

## 2 Material properties of PE

### 2.1 General material properties of polyethylene (PE)

Thermoplastics are sub-divisible into two groups: amorphous and semi-crystalline thermoplastics. Polyethylene is a polyolefin, which forms a separate group among the semi-crystalline thermoplastics. Polyethylene, abbreviated PE, is an umbrella term for a group on individually distinctive PE types.

In specific, the following PE types are distinguished:

- PE-LD (Density: 0.9 - 0.91 g/cm<sup>3</sup>)
- PE-LLD (Density: 0.91 - 0.93 g/cm<sup>3</sup>)
- PE-MD (Density: 0.93 - 0.94 g/cm<sup>3</sup>)
- PE-HD (Density: 0.94 - 0.965 g/cm<sup>3</sup>)

It is PE-HD that is of primary interest for use in plastic pipe construction, although PE-MD is also used in the gas-pipe sector. The characteristics of PE-MD will, however, not be further detailed in this Specification Manual. PE-HD (high density) has a high density with an average molar mass (MM) between 40,000 and 400,000 g/mol (depending on the manufacturing process and the process parameters). In comparison, PE-LD (low density) has a lower density and therefore a molar mass of up to 600,000 g/mol. PE-HD is manufactured as a polymer either by using a medium pressure procedure (Phillips) or a low pressure procedure (Ziegler). Polymers based on ethylene offer semi-finished product manufacturers a great deal of latitude in making modifications. For pipe and fitting manufacture, it is the mechanical properties of PE that are foregrounded (elastic stiffness).

As mentioned at the beginning of this chapter, PE is to be understood as an umbrella term for a thermoplastic group. For instance, PE includes the substance PE100.

More attention will be paid to the significance of the numerical values (e.g. PE100) in the course of chapter 4. For the sake of simplification, the label "PE" will be used throughout the rest of this manual to designate PE-HD. PE is resistant to acids, bases, saline solutions, water, alcohol and oil. Under 60°C, it is practically insoluble in nearly all organic solvents. PE can readily withstand ionised rays if they are not too strong and will not become radioactive itself. It is furthermore readily weldable, although there are problems involved in gluing and decorating PE. The surfaces will allow imprinting or painting to adhere only after physical or chemical pre-treatment. Bonding can only be done with the help of contact glue, although such adhesive bonds cannot be subject to very high mechanical loads.

### 2.2 Properties of PE100

	Unit	Test method	Value
<b>Density at 23°C</b>	g/cm <sup>3</sup>	ISO 1183	0.958
<b>Elasticity modulus</b>	N/mm <sup>2</sup>	ISO 527	900
<b>Tensile creep modulus</b>	N/mm <sup>2</sup>	ISO 899	850
<b>Bending creep modulus</b>	N/mm <sup>2</sup>	DIN 54852-Z4	1200
<b>Tensile strength at 23°C</b>	N/mm <sup>2</sup>	ISO 527	23
<b>Elongation at break</b>	%	ISO R 527	>600
<b>Linear expansion coefficient</b>	mm/mK	DIN 53752	0.13 - 0.19
<b>Indentation hardness</b>	N/mm <sup>2</sup>	ISO 2039	36 - 46
<b>Ignition temperature</b>	°C	-	~350
<b>Thermal conductivity</b>	W/m . K	DIN 52612	0.23
<b>Shore hardness</b>		ISO 868	65
<b>Crystallite melting range</b>	°C		~130
<b>Operational temperature range</b>	°C	-	-40 - +100
<b>Melt flow rate MFR 190/5</b>	g/10min	ISO 1133	0.43

Table 2.1

## Material properties of PE


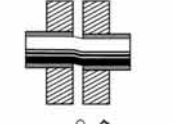
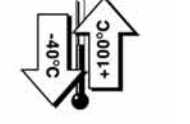


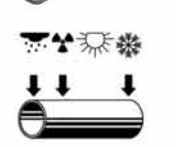



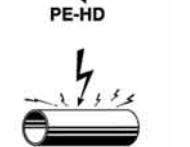



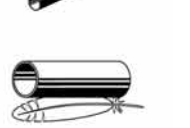
	Properties PE	Benefits
	Impact-resistant and tough	Unbreakable at temperatures > 5°C
	Elastic	Suitable for underground pipes through adjustment to local ground movement
	Thermal resistant	Application possible between -40°C and 100°C
	Smooth internal wall	Low blockage risk due to low deposit/residue effects
	Wear resistant	Lower costs due to relatively long life
	Weather-resistant / UV resistant	Application in open air unrestricted through colouring with carbon black
	Chemical Resistance	Suitable for the transport of polluted waste water
	Poor heat conductivity	No condensation during short periods of cooling
	Non-toxic	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 times
	Light in weight	Cost-saving in transport and handling

Table 2.2

### 2.3 Chemical resistance

Table 2.3 indicates the chemical resistance of PE to various media at a number of temperatures.

In transporting chemicals, consideration needs to be given to the following factors:

- the medium
- concentration of the medium
- temperature
- duration of the load
- flow volume

The elastomer resistance list is intended as an aid for determining the suitability of a given seal. The indicated values refer to the volume of swelling for the rubber compound, which is only one of the indications concerning resistance. Chemical damage to the polymer chain can also lead to changes in mechanical properties such as tensile strength, elasticity at break, etc. The most commonly indicated values are measured at a temperature of 20°C. A longer exposure to a higher temperature can create more aggressive conditions that reduce the life-span of elastomers.

#### Explanation of symbols used for PE pipes and fittings:

+	Resistant: based on performed tests, PE is in general a suitable material for this application
/	Limited resistance: further research required
-	Non-resistant

**Empty field** = The material has not been tested on this medium at this temperature.

- 1 Little or no effect: volume change <10%, the elastomer can display slight swelling and/or loss of physical characteristics under heavy conditions.
- 2 Possible change of physical qualities: volume change of 10-20%, the elastomer can display swelling and a change of physical characteristics, can be suitable for structural applications.
- 3 Substantial change in physical characteristics: the elastomer displays a substantial change in volume and physical qualities.
- 4 Excessive change: elastomer is unsuitable.

**Empty field** = The elastomer has not been tested on this medium.

#### Abbreviations used:

PE	= polyethylene
NBR	= acrylonitrile butadiene
EPDM	= ethylene propylene
FPM	= fluorocarbon
SBR	= styrol butadiene

## Material properties of PE

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

**Material properties of PE**

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

## Material properties of PE

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

**Material properties of PE**

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

## Material properties of PE

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

**Material properties of PE**

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

## Material properties of PE

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	
Sodium Bisulfate	NaHSO <sub>4</sub>	Aqueous solution	10%	+	+	+	1	1	1	2
Sodium Bisulfite	NaHSO <sub>3</sub>	Aqueous solution	100%	+	+	+	1	1	1	2
Sodium Bromate	NaBrO <sub>3</sub>	Aqueous solution	All	+	/					
Sodium Bromide	NaBr	Aqueous solution	Saturated	+	+	+				
Sodium Carbonate (Soda)	Na <sub>2</sub> CO <sub>3</sub>	Aqueous solution	Saturated	+	+	+	2	1	1	1
Sodium Chlorate	NaClO <sub>3</sub>	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 <sub>2</sub> CrO <sub>4</sub>	Aqueous solution	Solution	+						
Sodium Cyanide	NaCN	Aqueous solution	All	+	+	+	2	1	1	1
Sodium Disulphite	Na <sub>2</sub> S <sub>2</sub> O <sub>5</sub>	Aqueous solution	All	+			1	1	1	2
Sodium Ferrocyanide	Na <sub>4</sub> FeCN <sub>6</sub>	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 <sub>2</sub> SiO <sub>3</sub>	Aqueous solution	<5%	+	+	+				
Sodium Metasilicate	Na <sub>2</sub> SiO <sub>3</sub>	Aqueous solution	Saturated	+	+	+	1	1	1	1
Sodium Nitrate	NaNO <sub>3</sub>	Aqueous solution	Saturated	+	+	+	1	1	1	1
Sodium Nitrite	NaNO <sub>2</sub>	Aqueous solution	Saturated	+						
Sodium Oxalate	Na <sub>2</sub> C <sub>2</sub> O <sub>4</sub>	Aqueous solution	Saturated	+						
Sodium Perborate	NaBO <sub>3</sub>	Aqueous solution	All	+			2	1	1	2
Sodium Perchlorate	NaClO <sub>4</sub>	Aqueous solution	Indetermined	+						
Sodium Peroxide	Na <sub>2</sub> O <sub>2</sub>	Solution		+			2	1	1	2
Sodium Persulphate	Na <sub>2</sub> S <sub>2</sub> O <sub>8</sub>	Aqueous solution	Saturated	+	+	+				
Sodium Phosphate	Na <sub>3</sub> PO <sub>4</sub>	Aqueous solution	Saturated	+	+	+	1	1	1	1
Sodium Phosphate	Na <sub>2</sub> HPO <sub>4</sub>	Aqueous solution	Saturated	+	+		1	1	1	
<b>Monoacid</b>										
Sodium Sulfate	Na <sub>2</sub> SO <sub>4</sub>	Aqueous solution	Saturated	+	+	+	1	1	1	1
Sodium Sulfide	Na <sub>2</sub> S	Aqueous solution	Solution	+	+	+	2	1	1	3
Sodium Sulfide	Na <sub>2</sub> S	Aqueous solution	Saturated	+	+	+	2	1	1	3
Sodium Sulfite	Na <sub>2</sub> SO <sub>3</sub>	Aqueous solution	Saturated	+	+	+				
Sodium Thiocyanate	NaSCN	Aqueous solution	Indetermined	+	+	+				
Sodium Thiosulphate	Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub>	Aqueous solution	Saturated	+	+	+	3	1	1	2
Stannic Chloride	SnCl <sub>4</sub>	Aqueous solution	Saturated	+	+	+	1	1	1	2
Stannous Chloride	SnCl <sub>2</sub>	Aqueous solution	Saturated	+	+	+	1	1	1	1
Stearic Acid	C <sub>17</sub> H <sub>35</sub> COOH	Technically pure	100%	+		/	1	1	1	1
Styrene	C <sub>6</sub> H <sub>5</sub> CH=CH <sub>2</sub>		100%	/	-	-	4	4	1	4
Sugar Syrup			Saturated	+	+	+	1	1	1	1
Sulfamic Acid	HSO <sub>3</sub> NH <sub>2</sub>	Aqueous solution	20%	-						
Sulphur	S		100%	+	+	+				
Sulphur Dioxide Liquid	SO <sub>2</sub>	Aqueous solution	Saturated	+	+	+				
Sulphur Dioxide Liquid	SO <sub>2</sub>	Technically pure	100%	-						
Sulphur Dioxide Liquid	SO <sub>2</sub>	Technically pure	100%	+	+	+				
Sulphur Trioxide	SO <sub>3</sub>		100%	-						
Sulphuric Acid	H <sub>2</sub> SO <sub>4</sub>	Aqueous solution	10%	+	+	+	2	1	2	2
Sulphuric Acid	H <sub>2</sub> SO <sub>4</sub>	Aqueous solution	50%	+	+	+	4	1	2	4
Sulphuric Acid	H <sub>2</sub> SO <sub>4</sub>	Aqueous solution	80%	+	+	/	4	2	2	4
Sulphuric Acid	H <sub>2</sub> SO <sub>4</sub>	Aqueous solution	90%	/	/	-				
Sulphuric Acid	H <sub>2</sub> SO <sub>4</sub>	Aqueous solution	96%	-	-	-	4	4	2	4
Sulphuric Acid	H <sub>2</sub> SO <sub>4</sub>	Aqueous solution	98%	-	-	-				
indetermined										
Sulphuric Acid	H <sub>2</sub> SO <sub>4</sub>	Technically pure	100%	-	-	-				
Sulphurous Acid	H <sub>2</sub> SO <sub>3</sub>	Aqueous solution	Saturated	+	+	+	2	2	1	2
Tallow Emulsion			Comm. Comp.	+	/	/	2	2	1	4
Tannic Acid	C <sub>76</sub> H <sub>52</sub> O <sub>46</sub>	Aqueous solution	All	+	+	+	2	2	2	2
Tartaric Acid	COOH(CHOH) <sub>2</sub> COOH	Aqueous solution	All	+	+	+				
Tetrachloroethane	CHCl <sub>2</sub> CHCl <sub>2</sub>		100%	/	-		4	4	1	4

## Material properties of PE

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
<b>Tetrachloroethylene</b>	Cl <sub>2</sub> C=CCl <sub>2</sub>		100%	/	-		4	4	2	4
<b>Tetraethyl Lead</b>	Pb(C <sub>2</sub> H <sub>5</sub> ) <sub>4</sub>	Technically pure	100%	+			2	4	1	4
<b>Tetrahydrofurane</b>	(CH <sub>2</sub> ) <sub>4</sub> O		100%	/	-		4	4	4	4
<b>Tetrahydronaphthalene</b>	C <sub>10</sub> H <sub>12</sub>		100%	/						
<b>Thionyl Chloride</b>	SOCl <sub>2</sub>	Technically pure	100%	-			2/3	1	1	2/3
<b>Thiophene</b>	C <sub>4</sub> H <sub>8</sub> S		100%	/	/	/	4	4	4	4
<b>Toluene</b>	C <sub>6</sub> H <sub>5</sub> CH <sub>3</sub>	Technically pure	100%	/	-	-	4	4	2	4
<b>Toluic Acid</b>	CH <sub>3</sub> C <sub>6</sub> H <sub>4</sub> COOH		50%	/						
<b>Transformer Oil</b>			Comm. Comp.	+	/	/	2	4	2	4
<b>Tributylphosphate</b>	(C <sub>4</sub> H <sub>9</sub> ) <sub>3</sub> PO <sub>4</sub>	Technically pure	100%	+	+	+	4	2	3	4
<b>Trichlorethylene</b>	ClCH=CCl <sub>2</sub>	Technically pure	100%	-	-	-	4	4	2	4
<b>Trichloroacetic Acid</b>	CCl <sub>3</sub> COOH	Aqueous solution	50%	+	/	/	2	2	4	4
<b>Trichloroacetic Acid</b>	CCl <sub>3</sub> COOH	Technically pure	100%	+	/	-	2	2	4	4
<b>Trichloroethane</b>	CH <sub>3</sub> CCl <sub>3</sub>	Technically pure	100%	/			4	4	1	4
<b>Tricresylphosphate</b>	(CH <sub>3</sub> C <sub>6</sub> H <sub>4</sub> O) <sub>3</sub> PO <sub>4</sub>	Technically pure	100%	+	+	+	4	2	2	4
<b>Triethanolamine</b>	N(CH <sub>2</sub> CH <sub>2</sub> OH) <sub>3</sub>	Technically pure	100%	+	+	/	3	1	4	2
<b>Triocetylphosphate</b>	(C <sub>8</sub> H <sub>17</sub> ) <sub>3</sub> PO <sub>4</sub>	Technically pure	100%	/			4	1	2	4
<b>Turpentine Oil</b>		Technically pure	100%	/	-	-	2	4	1	4
<b>Urea</b>	NH <sub>2</sub> CONH <sub>2</sub>	Aqueous solution	<=10%	+	+	+	1	1	1	1
<b>Urea</b>	NH <sub>2</sub> CONH <sub>2</sub>	Aqueous solution	33%	+	+	+	1	1	1	1
<b>Urine</b>			Indetermined	+	+	+				
<b>Vaseline Oil</b>			Comm. Comp.	+	+	/	1		1	4
<b>Vegetable Oils and fats</b>			Comm. Comp.	+	/		1	4	1	3
<b>Water</b>	H <sub>2</sub> O		100%	+	+	+	1	1	1	1
<b>Water</b>	H <sub>2</sub> O		100%	+	+	+	1	1	1	1
<b>Water</b>	H <sub>2</sub> O		100%	+	+	+	1	1	1	1
<b>Water</b>	H <sub>2</sub> O		100%	+	+	+	2	1	2	2
<b>Water</b>	H <sub>2</sub> O		100%	+	+	+	2	1	2	2
<b>Water, Rain</b>	H <sub>2</sub> O		100%	+	+	+	1	1	1	1
<b>Water, Salt</b>	H <sub>2</sub> O+NaCl		Saturated	+	+	+	1	1	1	1
<b>Water, Sea</b>			100%	+	+	+	1	1	1	1
<b>Wine</b>			Comm. Comp.	+	+	+	1	1	1	1
<b>Wine Vinegar</b>		Technically pure	Comm. Comp.	+	+	+				
<b>Xylene</b>	C <sub>6</sub> H <sub>4</sub> (CH <sub>3</sub> ) <sub>2</sub>		100%	-			4	4	2	4
<b>Zinc Acetate</b>	Zn(CH <sub>3</sub> COO) <sub>2</sub>		Indetermined	+	+	+	2	1	4	4
<b>Zinc Chloride</b>	ZnCl <sub>2</sub>	Aqueous solution	Solution	+	+	+	2	1	1	2
<b>Zinc Chloride</b>	ZnCl <sub>2</sub>	Aqueous solution	Saturated	+	+	+	2	1	1	2
<b>Zinc Chromate</b>	ZnCrO <sub>4</sub>	Aqueous solution	Indetermined	+	+	+				
<b>Zinc Cyanide</b>	Zn(CN) <sub>2</sub>	Aqueous solution	All	+	+	+				
<b>Zinc Nitrate</b>	Zn(NO <sub>3</sub> ) <sub>2</sub>	Aqueous solution	Indetermined	+	+	+				
<b>Zinc Sulfate</b>	ZnSO <sub>4</sub>	Aqueous solution	Solution	+	+	+	1	1	1	1
<b>Zinc Sulfate</b>	ZnSO <sub>4</sub>	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.

## Material properties of PE

### 2.4 Health assessment of PE

#### Physiological assessment

##### General product safety

The European General Product Safety Directive (GPSD) has been incorporated in the Netherlands Commodities Act and the General Product Safety (Commodities Act) Decree. The core of the GPSD is the obligation of companies only to sell safe products.

##### Legislation on hygiene

New European legislation on food and feed hygiene came into effect on 1 January 2006. The EC General Food Law (GFL) lays the groundwork for food safety. Further elaboration occurs in an EC Food Hygiene Regulation, an EC Feed Hygiene Regulation and a Control Regulation for government. Within this hygiene package, the Netherlands Food and Consumer Product Safety Authority (Voedsel en Waren Autoriteit, abbreviated VWA) has a central role. The VWA is the governmental organisation that investigates and monitors the safety of food and consumer products.

##### Packaging and Consumer Product Regulation

The Netherlands Packaging and Consumer Product (Commodities Act) Regulation (Regeling Verpakkingen en Gebruiksartikelen, abbreviated RVG) consists of a list of authorised materials that may be used to produce and package foodstuffs. The authorised RVG list gives values to a number of substances indicating the quantities that may be present in the end product as long as Article 2 Paragraph 1 Item c RVG (Commodities Act) is complied with. In addition, the regulation contains a large number of (migration) limits for the end product. Polyolefins, such as PE, are frequently used as packaging material.

#### National regulation of the water supply in the Netherlands

The Netherlands Water Supply Act (Waterleidingwet) has the principle role in protecting public health against the risk associated with the delivery or supply of tap water. Formulated in 1980, the first European Drinking Water Directive imposed very strict requirements on the quality of the water meant for human consumption. This EU directive was implemented in the Netherlands in the Water Supply Decree (Waterleidingbesluit), which stipulates that tap water must meet certain legal quality requirements. Materials used in obtaining, preparing, treating, storing, transporting or distributing tap water may not have adverse consequences for public health.

#### Certificate for toxicological elements

An important instrument for protecting the quality of drinking water in the Netherlands is the Water Supply (Materials and Chemicals) Regulation (Regeling materialen en chemicaliën leidingwatervoorziening). This regulation imposes requirements on the materials and chemicals used in the preparation and distribution of drinking water and that therefore come into contact with the drinking water. Under this regulation, products that satisfy the stated requirements are given an official quality certificate by the Minister of Housing, Spatial Development and the Environment: the KIWA ATA (Certificate for Toxicological Elements).

The requirements governing the quality of drinking water in the Netherlands are laid down in the Water Supply Decree. To enable testing of all the materials and chemicals used in the drinking water sector, KIWA has established Authorised Lists containing precise statements of the requirements that chemicals and materials must satisfy to be toxicologically permissible. There is an Authorised List for all plastic pipe materials, such as PE100 and rubber products.

### 2.5 Chapter summary

<b>Polyethylene</b>	Polyethylene is abbreviated "PE". PE is a semi-crystalline thermoplastic belonging to the polyolefin group. Depending on the average molar mass, the compound produced may be PE-LD (low density PE), PE-LLD (linear low density PE), PE-MD (medium density PE) and PE-HD (high density PE).
<b>Health assessment of PE</b>	The health assessment of plastic is laid down in food legislation and differs from country to country, making it necessary for manufacturers to inquire further. In the Netherlands, regulations have been established to govern substance quantities that can be present in end products. Authorised Lists have been formulated containing the materials that meet imposed requirements. PE is found on these Authorised Lists.