric Acid (40%)	20	NR	NR
Hydrofluoric Acid (70%)	NR	NR	NR
Hydrofluoric Acid (100%)	NR	NR	NR
Hydrogen Peroxide (10%)	20	NR	NR
Hydrogen Peroxide (90%)	NR	NR	NR
Hydrogen Sulphide (5%)	60	60	60
Hypochlorous Acid	20	NR	NR
Iodine soln. (0.7 g/l)	20	NR	NR
Isopropanol (70%)	20	20	NR
Isopropylacetate	20	20	NR
Iron Salts (10% soln.)	60	60	60
Kerosene	20	20	20
Ketones	20	20	NR
Lactic Acid (20%)	60	60	60
Linoleic Acid	20	20	20
Linseed Oil	20	20	20
Liquid Propane Gas	20	20	20
Machine Oil	20	20	20
Magnesium Salts (15% soln.)	60	60	60
Mercuric Salts (15% soln.)	60	60	60
Methanol	20	20	NR
Methyl Acetate	20	20	20
Methyl Bromide	20	20	NR
Methyl Cellosolve	20	20	20
Methyl Ethyl Ketone	20	20	NR
Methyl Isobutyl Ketone	20	20	NR
Methyl Dichloride	20	NR	NR
Methylene Chloride (100%)	20	NR	NR
Mineral Oil	20	20	20
Naphthalene	20	20	NR
Nickel Salts (15% soln.)	60	60	60
Nitric Acid (5%)	20	20	20
Nitric Acid 10% (SG 1.05)	20	20	NR
Nitric Acid (20%)	20	20	NR
Nitric Acid 30% (SG 1.18)	20	NR	NR

Figures in table are maximum temperatures for contact.

	Splash (°C)	Occasional Short Term Contact (°C)	Prolonged Contact (°C)
Nitric Acid (70%)	20	NR	NR
Nitric Acid fuming (SG 1.51)	NR	NR	NR
Nitrobenzene	20	NR	NR
Nitrous Acid	20	20	20
Octane	20	20	20
Oleic Acid	20	20	NR
Ozone	20	20	20
Paraffin	20	20	20
Peracetic Acid	20	20	NR
Petrol	20	20	20
Phenol (10%)	20	20	NR
Phenol in Water (20 w/w)	20	20	20
Phosphoric Acid 20% (SG 1.1)	60	60	60
Phosphoric Acid (30%)	20	20	20
Phosphoric Acid (85%)	20	NR	NR
Phosphoric Acid conc. (SG 1.87)	20	NR	NR
Polyglycol Ethers	20	NR	NR
Potassium Salts (15% soln.) (other than potassium permanganate)	60	60	60
Potassium Hypochlorite (15%)	20	NR	NR
Potassium Permanganate (15%)	20	NR	NR
Potassium Hydroxide (5%)	20	20	NR
Potassium Hydroxide (10%)	20	20	NR
Potassium Hydroxide (30%)	20	NR	NR
Propylene Dichloride	20	NR	NR
Rubber Latex	60	60	60
Silver Nitrate (15%)	60	60	60
Slurry (cow, pig, poultry etc.)	30	30	30
Sodium Carbonate (2%)	60	60	60
Sodium Carbonate (15%)	60	60	60
Sodium Chloride (5%)	60	60	60
Sodium Chloride (10%)	60	60	60
Sodium Hydroxide (1%)	20	20	20
Sodium Hydroxide (5%)	20	20	NR
Sodium Hydroxide (10%)	20	20	NR
Sodium Hydroxide (30%)	20	20	NR
Sodium Hypochlorite	20	NR	NR
Sodium Sulphate (15%)	60	60	60
Starch	60	60	60
Sulphur Dioxide (wet grades,100%)	20	NR	NR
Sulphur Dioxide (wet grades, 5%)	20	20	20
Sulphuric Acid (10%)	20	20	20
Sulphuric Acid 34% (SG 1.25)	20	20	20
Sulphuric Acid (50%)	20	20	20
Sulphuric Acid 100% (SG 1.83)	20	NR	NR
Sulphurous Acid (15%)	20	20	20
Tetrachloroethylene	20	20	NR
Tetrahydrofuran	20	NR	NR

Figures in table are maximum temperatures for contact.

	Splash (˚C)	Occasional Short Term Contact (˚C)	Prolonged Contact (˚C)
Toluene	20	NR	NR
Trichloroacetic Acid (10%)	20	20	NR
Trichloroacetic Acid (100%)	20	NR	NR
Trichloroethylene	20	20	NR
Trichlorophenol	20	20	NR
Turpentine (White Spirit)	20	20	20
Water	60	60	60
Xylene	20	NR	NR
Zinc Chloride	60	60	60
Zinc Sulphate	60	60	60

Figures in table are maximum temperatures for contact.

Plastic powder for performance pipes!


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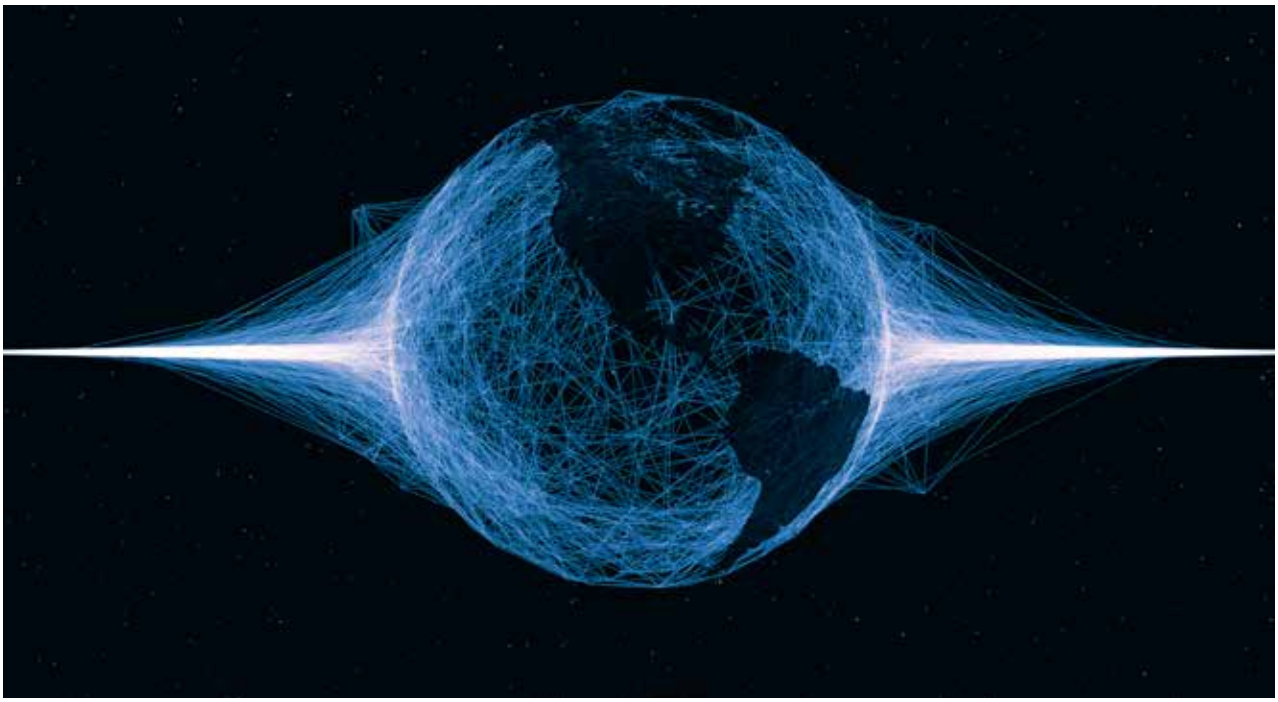

Alvenius was founded in 1951 and ever since we have focused on supplying the global market with high-quality quick coupling steel pipe systems.

Today, Alvenius focuses its expertise on the segments tunnels, mines, industry, fire protection and extinguishing, water and wastewater systems and artificial snow making.

We have a presence in Asia, Africa, the Middle East, North and South America, Europe and, of course, our domestic market Sweden.

Our international approach offers many advantages.

Above all else, it means that we understand the conditions and demands of your particular market – wherever that may be.

ALVENIUS®

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