

Material characteristics

2 Material properties

Polyethylene, PE for short, is a semi crystalline thermoplastic and is a generic term for different kinds of PE. By colouring with 2% of "carbon black" the PE gets its black colour.

The following kinds of PE are generally used:

LDPE (Density 0,90-0,91 g/cm³)

MDPE (Density 0,93-0,94 g/cm³)

HDPE (Density 0,94-0,97 g/cm³)

In pipe systems generally only HDPE is used. HDPE has a high resistance against acids, bases and aqueous salt-solutions. Below 60°C it is practically unsolvable in organic solutions. HDPE has a good resistance against light ionised radiation without becoming radioactive itself. In table 2.1 the properties and benefits of the Akatherm HDPE are highlighted.

Table 2.2 See following page

2.1 Physical characteristics of HDPE

	Unit	Test method	Value
Density at 23°C	g/cm ³	ISO 1183	0,954
Elasticity modulus	N/mm ²	ISO 527	850
Bending creep modulus	N/mm ²	DIN 54852-Z4	1000
Tensile strength at 23°C	N/mm ²	ISO 527	22
Elongation at break	%	ISO R 527	300
Linear expansion coefficient	mm/mK	DIN 53752	0,13 - 0,19
Indentation hardness	N/mm ²	ISO 2039	36 - 46
Ignition temperature	°C	-	~350
Thermal conductivity	W/m . K	DIN 52612	0,37 - 0,43
Shore hardness		ISO 868	61
Crystallite melting range	°C		125 - 131
Operational temperature range	°C	-	-40 - +100
Melt Flow Rate MFR 190/5	g/10 min	ISO 1133	0,43

Table 2.1

Material characteristics






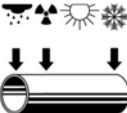







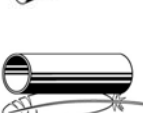
	Properties HDPE	Benefits
	Impact-resistant and tough	Unbreakable temperatures > 5°C
	Elastic	Suitable for underground pipes through adjustment to local ground movement
	Thermal resistant	Application possible between -40°C and 100°C
	Smooth internal wall	Low blockage risk due to low deposit/residue effects
	Wear resistant	Lower costs due to relatively long life
	Weather resistant/UV resistant	Application in open air unrestricted through colouring with carbon black
	Chemical resistant	Suitable for transport of polluted waste water
	Poor heat conductivity	No condensation during short periods of cooling
	Recyclable PE-HD	Environmentally friendly
	Insulating	Non-conductive
	Highly suitable for welding	Easy installation using butt-welding and electrofusion techniques
	Homogeneous welded joints	End load resistant and leak proof
	Prefabrication	Reduces on-site installation time
	Light in weight	Cost-saving in transport and handling

Table 2.2

Material characteristics

2.2 Chemical resistance

In table 2.3 the chemical resistance of HDPE is depicted per medium at a number of different temperatures. In general we can define the resistance as follows:

For standard soil and waste systems the resistance of HDPE is perfect. In these pipes systems hardly ever aggressive fluids are drained. When transporting chemical waste waters in laboratories and the chemical industry the following factors have to be taken in account:

- The medium
- The concentration of this medium
- Temperature
- Duration of exposure
- Volume

The chemical resistance list of the electrometric seals is to aid in establishing the suitability of a certain seal. This is only an indication of its suitability. The chemical deterioration of the polymer chain can lead to changes in the mechanical characteristics like tensile strength and elongation at break etc. The data is valid for a temperature of 20°C. At higher temperatures or longer duration of exposure a more aggressive condition can occur which shortens the lifespan of the seal.

Used symbols

HDPE pipe and fittings:

- + Resistant, based on the test carried out HDPE is in general a suitable material for this application.
- / Limited resistance, further research necessary.
- no resistance.

Empty field No data available.

Elastomeric seals:

- 1** Little or no effect, volume change <10%. In heavy conditions this elastomere can show a small increase in volume and /or loss of physical properties.
- 2** Possible change of physical properties, volume change 10%-20%, the elastomere can show increase in volume and a change in physical properties but can be suitable for static applications.
- 3** Noticeable change of physical properties, large change in volume, and physical properties.
- 4** Elastomeric seal is not suitable. Influence to great.

Empty field No data available.

Abbreviations:

- Comm. Comp. = Commercial composition
- HDPE = High Density Polyethylene
- NBR = Acryl nitrile - butadiene rubber
- EPDM = Ethylene propylene copolymer
- FPM = Vinylidene fluoride copolymer
- SBR = Styrol butadiene rubber

Material characteristics

Component			Concentration	Pipe and fittings			Elastomeric seals			
Name	Formula	Remark		HDPE			NBR	EPDM	FPM	SBR
				°C	°C	°C	°C	°C	°C	°C
				20	40	60	20	20	20	20
Acetaldehyde	CH ₃ CHO	Aqueous solution	40%	+	+	/	4	2	4	3
Acetaldehyde	CH ₃ CHO	Technically pure	100%	+	/	/	4	2	4	3
Acetic Acid	CH ₃ COOH	Aqueous solution	10%	+	+	+	4	3/4	4	4
Acetic Acid	CH ₃ COOH	Aqueous solution	30%	+	+	+	4	4	4	4
Acetic Acid	CH ₃ COOH	Aqueous solution	60%	+	+	+	4	4	4	4
Acetic Acid	CH ₃ COOH	Aqueous solution	80%	/	/	-	4	4	4	4
Acetic Acid	CH ₃ COOH	Technically pure	100%	+	+	/	4	4	4	4
Acetic Acid Anhydride	(CH ₃ CO) ₂ O	Technically pure	100%	+	/	/	4	2	4	2
Acetone	CH ₃ COCH ₃	Aqueous solution	10%	+	+	+	4	1	4	2/3
Acetone	CH ₃ COCH ₃	Technically pure	100%	/	/	/	4	1	4	2/4
Acetophenone	CH ₃ COC ₆ H ₅	Technically pure	Indetermined	+	+	+	4	1	4	4
Acrylonitrile	CH ₂ =CH-CN	Technically pure	100%	+	+	+	4	4	4	3
Adipic Acid	HOOC(CH ₂) ₄ COOH	Aqueous solution	Saturated	+	+	+	1	1	1	1
Alcohol			40%	+						
Alcoholic Spirits			Comm. Comp.	+	+					
Allyl Alcohol	CH ₂ =CH-CH ₂ OH	Aqueous solution	96%	+	+	+				
Alum	Al ₂ (SO ₄) ₃ K ₂ SO ₄ ·4H ₂ O	Aqueous solution	Solution	+	+	+	2	1	1	1
Alum	Al ₂ (SO ₄) ₃ K ₂ SO ₄ ·4H ₂ O	Aqueous solution	Saturated	+	+	+	2	1	1	1
Aluminium Acetate	(CH ₃ COO) ₃ Al	Aqueous solution	Saturated	+	+	+	2	1	4	4
Aluminium Bromide	AlBr ₃	Aqueous solution	Saturated	+	+	+	1	1	1	1
Aluminium Chloride	AlCl ₃	Aqueous solution	All	+	+	+	2	1	1	1
Aluminium Fluoride	AlF ₃	Aqueous solution	Saturated	+	+	+	2	1	1	1
Aluminium Nitrate	Al(NO ₃) ₃	Aqueous solution	Saturated	+			1	1	1	1
Aluminium Sulfate	Al ₂ (SO ₄) ₃	Aqueous solution	10%	+	+	+	2	1	1	1
Aluminium Sulfate	Al ₂ (SO ₄) ₃	Aqueous solution	Saturated	+	+	+	2	1	1	1
Ammonia	NH ₃	Aqueous solution	Solution	+	+	+	2	1	3	2
Ammonia Gas	NH ₃	Aqueous solution	Saturated	+	+	+	2	1	3	2
Ammonia Gas	NH ₃	Technically pure	100%	+	+	+	2	1	3	2
Ammonium Acetate	CH ₃ COONH ₄	Aqueous solution	Saturated	+	+	+				
Ammonium Bifluoride	NH ₄ FHF	Aqueous solution	Saturated	+	+	+				
Ammonium Carbonate	(NH ₄) ₂ CO ₃	Aqueous solution	100%	+	+	+	2	1	2	2
Ammonium Chloride	NH ₄ Cl	Aqueous solution	Saturated	+	+	+	1	1	1	1
Ammonium Fluoride	NH ₄ F	Aqueous solution	25%	+	+	+	1	1	1	1
Ammonium Fosfate	(NH ₄) ₃ PO ₄ ·X H ₂ O		All	+	+	+	1	1	1	1
Ammonium Hydroxide	NH ₄ OH	Aqueous solution	Solution	+	+	+	4	1	2	4
Ammonium Hydroxide	NH ₄ OH	Aqueous solution	Saturated	+	+	+	4	1	2	4
Ammonium Nitrate	NH ₄ NO ₃	Aqueous solution	Saturated	+	+	/	2	1	1	1
Ammonium Sulfate	(NH ₄) ₂ SO ₄	Aqueous solution	All	+	+	+	1	1	1	1
Ammonium Sulphydrate	NH ₄ OH(NH ₄) ₂ SO ₄	Aqueous solution	Solution	+						
Ammonium Sulphydrate	NH ₄ OH(NH ₄) ₂ SO ₃	Aqueous solution	Saturated	+						
Ammonium Sulfide	(NH ₄) ₂ S	Aqueous solution	10%	+	+	+	1	1	1	1
Ammonium Sulfide	(NH ₄) ₂ S	Aqueous solution	Saturated	+	+	+	1	1	1	1
Amyl Acetate	CH ₃ COO(CH ₂) ₄ CH ₃	Technically pure	100%	+	+	+	4	2	4	3
Amyl Alcohol	CH ₃ (CH ₂) ₃ CH ₂ OH		100%	+	+	/	2	2	2	1
Amyl Chloride	CH ₃ (CH ₂) ₄ Cl	Technically pure	100%	-				4	1	4
Aniline	C ₆ H ₅ NH ₂	Technically pure	100%	/			4	2/3	1	3
Aniline Chlorhydrate	C ₆ H ₅ NH ₂ HCl	Aqueous solution	Saturated	/	/	/	2	2	1	1
Anthraquinone Sulfonic Acid			Solution	+						
Antimony Trichloride	SbCl ₃	Aqueous solution	90%	+	+	+	1	1	1	1
Aqua Regia	3HCl+1HNO ₃		100%	-	-	-	4	4	2/3	4
Arsenic Acid	H ₃ AsO ₄		Saturated	+	+					
Barium Carbonate	BaCO ₃	Aqueous solution	All	+	+	+				
Barium Chloride	BaCl ₂	Aqueous solution	All	+	+	+	1	1	1	1
Barium Hydroxide	Ba(OH) ₂	Aqueous solution	Saturated	+	+	+	1	1	1	1
Barium Nitrate	Ba(NO ₃) ₂	Aqueous solution	Saturated	+	+	+				
Barium Sulfate	BaSO ₄	Aqueous solution	Saturated	+	+	+	1	1	1	1
Barium Sulfide	BaS	Aqueous solution	Saturated	+	+	+	1	1	1	2
Beer			100%	+	+	+	1	1	1	1
Benzaldehyde	C ₆ H ₅ CHO	Aqueous solution	Saturated	+	+	+	4	2	4	3
Benzene	C ₆ H ₆	Technically pure	100%	/	-	-	4	4	3	4
Benzene + Benzine			20/80%	/	-	-	2/3	4	2	4

Material characteristics

Component			Concentration	Pipe and fittings			Elastomeric seals			
Name	Formula	Remark		HDPE			NBR	EPDM	FPM	SBR
				°C	°C	°C	°C	°C	°C	°C
				20	40	60	20	20	20	20
Benzene Sulfonic Acid	C ₆ H ₅ SO ₃ H	Aqueous solution	10%	-			4	4	1	4
Benzine (Free Of Pb And Aromatic)	C ₅ H ₁₂ +C ₁₂ H ₂₆	Technically pure	100%	+	+	/	4	4	1	4
Benzoic Acid	C ₆ H ₅ COOH	Aqueous solution	Saturated	+	+	+	4	4	1	4
Benzyl Alcohol	C ₆ H ₅ CH ₂ OH	Technically pure	100%	+	+	/	4	1	1	4
Bleaching Lye	NaClO+NaCl		12,5% Cl	/	/		4	1	1	4
Borax	Na ₂ B ₄ O ₇	Aqueous solution	All	+	+	+	1	1	1	1
Boric Acid	H ₃ BO ₃	Aqueous solution	Saturated	+	+	+	1	1	1	1
Brine			Comm. Comp.	+						
Bromic Acid	HBrO ₃		10%	+	+	+	4	1	1	4
Bromine,Liquid	Br ₂	Technically pure	100%	-			4	3	2	4
Bromine,Liquid	Br ₂		High	-			4	4	1	4
Butadiene	CH ₂ =CH-CH=CH ₂	Gas	100%	+			3	4	2	4
Butane Gas	CH ₃ CH ₂ CH ₂ CH ₃		100%	+	+	+	2	4	2	4
Butanediol	OHCH ₂ CH ₂ CH ₂ CH ₂ OH	Aqueous solution	10%	+	+	+				
Butanediol	OHCH ₂ CH ₂ CH ₂ CH ₂ OH	Aqueous solution	Concentrated	/	-	-				
Butyl Acetate	CH ₃ COOCH ₂ CH ₂ CH ₂ CH ₃	Technically pure	100%	/	/	/	4	2	4	4
Butyl Alcohol	CH ₃ (CH ₂) ₃ OH	Technically pure	100%	+	+	+	1	2	1	1
Butyl Ether	(CH ₃ (CH ₂) ₃) ₂ O	Technically pure	100%	/	-	-	4	3	4	4
Butyl Phenol	C ₄ H ₉ C ₆ H ₄ OH	Technically pure	100%	-			4	4	2	4
Butyl Phthalate	HOOC ₆ H ₄ COOC ₄ H ₉	Technically pure	100%	+	/	/				
Butylene	CH ₂ =CH-CH ₂ CH ₄	Liquid	100%	-			2	4	1	4
Butylene Glycol	OHCH ₂ -CH=CH-CH ₂ OH	Technically pure	100%	+	+	+	1	1	1	1
Butylene	CH ₂ =CH-CH ₂ CH ₃	Technically pure	100%	-			2	4	1	4
Butyric Acid	CH ₃ CH ₂ CH ₂ COOH	Aqueous solution	20%	+	+	/				
Butyric Acid	CH ₃ CH ₂ CH ₂ COOH	Technically pure	100%	+	+	/				
Calcium Acetate	Ca(CH ₃ COO) ₂	Aqueous solution	Saturated	+	+	+	2	1	4	4
Calcium Bisulfite	Ca(HSO ₃) ₂	Aqueous solution	Saturated	+	+	+	2	1	2	2
Calcium Carbonate	CaCO ₃	Aqueous solution	All	+	+	+	1	1	1	1
Calcium Chlorate	Ca(ClO ₃) ₂	Aqueous solution	Saturated	+	+	+	1	1	1	1
Calcium Chloride	CaCl ₂	Aqueous solution	All	+	+	+	1	1	1	1
Calcium Hydroxide	Ca(OH) ₂	Aqueous solution	All	+	+	+	1	1	1	1
Calcium Hypochloride	Ca(ClO) ₂	Aqueous solution	Saturated	+	+	+	4	1	1	4
Calcium Nitrate	Ca(NO ₃) ₂	Aqueous solution	50%	+	+	+	1	1	1	1
Calcium Sulfate	CaSO ₄	Aqueous solution	Saturated	+	+	+				
Calcium Sulfide	CaS	Aqueous solution	Saturated	/	/	/	1	1	1	2
Camphor Oil			Comm. Comp.	-	-					
Carbon Dioxide	CO ₂ +H ₂ O	Aqueous solution	Indetermined	+	+	+	1	1	1	1
Carbon Dioxide	CO ₂	Gas	100%	+	+	+	1	1	1	1
Carbon Disulfide	CS ₂	Technically pure	100%	/	-		4	4	1	4
Carbon Monoxid	CO	Gas	100%	+	+	+	2	2	1	2
Carbon Tetrachloride	CCl ₄	Technically pure	100%	-						
Carbonic Acid	H ₂ CO ₃	Aqueous solution	Saturated	+	+	+				
Chloramine	C ₆ H ₅ SO ₂ NNaCl	Aqueous solution	Solution	+						
Chloric Acid	HClO ₃	Aqueous solution	20%	/						
Chlorine	Cl ₂	Wet	All	/	-		4	3	1	4
Chlorine	Cl ₂	Gas	100%	/	/	-	4	2	4	4
Chlorine	Cl ₂	Technically pure	100%	-						
Chlorine Water	Cl ₂ +H ₂ O		Saturated	/	/					
Chloro Benzene	C ₆ H ₅ Cl	Technically pure	100%	/	-	-				
Chloro Sulfonic Acid	HClSO ₃	Technically pure	100%	-	-	-				
Chloroform	CHCl ₃	Technically pure	100%	-			4	4	2	4
Chrome Alum	KCr(SO ₄) ₂	Aqueous solution	Saturated	+	+	+				
Chrome Alum	KCr(SO ₄) ₂		Indetermined	+	+	+				
Chromic Acid	CrO ₃ +H ₂ O	Aqueous solution	10%	/	-	-	4	2/3	1	4
Chromic Acid	CrO ₃ +H ₂ O	Aqueous solution	30%	/	-	-	4	2/3	1	4
Chromic Acid	CrO ₃ +H ₂ O	Aqueous solution	50%	/	-	-	4	2/3	1	4
Citric Acid	C ₃ H ₄ (OH)(COOH) ₃	Aqueous solution	50%	+	+	+	2	1	1	2
Compressed Air with Oil			100%	+	+					
Copper Acetate	Cu(COOCH ₃) ₂		Saturated	+			2	1	4	4
Copper Chloride	CuCl ₂	Aqueous solution	Saturated	+	+	+	1	1	1	1
Copper Fluoride	CuF ₂	Aqueous solution	All	+	+	+	2	1	1	1
Copper Nitrate	Cu(NO ₃) ₂	Aqueous solution	Indetermined	+	+	+	2	1	1	1

Material characteristics

Component			Concentration	Pipe and fittings			Elastomeric seals			
Name	Formula	Remark		HDPE			NBR	EPDM	FPM	SBR
				°C	°C	°C	°C	°C	°C	°C
				20	40	60	20	20	20	20
Copper Sulfate	CuSO ₄	Aqueous solution	Solution	+	+	+	1	1	1	1
Copper Sulfate	CuSO ₄	Aqueous solution	Saturated	+	+	+	1	1	1	1
Cresol	CH ₃ C ₆ H ₄ OH	Aqueous solution	>=90%	+	+	/				
Cresol	CH ₃ C ₆ H ₄ OH	Aqueous solution	Solution	+	+	/				
Croton Aldehyde	CH ₃ -CH=CH-CHO	Technically pure	100%	/						
Cryolite	Na ₃ AlF ₆	Aqueous solution	Saturated	/	/	-				
Cyclohexane	C ₆ H ₁₂	Technically pure	100%	+	+	+	2	4	1	4
Cyclohexanol	C ₆ H ₁₁ OH	Technically pure	100%	+	/	/	2	4	2	3
Cyclohexanone	C ₆ H ₁₀ O	Technically pure	100%	+	/	/	4	3	4	4
Decalin (Decahydronaftalene)	C ₁₀ H ₁₈	Technically pure	100%	+	/	/				
Detergents		Aqueous solution	Comm. Comp.	+	+	+				
Dextrine			Comm. Comp.	+	+	+				
Dextrose	C ₆ H ₁₂ O ₆	Aqueous solution	All	+	+	+				
Dextrose	C ₆ H ₁₂ O ₆	Aqueous solution	Saturated	+	+	+				
Dextrose	C ₆ H ₁₂ O ₆	Aqueous solution	All	+	+	+	1	1	1	1
Dibutyl Phthalate	C ₆ H ₄ (COOC ₄ H ₉) ₂	Technically pure	100%	-			4	2	2	4
Dibutyl Sebacate	C ₈ H ₁₆ (COOC ₄ H ₉) ₂	Technically pure	100%	+			4	2	2	4
Dichloro Benzene	C ₆ H ₄ Cl ₂	Technically pure	100%	/			4	4	2	4
Dichloroacetic Acid	Cl ₂ CHCOOH	Aqueous solution	50%	+	+	+	2	2	2	2
Dichloroacetic Acid	Cl ₂ CHCOOH	Technically pure	100%	+	+	/	3	2	3	3
Dichloroacetic Acid Methyl Ester	Cl ₂ CHCOOCH ₃	Technically pure	100%	+	+	+				
Dichloroethylene	CHCl=CHCl	Technically pure	100%	-			2		2	4
Diesel Oil			100%	+	/	/	1	4	1	4
Diethylether	C ₂ H ₅ OC ₂ H ₅	Technically pure	100%	-	-		4	4	4	4
Diglycolic Acid	HOOCCH ₂ OCH ₂ COOH	Aqueous solution	Saturated	+						
Di-isobutyl Ketone	(CH ₃) ₂ CHCH ₂ COCH ₂ CH (CH ₃) ₂	Technically pure	100%	+	/	-	4	2	4	2/3
Dimethyl Amine	(CH ₃) ₂ NH	Technically pure	100%	/	-					
Dimethyl Formamide	HCON(CH ₃) ₂	Technically pure	100%	+	+	/	4	2	4	3
Diocetyl Phthalate	C ₆ H ₄ (COOC ₈ H ₁₇) ₂	Technically pure	100%	+	/	/	4	2	2	4
Dioxane	(CH ₂) ₄ O ₂	Technically pure	100%	+	+	+	4	2/3	4	4
Ethyl Acetate	CH ₃ COOCH ₂ CH ₃	Technically pure	100%	+	/	-	4	2/3	4	4
Ethyl Alcohol	CH ₃ CH ₂ OH	Aqueous solution	96%	+	+	/	2	1	2	1
Ethyl Benzene	C ₆ H ₅ C ₂ H ₅	Technically pure	100%	/	/	/	4	4	2	4
Ethyl Chloride	CH ₃ CH ₂ Cl	Technically pure	100%	/	-		2/3	4	2	4
Ethyl Ether	CH ₃ CH ₂ OCH ₂ CH ₃	Technically pure	100%	/			3	3	4	4
Ethylene Chlorohydrin	ClCH ₂ CH ₂ OH	Technically pure	100%	+	+	/	4	2	2	2
Ethylene Diamina	NH ₂ CH ₂ CH ₂ NH ₂	Technically pure	100%	-	-	-	2	1	4	2
Ethylene Dichloride	CH ₂ ClCH ₂ Cl	Technically pure	100%	/	/		4	4	2/3	4
Ethylene Glycol	HOCH ₂ -CH ₂ OH	Technically pure	100%	+	+	+	1	1	1	1
Ethylene Oxide	C ₂ H ₄ O	Technically pure	100%	-			3	3	4	4
Exhaust fumes			Traces	+	+	+				
Fatty Acids	R>C ₆	Technically pure	100%	+	+	/				
Ferric Chloride	FeCl ₃	Aqueous solution	Saturated	+	+	+	2	1	1	2
Ferric Nitrate	Fe(NO ₃) ₃		Indetermined	+	+	+				
Ferric Sulfate	Fe ₂ (SO ₄) ₃	Aqueous solution	Saturated	+	+	+				
Ferrous Chloride	FeCl ₂	Aqueous solution	Saturated	+	+	+	2	1	1	2
Ferrous Nitrate	Fe(NO ₃) ₂	Aqueous solution	Saturated	+	+	+				
Ferrous Sulfate	FeSO ₄	Aqueous solution	Saturated	+	+	+	2	1	1	2
Fertilizer Salts		Aqueous solution	10%	+	+	+				
Fertilizer Salts		Aqueous solution	Saturated	+	+	+				
Fluoboric Acid	HF ₄	Technically pure	100%	+	+	+	1	1		1
Fluorine Gas Dry	F ₂		100%	-			4		1	4
Fluosilicic Acid	H ₂ SiF ₆	Aqueous solution	32%	+	+	+				
Formaldehyde	CH ₂ O	Aqueous solution	37%	+	+	+	1	1	1	1
Formamide	HCONH ₂	Technically pure	100%	+	+	+	2	2	1	1
Formic Acid	HCOOH	Aqueous solution	50%	+	+	+	4	2	4	2
Formic Acid	HCOOH	Technically pure	100%	+	+	+	4	2	4	2
Freon F-12	CCl ₂ F ₂	Technically pure	100%	-			2	2/3	2	4
Fruit pulp and juice			Comm. Comp.	+						

Material characteristics

Component			Concentration	Pipe and fittings			Elastomeric seals			
Name	Formula	Remark		HDPE			NBR	EPDM	FPM	SBR
				°C	°C	°C	°C	°C	°C	°C
				20	40	60	20	20	20	20
Furfuryl Alcohol	C ₅ H ₆ O ₂	Technically pure	100%	+	+	/	4	2		4
Gelatine			100%	+	+	+	1	1	1	1
Glycerine	C ₃ H ₅ (OH) ₃	Aqueous solution	All	+	+	+	1	1	2	1
Glycocoll	NH ₂ CH ₂ COOH	Aqueous solution	10%	+	+					
Glycolic Acid	HOCH ₂ COOH	Aqueous solution	37%	+	+	+				
Gas containing:										
- Carbon Dioxide	CO ₂	Gas	All	+	+	+				
- Carbon Monoxid	CO	Gas	All	+	+	+				
- Hydrochloric Acid	HCL	Gas	All	+	+	+				
- Hydrochloric Acid	HCL	Gas	All	+	+	+				
- Hydrofluoric Acid	HF	Gas	< 0,1 %	+	+	+				
- Nitrous Vapours	NO, NO ₂ , N ₂ O ₃ , NO _x	Gas	< 0,1 %	+	+	+				
- Nitrous Vapours	NO, NO ₂ , N ₂ O ₃ , NO _x	Gas	5%	+	+	+				
- Oleum	H ₂ SO ₄ + SO ₃	Gas	< 0,1 %	-	-	-				
- Oleum	H ₂ SO ₄ + SO ₃	Gas	5%	-	-	-				
- Sulphur Dioxide Liquid	SO ₂	Gas	All	+	+	+				
- Sulphur Trioxide	SO ₃	Gas	< 0,1 %	-	-	-				
- Sulphuric Acid	H ₂ SO ₄	Gas	All	+	+	+				
Heptane	C ₇ H ₁₆	Technically pure	100%	+	/	-	1	4	1	4
Hexane	C ₆ H ₁₄	Technically pure	100%	+	/	/	1	4	1	4
Hydrazine Hydrate	NH ₂ -NH ₂ H ₂ O	Aqueous solution	Solution	+	+	+	2	1	1	
Hydrobromic Acid	HBr		10%	+	+	+	3	2	1	3
Hydrobromic Acid	HBr		48%	+	+	+	4	1	1	4
Hydrochloric Acid	HCl	Aqueous solution	10%	+	+	+				
Hydrochloric Acid	HCl	Aqueous solution	30%	+	+	+	2/3	1	2	2/3
Hydrochloric Acid	HCl	Aqueous solution	5%	+	+	+				
Hydrochloric Acid	HCl	Aqueous solution	Saturated	+	+	+				
Hydrocyanic Acid	HCN	Aqueous solution	Solution	+	+	+	2	2	1	2
Hydrocyanic Acid	HCN	Technically pure		+	+	+	2	2	1	2
Hydrofluoric Acid	HF	Aqueous solution	10%	+	+	/	4	3	2/3	3
Hydrofluoric Acid	HF	Aqueous solution	40%	+	/	/	4	3	2/3	3
Hydrofluoric Acid	HF	Aqueous solution	70%	+	/	/	4	3	2/3	3
Hydrogen Gas	H ₂		100%	+	+	+	2	1	1	4
Hydrogen Peroxide	H ₂ O ₂	Aqueous solution	10%	+	+	+	2	1	1	2
Hydrogen Peroxide	H ₂ O ₂	Aqueous solution	50%	+	+	/	2	1	1	2
Hydrogen Peroxide	H ₂ O ₂	Aqueous solution	90%	+	-	-	2	1	1	2
Hydrogen Sulfide	H ₂ S	Aqueous solution	Saturated	+	+	+				
Hydrogen Sulfide	H ₂ S		100%	+	+	/				
Hydroquinone	C ₆ H ₄ O ₂	Aqueous solution	Saturated	+	+	+	3	4	2	4
Hydroxylamine Sulphate	(NH ₂ OH) ₂ -H ₂ SO ₄	Aqueous solution	All	+	+	+				
Iodine Dry And Wet	I ₂		3%	/	-	-	1	2	1	1
Iso-Octane	C ₈ H ₁₈		100%	/	/	-	1	4	1	4
Isopropyl Alcohol	(CH ₃) ₂ CHOH	Technically pure	100%	+	+	+	2	1	1	2
Isopropyl Ether	(CH ₃) ₂ CHOCH(CH ₃) ₂	Technically pure	100%	/	-	-	2/3	3	4	4
Lactic Acid	CH ₃ CHOHCOOH	Aqueous solution	<=28%	+	+	+	2	1	1	3
Lanoline			Comm. Comp.	+	+	+	1	4	1	4
Lard Oil			Comm. Comp.	+						
Lead Acetate	Pb(CH ₃ COO) ₂	Aqueous solution	Saturated	+	+	+	1	1	4	4
Lead Chloride	PbCl ₂	Aqueous solution	Saturated	+	+					
Lead Nitrate	Pb(NO ₃) ₂	Aqueous solution	Saturated	+			1	1	1	1
Lead Sulfate	PbSO ₄	Aqueous solution	Saturated	+	+	+				
Linseed Oil			Comm. Comp.			/	1	3	1	4
Lubricating Oils			Comm. Comp.	-			2	4	1	4
Lubricating Oils,Free Of Aromatic			Comm. Comp.	+	+	/	1	4	1	4
Magnesium Carbonate	MgCO ₃	Aqueous solution	All	+	+	+	1	1	1	1
Magnesium Chloride	MgCl ₂	Aqueous solution	Saturated	+	+	+	2	1	1	1
Magnesium Nitrate	Mg(NO ₃) ₂	Aqueous solution	Indetermined	+	+	+				
Magnesium Sulfate	MgSO ₄		Saturated	+	+	+	2	1	1	1
Maize Oil			Comm. Comp.	+	+	/	1	1	1	4
Maleic Acid	HOOC-CH=CH-COOH	Aqueous solution	Saturated	+	+	+	1	1	1	1
Malic Acid	HOOCCH ₂ CHOHCOOH	Aqueous solution	Saturated	+			1	4	1	2

Material characteristics

Component			Concentration	Pipe and fittings			Elastomeric seals			
Name	Formula	Remark		HDPE			NBR	EPDM	FPM	SBR
				°C	°C	°C	°C	°C	°C	°C
				20	40	60	20	20	20	20
Mercuric Chloride	HgCl ₂	Aqueous solution	Saturated	+	+	+	1	1	1	1
Mercuric Cyanide	Hg(CN) ₂	Aqueous solution	All	+	+	+				
Mercuric Sulfate	HgSO ₄	Aqueous solution	Saturated	+	+	+				
Mercurous Nitrate	HgNO ₃	Aqueous solution	Saturated	+	+	+				
Mercury	Hg	Technically pure	100%	+	+	+	1	1	1	1
Methane	CH ₄		100%	+			1	3	1	3
Methanesulfonic Acid	CH ₃ SO ₃ H	Aqueous solution	50%	/	/					
Methanesulfonic Acid	CH ₃ SO ₃ H	Technically pure	100%	-	-					
Methyl Acetate	CH ₃ COOCH ₃	Technically pure	100%	+			4	2	4	4
Methyl Alcohol	CH ₃ OH	Technically pure	100%	+	+	+				
Methyl Amine	CH ₃ NH ₂	Aqueous solution	32%	/			4	1	4	2
Methyl Bromide	CH ₃ Br	Technically pure	100%	/			4	4	1	4
Methyl Chloride	CH ₂ Cl	Technically pure	100%	/			4	3	1	4
Methyl Ethyl Ketone	CH ₃ COCH ₂ CH ₃		100%	+	/	-	4	2	4	4
Methylene Chloride	CH ₂ Cl ₂		100%	/			4	4	3	4
Milk			100%	+	+	+	1	1	1	1
Mineral oil			Comm. Comp.	/	/	-	1	4	1	4
Mixed Acids (Chromic, Sulphuric)	H ₂ CrO ₄ /H ₂ SO ₄ /H ₂ O		50/15/35%	-						
Mixed Acids (Sulphuric, Nitric)	H ₂ SO ₄ /HNO ₃ /H ₂ O		10/20/70%	/	/	/				
Mixed Acids (Sulphuric, Nitric)	H ₂ SO ₄ /HNO ₃ /H ₂ O		48/49/3	-	-	-				
Mixed Acids (Sulphuric, Nitric)	H ₂ SO ₄ /HNO ₃ /H ₂ O		50/50%	-	-	-				
Mixed Acids (Sulphuric, Phosphoric)	H ₂ SO ₄ /H ₃ PO ₄ /H ₂ O		30/60/10%	+	/					
Molasses			Comm. Comp.	+	/	/	1	1	1	1
Monochloroacetic Acid	ClCH ₂ COOH	Aqueous solution	50%	+	/	/	4	2		4
Monochloroacetic Acid Ethyl Ester	ClCH ₂ COOCH ₂ CH ₃	Technically pure	100%	+	+	+				
Naphthalene	C ₁₀ H ₈	Technically pure	100%	+	/	/				
Nickel Chloride	NiCl ₂	Aqueous solution	All	+	+	+	1	1	1	1
Nickel Nitrate	Ni(NO ₃) ₂	Aqueous solution	Saturated	+	+	+				
Nickel Sulfate	NiSO ₄	Aqueous solution	Solution	+	+	/	1	1	1	1
Nickel Sulfate	NiSO ₄	Aqueous solution	Saturated	+	+	+	1	1	1	1
Nicotine	C ₁₀ H ₁₄ N ₂		Indetermined	+	+	+				
Nitric Acid	HNO ₃	Aqueous solution	20%	+	/	/	4	4	2/3	4
Nitric Acid	HNO ₃	Aqueous solution	40%	/	-	-	4	4	2/3	4
Nitric Acid	HNO ₃	Aqueous solution	70%	-	-	-	4	4	2/3	4
Nitric Acid	HNO ₃	Technically pure	100%	-			4	4	2/3	4
Nitrobenzene	C ₆ H ₅ NO ₂		100%	+	/	/				
Nitroethane	CH ₃ CH ₂ NO ₂	Technically pure	100%	+	/	/	4	2	4	2
Nitromethane	CH ₃ NO ₂	Technically pure	100%	+	/	/	4	2	4	2
Nitrotoluene	CH ₃ C ₆ H ₄ NO ₂	Technically pure	100%	+	+	/				
Nitrous Gases	NO _x	Anhydrous	Solution	+	+	+	1	1	1	1
Oleic Acid	C ₁₇ H ₃₃ COOH	Technically pure	100%	+	+	/	2	3	1	4
Oleum	H ₂ SO ₄ +SO ₃		10%	-			4	4	1	4
Oleum	H ₂ SO ₄ +SO ₃		High	-			4	4	1	4
Oleum	H ₂ SO ₄ +SO ₃		Traces	-			4	4	1	4
Olive Oil			Comm. Comp.	+	+	/	1	4	1	4
Oxalic Acid	HOOC ₂ COOH	Aqueous solution	10%	+	+	+	1	1	1	1
Oxalic Acid	HOOC ₂ COOH	Aqueous solution	Saturated	+	+	+	1	1	1	1
Oxygen	O ₂		All	+	+	/	2	1	1	4
Ozone Gas	O ₃	Aqueous solution	Saturated	/	-		4	1	1	4
Ozone Gas	O ₃		>2%	/	-		4	1	1	4
Palmitic Acid	CH ₃ (CH ₂) ₁₄ COOH		70%	/	-	-				
Paraffin Emulsion		Water-emulsie	Comm. Comp.	/	/	/	1	4	1	4
Paraffin Oil			Comm. Comp.	+	+	+	1	4	1	4
Peanut Oil			Comm. Comp.	+			1	3	1	4
Perchloric Acid	HClO ₄	Aqueous solution	10%	+	+	+	4	1	1	4
Perchloric Acid	HClO ₄	Aqueous solution	70%	+	/	-	4	1	1	4

Material characteristics

Component			Concentration	Pipe and fittings			Elastomeric seals			
Name	Formula	Remark		HDPE			NBR	EPDM	FPM	SBR
				°C			°C	°C	°C	°C
				20	40	60	20	20	20	20
Perchloric Acid	HClO ₄	Aqueous solution	10%	+	+		4	1	2	4
Petroleum		Technically pure	100%	+	+	/	1	4	1	4
Petroleum Ether		Technically pure	100%	+	/	/	1	4	1	4
Phenol	C ₆ H ₅ OH	Aqueous solution	1%	+	/		4	4	2	4
Phenol	C ₆ H ₅ OH	Aqueous solution	90%	+	+		4	4	1	4
Phenylhydrazine	C ₆ H ₅ NHNH ₂	Technically pure	100%	/	/	/	3	3	2	4
Phenylhydrazine Hydrochloride	C ₆ H ₅ NHNH ₂ HCl	Aqueous solution	Saturated	+						
Phosphoric Acid	H ₃ PO ₄	Aqueous solution	25%	+	+	+	1	1	1	1
Phosphoric Acid	H ₃ PO ₄	Aqueous solution	50%	+	+	+	1	1	1	1
Phosphoric Acid	H ₃ PO ₄	Aqueous solution	85%	+	+	/	1	1	1	1
Phosphorous Penta-Trichloride	PCl ₅ -PCl ₃	Technically pure	100%	+	/	/				
Phosphorous Pentoxide	P ₂ O ₅	Technically pure	100%	+	+	+				
Photographic Developer			Comm. Comp.	+			1	2	1	2
Photographic Emulsion			Comm. Comp.	+	+					
Phthalic Acid	C ₆ H ₄ (COOH) ₂	Aqueous solution	50%	+	+	+				
Picric Acid	C ₆ H ₂ (OH)(NO ₂) ₃	Aqueous solution	1%	+	+	/	2	1	1	2
Potassium Acetate	CH ₃ COOK	Aqueous solution	Saturated	+	+	+	1	1	2	4
Potassium Bicarbonate	KHCO ₃	Aqueous solution	Saturated	+	+	+	1	1	1	1
Potassium Bichromate	K ₂ Cr ₂ O ₇	Aqueous solution	Saturated	+	+		2	1	1	2
Potassium Bisulfate	KHSO ₄	Aqueous solution	Indetermined	+	+	+	1	1	1	1
Potassium Borate	K ₃ BO ₃	Aqueous solution	Saturated	+	+	+				
Potassium Bromate	KBrO ₃	Aqueous solution	Saturated	+	+	/	1	1	1	1
Potassium Bromide	KBr	Aqueous solution	Saturated	+	+	+	1	1	1	1
Potassium Carbonate	K ₂ CO ₃	Aqueous solution	Saturated	+	+	+	1	1	1	1
Potassium Chlorate	KClO ₃	Aqueous solution	Saturated	+	+	+	4	1	1	2
Potassium Chloride	KCl	Aqueous solution	Saturated	+	+	+	1	1	1	1
Potassium Chromate	K ₂ CrO ₄	Aqueous solution	Saturated	+	+		2	1	1	2
Potassium Cyanide	KCN	Aqueous solution	Saturated	+	+	+	1	1	1	1
Potassium Ferricyanide	K ₄ Fe(CN) ₆ H ₂ O	Aqueous solution	Saturated	+	+	+				
Potassium Fluoride	KF	Aqueous solution	Saturated	+	+	+				
Potassium Hydroxide	KOH	Aqueous solution	<=60%	+	+	+	2	1	2/3	1
Potassium Hypochlorite	KClO	Aqueous solution	Indetermined	+	/	/				
Potassium Iodide	KI	Aqueous solution	Saturated	+	+	+				
Potassium Nitrate	KNO ₃	Aqueous solution	Saturated	+	+	+	1	1	1	1
Potassium Perborate	KBO ₃	Aqueous solution	Indetermined	+	+	+				
Potassium Perchlorate	KClO ₄	Aqueous solution	Saturated	+	+	+	3	1	1	3
Potassium Permanganate	KMnO ₄	Aqueous solution	10%	+	+	+				
Potassium Permanganate	KMnO ₄	Aqueous solution	Saturated	+	+	/				
Potassium Persulfate	K ₂ S ₂ O ₈	Aqueous solution	Saturated	+	+	+				
Potassium Phosphates	K ₂ HPO ₄ KH ₂ PO ₄	Aqueous solution	All	+	+	+				
Acids										
Potassium Sulfate	K ₂ SO ₄	Aqueous solution	Saturated	+	+	+	1	1	1	1
Propane Gas	CH ₃ CH ₂ CH ₃		100%	+			1	4	1	4
Propene Gas	CH ₃ CH ₂ CH ₃		100%	+			1	4	1	4
Propionic Acid	CH ₃ CH ₂ COOH	Aqueous solution	50%	+	+	+	2	4	1	4
Propyl Alcohol	C ₃ H ₇ OH	Aqueous solution	97%	+	+	+				
Propylene Glycol	CH ₃ CHOHCH ₂ OH	Technically pure	100%	+	+	+	2	1	1	1
Propylene Oxid		Technically pure	100%	+			4	1	4	4
Pyridine	C ₅ H ₅ N	Technically pure	100%	+	/	/	4	4	4	4
Silicic Acid	H ₂ SiO ₃	Aqueous solution	All	+	+	+				
Silicone Oil			Comm. Comp.	+	+	/	1	1	1	1
Silver Cyanide	AgCN	Aqueous solution	All	+	+	+				
Silver Nitrate	AgNO ₃	Aqueous solution	Saturated	+	+	+	1	1	1	1
Silver Sulfate	Ag ₂ SO ₄	Aqueous solution	Saturated	+	+	+				
Soap		Aqueous solution	All	+	+	+	1	1	1	2
Sodium Acetate	CH ₃ COONa	Aqueous solution	Saturated	+	+	+	2	1	4	4
Sodium Alum	NaAl(SO ₄) ₂	Aqueous solution	Saturated	+	+	+				
Sodium Benzoate	C ₆ H ₅ COONa		Saturated	+	+	+				

Material characteristics

Component			Concentration	Pipe and fittings			Elastomeric seals			
Name	Formula	Remark		HDPE			NBR	EPDM	FPM	SBR
				°C	°C	°C	°C	°C	°C	°C
				20	40	60	20	20	20	20
Sodium Bicarbonate	NaHCO ₃	Aqueous solution	Saturated	+	+	+	2	1	1	1
Sodium Bichromate	Na ₂ Cr ₂ O ₇	Aqueous solution	Saturated	+	+	+				
Sodium Bisulfate	NaHSO ₄	Aqueous solution	10%	+	+	+	1	1	1	2
Sodium Bisulfite	NaHSO ₃	Aqueous solution	100%	+	+	+	1	1	1	2
Sodium Bromate	NaBrO ₃	Aqueous solution	All	+	/					
Sodium Bromide	NaBr	Aqueous solution	Saturated	+	+	+				
Sodium Carbonate (Soda)	Na ₂ CO ₃	Aqueous solution	Saturated	+	+	+	2	1	1	1
Sodium Chlorate	NaClO ₃	Aqueous solution	All	+	+	+	2/3	2	1	4
Sodium Chloride	NaCl	Aqueous solution	Solution	+	+	+	1	1	1	1
Sodium Chloride	NaCl	Aqueous solution	Saturated	+	+	+	1	1	1	1
Sodium Chromate	Na ₂ CrO ₄	Aqueous solution	Solution	+						
Sodium Cyanide	NaCN	Aqueous solution	All	+	+	+	2	1	1	1
Sodium Disulphite	Na ₂ S ₂ O ₅	Aqueous solution	All	+			1	1	1	2
Sodium Ferrocyanide	Na ₄ FeCN ₆	Aqueous solution	Saturated	+	+					
Sodium Fluoride	NaF	Aqueous solution	Saturated	+						
Sodium Hydroxide	NaOH	Aqueous solution	10%	+	+	+	3	1	2	2
Sodium Hydroxide	NaOH	Aqueous solution	30%	+	+	+	4	1	3	2
Sodium Hydroxide	NaOH	Aqueous solution	50%	+	+	+	1	1	3	2
Sodium Hypochlorite	NaClO	Aqueous solution	12,50%	/	-		4	1	1	4
Sodium Hypochlorite	NaClO	Aqueous solution	3%	+	/	/	4	1	1	4
Sodium Iodide	NaI	Aqueous solution	All	+						
Sodium Metasilicate	Na ₂ SiO ₃	Aqueous solution	<5%	+	+	+				
Sodium Metasilicate	Na ₂ SiO ₃	Aqueous solution	Saturated	+	+	+	1	1	1	1
Sodium Nitrate	NaNO ₃	Aqueous solution	Saturated	+	+	+	1	1	1	1
Sodium Nitrite	NaNO ₂	Aqueous solution	Saturated	+						
Sodium Oxalate	Na ₂ C ₂ O ₄	Aqueous solution	Saturated	+						
Sodium Perborate	NaBO ₃	Aqueous solution	All	+			2	1	1	2
Sodium Perchlorate	NaClO ₄	Aqueous solution	Indetermined	+						
Sodium Peroxide	Na ₂ O ₂	Aqueous solution	Solution	+			2	1	1	2
Sodium Persulphate	Na ₂ S ₂ O ₈	Aqueous solution	Saturated	+	+	+				
Sodium Phosphate	Na ₃ PO ₄	Aqueous solution	Saturated	+	+	+	1	1	1	1
Sodium Phosphate Monoacid	Na ₂ HPO ₄	Aqueous solution	Saturated	+	+		1	1	1	
Sodium Sulfate	Na ₂ SO ₄	Aqueous solution	Saturated	+	+	+	1	1	1	1
Sodium Sulfide	Na ₂ S	Aqueous solution	Solution	+	+	+	2	1	1	3
Sodium Sulfide	Na ₂ S	Aqueous solution	Saturated	+	+	+	2	1	1	3
Sodium Sulfite	Na ₂ SO ₃	Aqueous solution	Saturated	+	+	+				
Sodium Thiocyanate	NaSCN	Aqueous solution	Indetermined	+	+	+				
Sodium Thiosulphate	Na ₂ S ₂ O ₃	Aqueous solution	Saturated	+	+	+	3	1	1	2
Stannic Chloride	SnCl ₄	Aqueous solution	Saturated	+	+	+	1	1	1	2
Stannous Chloride	SnCl ₂	Aqueous solution	Saturated	+	+	+	1	1	1	1
Stearic Acid	C ₁₇ H ₃₅ COOH	Technically pure	100%	+	/		1	1	1	1
Styrene	C ₆ H ₅ CH=CH ₂		100%	/	-	-	4	4	1	4
Sugar Syrup			Saturated	+	+	+	1	1	1	1
Sulfamic Acid	HSO ₃ NH ₂	Aqueous solution	20%	-						
Sulphur	S		100%	+	+	+				
Sulphur Dioxide Liquid	SO ₂	Aqueous solution	Saturated	+	+	+				
Sulphur Dioxide Liquid	SO ₂	Technically pure	100%	-						
Sulphur Dioxide Liquid	SO ₂	Technically pure	100%	+	+	+				
Sulphur Trioxide	SO ₃		100%	-						
Sulphuric Acid	H ₂ SO ₄	Aqueous solution	10%	+	+	+	2	1	2	2
Sulphuric Acid	H ₂ SO ₄	Aqueous solution	50%	+	+	+	4	1	2	4
Sulphuric Acid	H ₂ SO ₄	Aqueous solution	80%	+	+	/	4	2	2	4
Sulphuric Acid	H ₂ SO ₄	Aqueous solution	90%	/	/	-				
Sulphuric Acid	H ₂ SO ₄	Aqueous solution	96%	-	-	-	4	4	2	4
Sulphuric Acid	H ₂ SO ₄	Aqueous solution	98%	-	-	-				
Sulphuric Acid	H ₂ SO ₄		indetermined							
Sulphuric Acid	H ₂ SO ₄	Technically pure	100%	-	-	-				
Sulphurous Acid	H ₂ SO ₃	Aqueous solution	Saturated	+	+	+	2	2	1	2
Tallow Emulsion			Comm. Comp.	+	/	/	2	2	1	4
Tannic Acid	C ₇₆ H ₅₂ O ₄₆	Aqueous solution	All	+	+	+	2	2	2	2

Material characteristics

Component			Concentration	Pipe and fittings			Elastomeric seals			
Name	Formula	Remark		HDPE			NBR	EPDM	FPM	SBR
				°C			°C	°C	°C	°C
				20	40	60	20	20	20	20
Tartaric Acid	COOH(CHOH) ₂ COOH	Aqueous solution	All	+	+	+				
Tetrachloroethane	CHCl ₂ CHCl ₂		100%	/	-		4	4	1	4
Tetrachloroethylene	Cl ₂ C=CCl ₂		100%	/	-		4	4	2	4
Tetraethyl Lead	Pb(C ₂ H ₅) ₄	Technically pure	100%	+			2	4	1	4
Tetrahydrofurane	(CH ₂) ₄ O		100%	/	-		4	4	4	4
Tetrahydronaphthalene	C ₁₀ H ₁₂		100%	/						
Thionyl Chloride	SOCl ₂	Technically pure	100%	-			2/3	1	1	2/3
Thiophene	C ₄ H ₈ S		100%	/	/	/	4	4	4	4
Toluene	C ₆ H ₅ CH ₃	Technically pure	100%	/	-	-	4	4	2	4
Toluic Acid	CH ₃ C ₆ H ₄ COOH		50%	/						
Transformer Oil			Comm. Comp.	+	/	/	2	4	2	4
Tributylphosphate	(C ₄ H ₉) ₃ PO ₄	Technically pure	100%	+	+	+	4	2	3	4
Trichlorethylene	CICH=CCl ₂	Technically pure	100%	-	-	-	4	4	2	4
Trichloroacetic Acid	CCl ₃ COOH	Aqueous solution	50%	+	/	/	2	2	4	4
Trichloroacetic Acid	CCl ₃ COOH	Technically pure	100%	+	/	-	2	2	4	4
Trichloroethane	CH ₃ CCl ₃	Technically pure	100%	/			4	4	1	4
Tricresylphosphate	(CH ₃ C ₆ H ₄ O) ₃ PO ₄	Technically pure	100%	+	+	+	4	2	2	4
Triethanolamine	N(CH ₂ CH ₂ OH) ₃	Technically pure	100%	+	+	/	3	1	4	2
Trioctylphosphate	(C ₈ H ₁₇) ₃ PO ₄	Technically pure	100%	/			4	1	2	4
Turpentine Oil		Technically pure	100%	/	-	-	2	4	1	4
Urea	NH ₂ CONH ₂	Aqueous solution	<=10%	+	+	+	1	1	1	1
Urea	NH ₂ CONH ₂	Aqueous solution	33%	+	+	+	1	1	1	1
Urine			Indetermined	+	+	+				
Vaseline Oil			Comm. Comp.	+	+	/	1		1	4
Vegetable Oils and fats			Comm. Comp.	+	/		1	4	1	3
Water	H ₂ O		100%	+	+	+	1	1	1	1
Water	H ₂ O		100%	+	+	+	1	1	1	1
Water	H ₂ O		100%	+	+	+	1	1	1	1
Water	H ₂ O		100%	+	+	+	2	1	2	2
Water	H ₂ O		100%	+	+	+	2	1	2	2
Water, Rain	H ₂ O		100%	+	+	+	1	1	1	1
Water, Salt	H ₂ O+NaCl		Saturated	+	+	+	1	1	1	1
Water, Sea			100%	+	+	+	1	1	1	1
Wine			Comm. Comp.	+	+	+	1	1	1	1
Wine Vinegar		Technically pure	Comm. Comp.	+	+	+				
Xylene	C ₆ H ₄ (CH ₃) ₂		100%	-			4	4	2	4
Zinc Acetate	Zn(CH ₃ COO) ₂		Indetermined	+	+	+	2	1	4	4
Zinc Chloride	ZnCl ₂	Aqueous solution	Solution	+	+	+	2	1	1	2
Zinc Chloride	ZnCl ₂	Aqueous solution	Saturated	+	+	+	2	1	1	2
Zinc Chromate	ZnCrO ₄	Aqueous solution	Indetermined	+	+	+				
Zinc Cyanide	Zn(CN) ₂	Aqueous solution	All	+	+	+				
Zinc Nitrate	Zn(NO ₃) ₂	Aqueous solution	Indetermined	+	+	+				
Zinc Sulfate	ZnSO ₄	Aqueous solution	Solution	+	+	+	1	1	1	1
Zinc Sulfate	ZnSO ₄	Aqueous solution	Saturated	+	+	+	1	1	1	1

Table 2.3 Chemical resistance. The data is based on the latest knowledge. When in doubt please contact Technical Support.

2.3 Insulation

2.3.1 Noise insulation

What is noise?

Noise is a variance in air pressure that spreads like a wave. If quick changes in pressure occur between 20 and 20.000 times a second (frequency 20 Hz and 20kHz), they are audible to humans. The loudness of noise is determined by the amplitude of the wave, which is measured in decibels (dB).

A decibel is not a unit of measurement but provides a comparison between a reference point and the measured value. The human ear is most sensitive to frequencies between 1 kHz and 4 kHz, and to a lesser extent, to other frequencies. To make a good comparison, these differences in

sensitivity must be corrected by means of the so-called A-filter, which yields the measurement dB(A). Values measured in dB(A) are not corrected at 1000 Hz, which stands for 0 dB(A).

How noise is created

Noise can be created in various ways. For instance, 'airborne noise' comes from a source that causes the air to vibrate, such as a roof drainage system. 'Contact noise' is created by mechanical contact passing on vibrations to a structure through brackets, for example. Both types of noise must be taken into account. Airborne noise can be well insulated by working with absorbent material. Contact noise can be reduced by using soft material to acoustically uncouple the mechanical contact.

Noise according to standards

The Netherlands Building Decree (Bouwbesluit) imposes the following requirements concerning the shielding of installations in residences and residential buildings from noise:

1. As defined in NEN 5077, the characteristic noise level of a flush toilet located in a residence may not, according to the standard, exceed 30 dB(A) in a residential area outside the residence in question in order to limit noise nuisance.
2. The noise level of a flush toilet located in a residential building but outside any of the residences comprising it may not exceed 30 dB(A) in a living area of a residence or other building.

According to the standard, the values also apply to the residential areas of buildings not intended to be residential, such as:

- office and bank buildings
- hotel and restaurant buildings
- buildings involved in health care (hospitals, psychiatric institutions)

A noise level of 35 dB(A) applies to lodging houses and hotels.

In measuring noise, a distinction is made between transient and protracted noise. Noise measurements must measure the maximum noise level throughout a complete operational cycle with the noise meter at the S(low) setting. At noise levels of 35 to 45 dB(A), the chance of noise nuisance is relatively large, and noise nuisance is to be expected at levels exceeding 45 dB(A).

What causes internal sewer noise

The noise level resulting from internal sewers depends on such factors as:

- type of (drain) pipe
- type of bracketing used
- insulation
- fall height
- drainage capacity and diameter

The standard individually describes the noise levels to be expected from each source.

Down pipes that incorporate Akavent have proven in practice to produce less noise than traditional down pipes, in which fall velocities are higher. Akavent reduces fall velocities at each storey, reducing the noise created in an Akavent system to a level below that occurring in a traditional system.

A proper choice of materials and appropriate construction measures enable the noise produced to be well within the standard.

Measures against noise nuisance

Measures to be taken against noise nuisance can be divided into:

- Design measures
- Construction measures

Measures during design relate to the proper location of the drain pipes. In locating shafts in a multi-storey residential building, an effort should be made to avoid residential areas as much as possible. In non-residential construction, rooms such as storage, toilets and pantries have the preference over offices and meeting rooms.

Construction measures refer to the installation of architectural structures around pipes involving insulating provisions for both airborne and contact noise.

An insulating measure against airborne noise in residential construction involves encasing the pipes in concrete. The encasement of pipes in concrete floors is common practice in residential construction when the drain pipes have a design diameter of no more than 69 mm. A concrete cover of approximately 50 mm thick reduces the potential noise level by about 30 dB(A). Shafts in a multi-storied residential building are insulated by the shaft wall, for which the applicable standard describes some con-

structions in which appropriate noise insulation is provided. Additional noise-reducing measures are necessary if the shaft wall is not adequately insulated.

A measure against airborne noise in non-residential construction, in which pipes mostly run through ceilings, involves the installation of mineral wool ceilings, which result in a reduction of approximately 5 dB(A); mineral fibre can obtain a reduction of around 10 dB(A).

The production of contact noise is mostly 15 dB(A) to 20 dB(A) lower than airborne noise. Once airborne noise has been sufficiently limited, a determination can then be made of the extent to which contact noise must be reduced in order to obtain a sufficiently low overall noise level. Additionally, a role is played by the fastening technique used and the mass of the wall to which a pipe is attached. For this reason, the choice should be made to attach the pipes to the heaviest wall.

The standard identifies other insulation measures, including a list of acoustic effects in dB(A) for various noise insulation measures with regard to HDPE pipes.

2.3.2 Condensation insulation

Condensation occurs when the water vapour carried in the air is deposited on a 'colder' surface. Air at a given temperature can contain only a certain amount of water vapour. If the temperature falls, the excess amount of water vapour will then condense. The temperature of the air at which air is saturated with water vapour is called the 'dew point'. Condensation occurs when pipework has a temperature under the dew point of the surrounding air. Condensation is therefore dependent on a number of factors:

- room temperature (the warmer a room, the more water vapour can be contained in the air)
- relative humidity of the air
- temperature of the pipe surface

With the aid of the h-x (Mollier) diagram and a detailed calculation, a determination can be made of when and with which material a pipe needs to be insulated. Polyethylene has a relatively good thermal coefficient. No condensation will therefore occur during short periods of transporting 'cold' fluids.

There are, however, a number of rules of thumb:

Always insulate

- Pipes in wall cavities
- Pipes in drop ceilings
- Pipes in concrete
- Pipes in poorly conditioned industrial buildings (without proper circulation. For example, no heaters, fans, etc.)
- Pipes in paper storerooms (not properly conditioned areas)

Do not insulate

- Pipes in a properly conditioned industrial building (having sufficient air circulation due to heaters, fans, etc.) unless the contracting party or consultant deems this desirable.

If the choice is made to insulate, the entire pipe network must be insulated. An insulated circuit must always be a closed circuit.

2.4 Fire hazard

HDPE burns, but is not classified as flammable. Principal toxicant in the smoke is carbon monoxide. The ignition temperature of HDPE lies above 300°C. In designing new buildings a lot of attention goes to compartmenting the building. This is to prevent the fire from spreading to a neighboring room. The solution for the wall and ceiling penetrations is the use of a fire collar.

Installed around the Akatherm pipe they squeeze off the pipe when a certain temperature is reached and close the penetration hermetic.

Material characteristics

Depending on local regulations all wall and ceiling penetrations have to be safeguarded in this way above a certain diameter of pipe.

Safety data sheet

The safety data sheets are available on request.

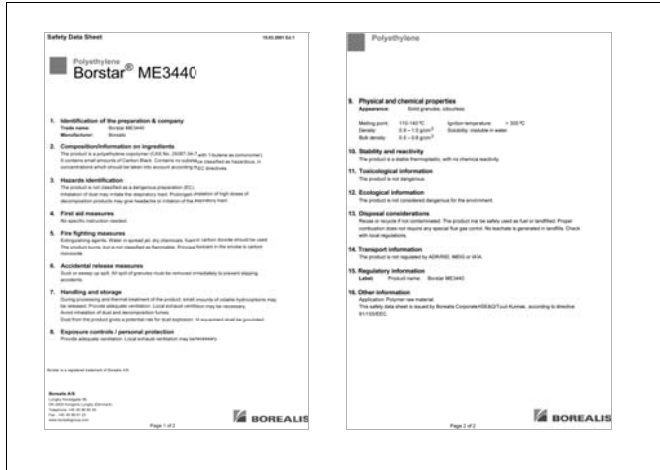


Illustration 2.1

