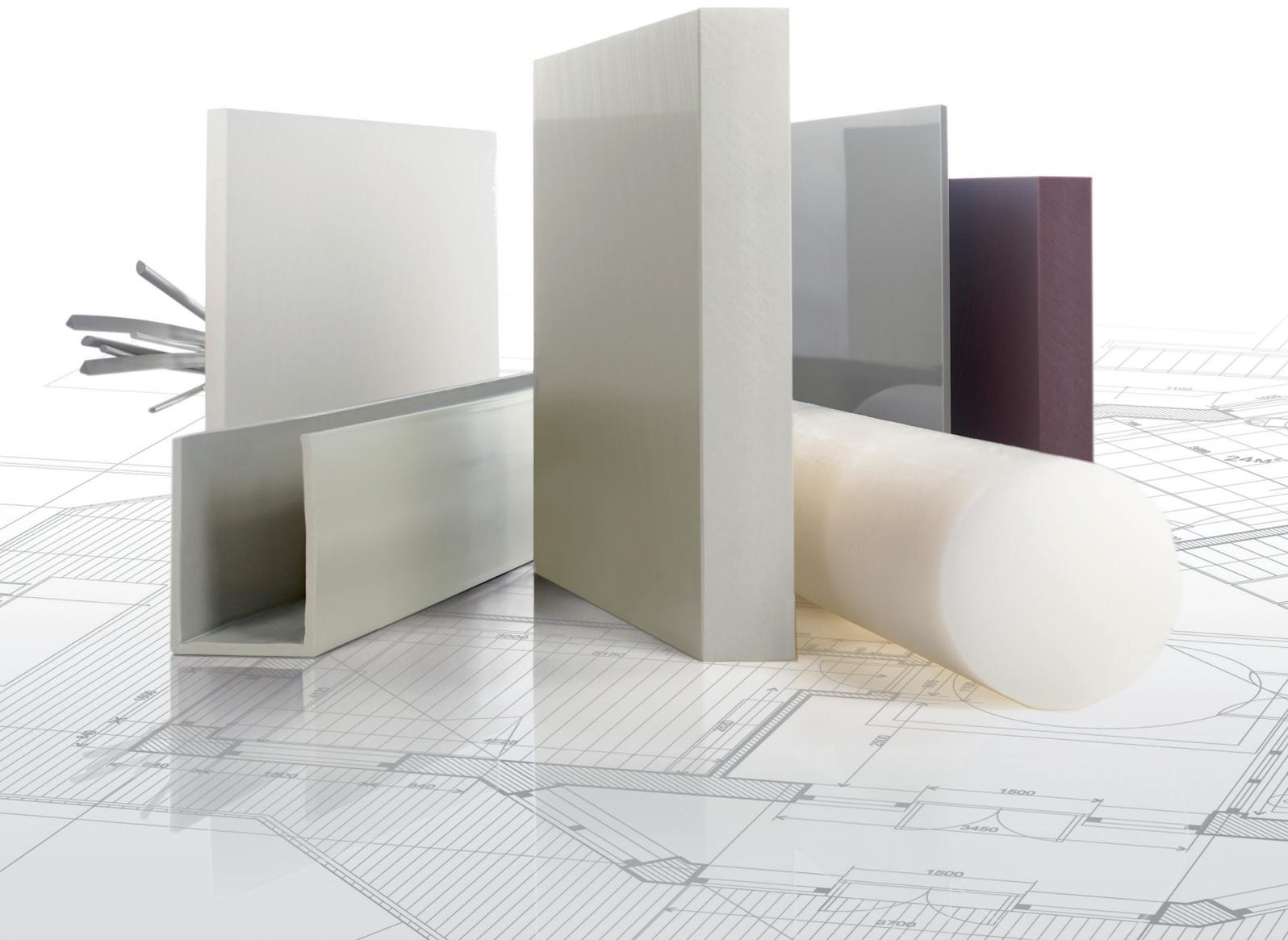


SIMONA



tech.info
SIMONA® PP

GLOBAL THERMOPLASTIC SOLUTIONS

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1 General

SIMONA® PP semi-finished parts are manufactured from a high-molecular-weight, isotactic homopolymer. The individual molecular chains of polypropylene contain up to 20,000 monomer units. The special characteristic of this polypropylene is a CH₃ group (methyl side group) in the monomeric unit. In the course of polymerisation the group can have various spatial arrangements. Consequently, it is subdivided into three possible molecular structures:

Isotactic polypropylene

All CH₃ groups are located on the same side of the carbon chain or point outwards if the arrangement is helical.

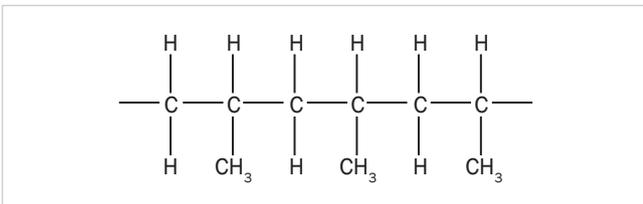


Figure 1: Diagram of isotactic PP

Syndiotactic polypropylene

The CH₃ groups occur in a regular sequence, alternating on different sides of the carbon chain.

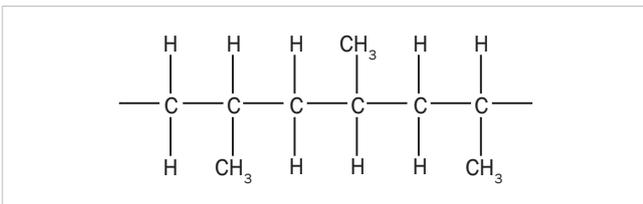


Figure 2: Diagram of syndiotactic PP

Atactic polypropylene

The CH₃ groups do not follow any rule regarding their position in relation to the main chain.

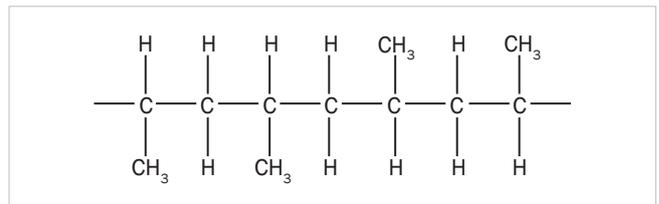


Figure 3: Diagram of atactic PP

For technical applications, isotactic PP is of higher priority because with rising isotacticity there is an increase in melting point, tensile strength, rigidity and hardness. In addition, the development of crystalline areas is promoted by the regular construction of chains. Their proportion is 50% - 60%.

SIMONA® PP-H AlphaPlus® and SIMONA® PP-H semi-finished parts are made of isotactic polypropylene with an ideal relationship between rigidity and toughness. SIMONA® PP-C is a block copolymer with fractions of isotactic polypropylene and polyethylene with a high degree of crystallinity. SIMONA PPs is a low-flammability PP. Syndiotactic and atactic products have so far not acquired any importance in engineering.

1.1 Properties

1.1.1 Types of polymerisation for polypropylene

In the relevant standards and guidelines a fundamental distinction is made between PP types PP-H, PP-B and PP-R. PP-H is the **h**omopolymer (polymer of monomeric propylene) with properties typical of PP. The copolymers (polymers of different monomers, usually propylene and ethylene in this case), i. e. PP **b**lock copolymers and PP **r**andom copolymers, on the other hand, are tougher.

PP-B in particular has a higher reserve of impact strength at temperatures below 0 °C. However, PP-B and PP-R exhibit less rigidity, especially at temperatures above 60 °C. The explanation for this is the linking of ethylene to the molecular chain,

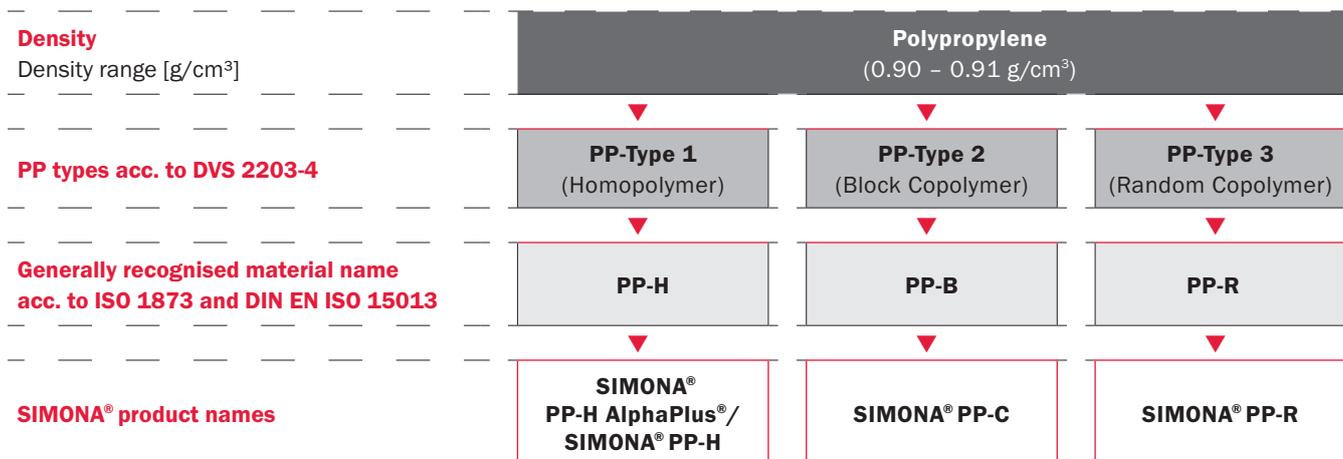
which owing to its characteristics (higher impact resistance at low temperatures, less rigidity at high temperatures) has an influence on the property profile of the polypropylene. Hardness and yield stress also decline when compared with PP-H.

The difference between a block copolymer (PP-B) and a random copolymer (PP-R) is the way in which comonomeric ethylene is linked to the molecular chain. In the case of PP-B this occurs in blocks and with PP-R the distribution is random.

Abbreviated name	Description	Density range [⊗] g/cm ³	Molecular structure [⊗]
PP-H	PP Type 1 (Homopolymer)	0.90 – 0.91	P-P-P-P-P-P-P-P-P-P-P-
PP-B	PP Type 2 (Block Copolymer)	0.90 – 0.91	P-P-E-E-P-P-P-P-E-E-P-P-
PP-R	PP Type 3 (Random Copolymer)	0.90 – 0.91	P-P-E-P-P-P-E-E-P-P-P-E-P-

[⊗] The density limit ranges may vary slightly depending on the source.

[⊗] P = propylene, E = ethylene



1.1.2 General

SIMONA® PP semi-finished parts have a number of excellent properties:

- Low density (in comparison with other materials)
- High chemical resistance, also to solvents
- High corrosion resistance
- High surface hardness
- Long service life
- Physiological safety
- Very low water absorption
- Very good electrical insulation properties
- Good fabrication and processing capability
- Universal use

1.1.3 Special modifications

For laboratory and apparatus construction

- SIMONA® PP-C (Block Copolymer)
Increased impact strength, even at low temperatures
- SIMONA® PPs (Homopolymer)
Classified according to DIN 4102 Part 1 as a low-flammability construction material in class B1
- SIMONA® PP-H-CU (Homopolymer)
Chemical resistance to metallic copper and hot copper liquors
- SIMONA® PP-H-TV 10/-TV 20/-TV 30/-TV 40 (Homopolymer)
Filled with 10, 20, 30 or 40% talcum; greater rigidity even at high temperatures
- SIMONA® PP-H AlphaPlus®-SK (Homopolymer)
Alpha-nucleated, backed with polyester fabric as an adhesion system for composite construction
- SIMONA® PP-EL (Homopolymer)
Surface resistance < 106 ohm; electrically conductive (see tech.info "SIMONA® Electrically Conductive (EL) Plastics")

Antistatic

This property varies considerably depending on relative humidity.

- SIMONA® PP-H-AS (Homopolymer)
Surface resistance approx. 109 – 1012 ohm
- SIMONA® PP-C-AS (Block Copolymer)
Surface resistance approx. 1014 ohm

Surface-treated

- SIMONA® PP-H embossed (Homopolymer)
With embossed surface on one side

For tank construction requiring mandatory test certificates

- SIMONA® PP-H AlphaPlus® (Homopolymer)
Alpha-nucleated

1.1.4 Alpha nucleation

The proven SIMONA® PP-H was enhanced to create SIMONA® PP-H AlphaPlus®. By adding a special nucleation agent and adapting process engineering, the microstructure is influenced when the PP melt cools down, thus achieving a finer and more uniform structure. This has a positive influence on the strength, notched impact strength and weldability of the material.

Key benefits of SIMONA® PP-H AlphaPlus® at a glance:

- Fine microstructure and stable crystalline structure
- Increased notched impact strength and enhanced rigidity
- Excellent weldability
- Increased creep rupture strength
- Enhanced chemical resistance and increased stress crack resistance

1.2 Areas of use

Use is to be recommended where high chemical resistance is required up to an upper temperature limit of +100 °C.

Apparatus, equipment, machines

- Drainage channels
- Extraction systems
- Drip pans
- Battery cells
- Pickling baths
- Chemical piping
- Fans
- Filling systems

Construction industry

- Concrete moulds
- Formwork for special concrete
- Radiator guards
- Artificial marble moulds
- Washbasins

Storage systems

- Sorting boxes
- Transport pallets
- Packaging elements
- Toolboxes
- Shelves

Applications requiring physiological safety

- Moulds, e.g. for ice cream, chocolate, cheese
- Small animal cages
- Kitchen utensils
- Prostheses and orthotic devices
- Sterilisation equipment
- Food warming plates and dishes
- Water desalination plants

1.3 Product range

For detailed information on the current product range of SIMONA® PP semi-finished parts and our other products, please visit www.simona.de.

Our Sales team will be pleased to advise you:

Phone +49 (0) 67 52 14-0

Fax +49 (0) 67 52 14-211

sales@simona.de

2 Technical information

2.1 Material specifications

Material Specifications

		SIMONA® PP-H AlphaPlus®	SIMONA® PP-H natural	SIMONA® PPs	SIMONA® PP-C
Density, g/cm ³ , DIN EN ISO 1183		0.91	0.90	0.95	0.91
Yield stress, MPa, DIN EN ISO 527		33	32	32	26
Elongation at yield, %, DIN EN ISO 527		8	8	8	7
Tensile modulus of elasticity, MPa, DIN EN ISO 527		1,700	1,400	1,600	1,200
Impact strength, kJ/m ² , DIN EN ISO 179		Without break	Without break	Without break	Without break
Notched impact strength, kJ/m ² , DIN EN ISO 179		9	7	6	45
Ball indentation hardness, MPa, DIN EN ISO 2039-1		-	-	70	50
Shore hardness D (15 s), DIN EN ISO 868		72	70	72	67
Mean coefficient of linear thermal expansion, K ⁻¹ , ISO 11359-2		1.6 x 10 ⁻⁴	1.6 x 10 ⁻⁴	1.6 x 10 ⁻⁴	1.6 x 10 ⁻⁴
Fire behaviour, DIN 4102		B2 normal flammability (own assessment without test certificate)	B2 normal flammability (own assessment without test certificate)	B1 low flammability: 2 – 20 mm (test certificate available)	B2 normal flammability (own assessment without test certificate)
Dielectric strength, kV/mm, VDE 60243-1		-	-	22	52
Surface resistivity, ohm, DIN IEC 60093		10 ¹⁴	10 ¹⁴	10 ¹⁴	10 ¹⁴
Temperature range, °C		0 to +100	0 to +100	0 to +100	-20 to +80
Chemical resistance		Excellent in contact with many acids, alkalis and solvents	Excellent in contact with many acids, alkalis and solvents	Excellent in contact with many acids, alkalis and solvents	Excellent in contact with many acids, alkalis and solvents
Physiological safety	BfR	✓	✓	-	✓
Food conformity	EU	✓	✓	-	-
	FDA	✓	✓	-	✓

All specifications are deemed to be approximate values in respect of the specific material and may vary depending on the processing methods used. In general, data specified applies to average values measured on extruded sheets with a thickness of 4 mm. In the case of sheets manufactured by means of pressing, testing is generally performed on sheets with a thickness of 20 mm. Deviations from the values specified are possible if the sheets in this thickness are not available. In the case of backed sheets, all technical specifications relate to the non-backed base sheets. Information presented herein is not necessarily applicable to other products (e. g. pipes, solid rods) of the same material or products that have undergone downstream processing. Suitability of materials for a specific field of application must be assessed by the party responsible for processing or the end-user. All technical specifications presented herein are designed merely to provide assistance in terms of project planning. They do not constitute a guarantee of specific properties or qualities. For further information, please contact our Technical Service Centre at tsc@simona.de.

2.2 Fire behaviour

SIMONA® PP-H AlphaPlus®, PP-H and PP-C are normal-flammability construction materials in accordance with DIN 4102 B2. SIMONA® PPs has low flammability in accordance with DIN 4102 B1.

- Autoignition temperature approx. 350 °C
- Oxygen index approx. 18% (minimum oxygen concentration that is necessary for combustion)

You will find the EC safety data sheet in section 6.

2.3 Performance in outdoor use

SIMONA® PP-H AlphaPlus®, PP-H, PP-C and PPs are not generally designed for outdoor use. However, experience with PP-H AlphaPlus® in outdoor use – without any mechanical stress – has been favourable over a number of years.

As with all high-polymer materials, polypropylene is damaged by the interaction of atmospheric oxygen and UV rays. In this case, uncoloured materials are more prone than pigmented ones. During the period of use, discoloration can occur, which is usually accompanied by a change in mechanical properties.

A more extensive service life for outdoor applications can be achieved with additional UV absorbers (SIMONA® PP-UV and SIMONA® PP-C-UV).

2.4 Physiological safety

According to Recommendation III by the German "Federal Institute for Risk Assessment" (BfR, previously BgVV), there are no reservations about using SIMONA® PP semi-finished parts for manufacturing commodities as defined by Section 2, paragraph 6, no. 1 of the German Food, Commodities and Feedstuffs Act (LFGB, as amended by an Announcement on 26 April 2006 in the German Federal Gazette I, p. 945).

All the monomers and additives used are listed in European Directive 2002/72/EC and addenda.

2.5 Chemical resistance

The non-polar nature of SIMONA® PP-H AlphaPlus®, PP-H, PP-C and PPs provides these thermoplastics with a high level of chemical resistance to the following substances, even at high temperatures:

- Salts (aqueous solutions)
- Acids
- Alkalis
- Alcohols
- Many solvents
- Fats
- Oils
- Waxes

In continuous contact with these media a small amount of swelling may occur but this does not generally affect the service capability of these materials.

There is limited chemical resistance (swelling) to:

- Aromatic compounds
- Halogenated hydrocarbons

There is no chemical resistance to strong oxidants such as:

- Nitric acid
- Chromic acid
- Halogens

Consequently, there is a higher risk of stress cracks, especially in the region of welds.

You will find detailed information in our SIMCHEM, a database on the chemical resistance of our materials (www.simchem.de).

2.6 Water absorption

SIMONA® PP-H AlphaPlus®, PP-H, PP-C and PPs only absorb very small quantities of water. Therefore, they do not swell when immersed in water.

2.7 Temperature range

The service temperature ranges of SIMONA® PP semi-finished parts are as follows:

Temperature ranges*

	PP/PPs
Continuous service temperature	0 °C to +80 °C
Without any significant mechanical stress in air as the ambient medium	up to +100 °C
Crystalline melting temperature	approx. +160 °C

* The figures do not apply to applications in tanks – such cases are subject to special design rules that have to be agreed on an individual basis.

Owing to their molecular structure, SIMONA® PP-H AlphaPlus® and PP-H are characterised by high rigidity, even in the upper service temperature range.

For the copolymeric SIMONA® PP-C, the service temperatures are between –20 °C and +80 °C. The material can be exposed to brief thermal stresses up to 90 °C without suffering any significant damage.

2.8 Resistance to microorganisms

SIMONA® PP-H AlphaPlus®, PP-H, PP-C and PPs are not nutrient surfaces for:

- Microorganisms
- Bacteria
- Fungus
- Spores
- Gnawing insects

2.9 Health aspects

As far as its chemical composition is concerned, PP is essentially only made of carbon and hydrogen. When they burn – provided there is a supply of atmospheric oxygen – virtually the only substances that develop are carbon dioxide, carbon monoxide and water, accompanied by very small quantities of soot and low-molecular-weight volumes of the relevant plastics. The ratio of carbon dioxide to carbon monoxide largely depends on the conditions of burning – temperature, ventilation and an unobstructed supply of atmospheric oxygen. Consequently, no burning fumes develop that resemble those of stearin (candle wax).

In the debate about the potential toxicity of fumes from burning plastics the fact that all burning fumes of any kind have a toxic effect is often overlooked. With this in mind, any claim that plastics exposed to fire develop particularly toxic gases is incorrect.

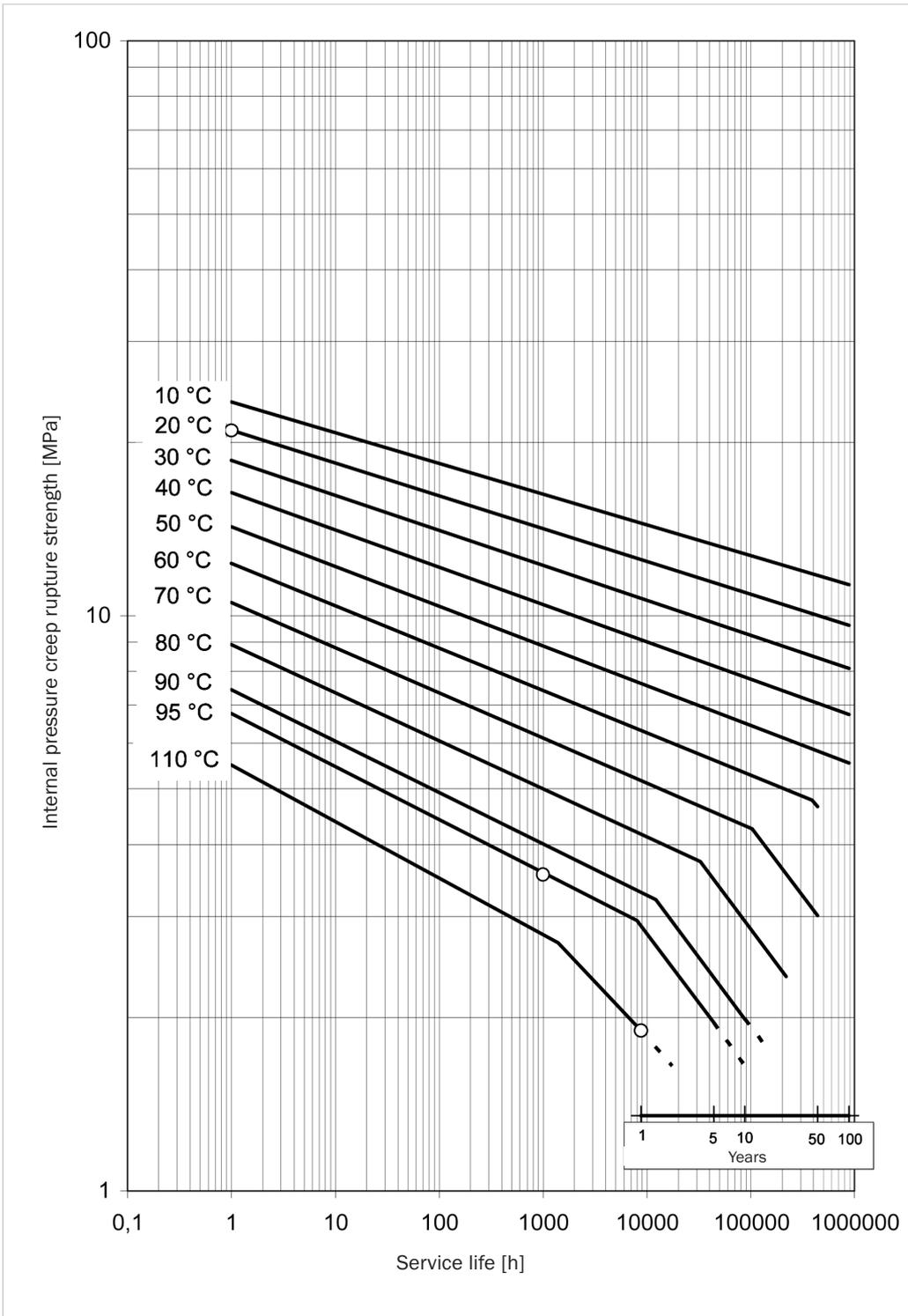
The most suitable extinguishant to combat burning PP is water.

2.10 Tank construction requiring mandatory test certificates

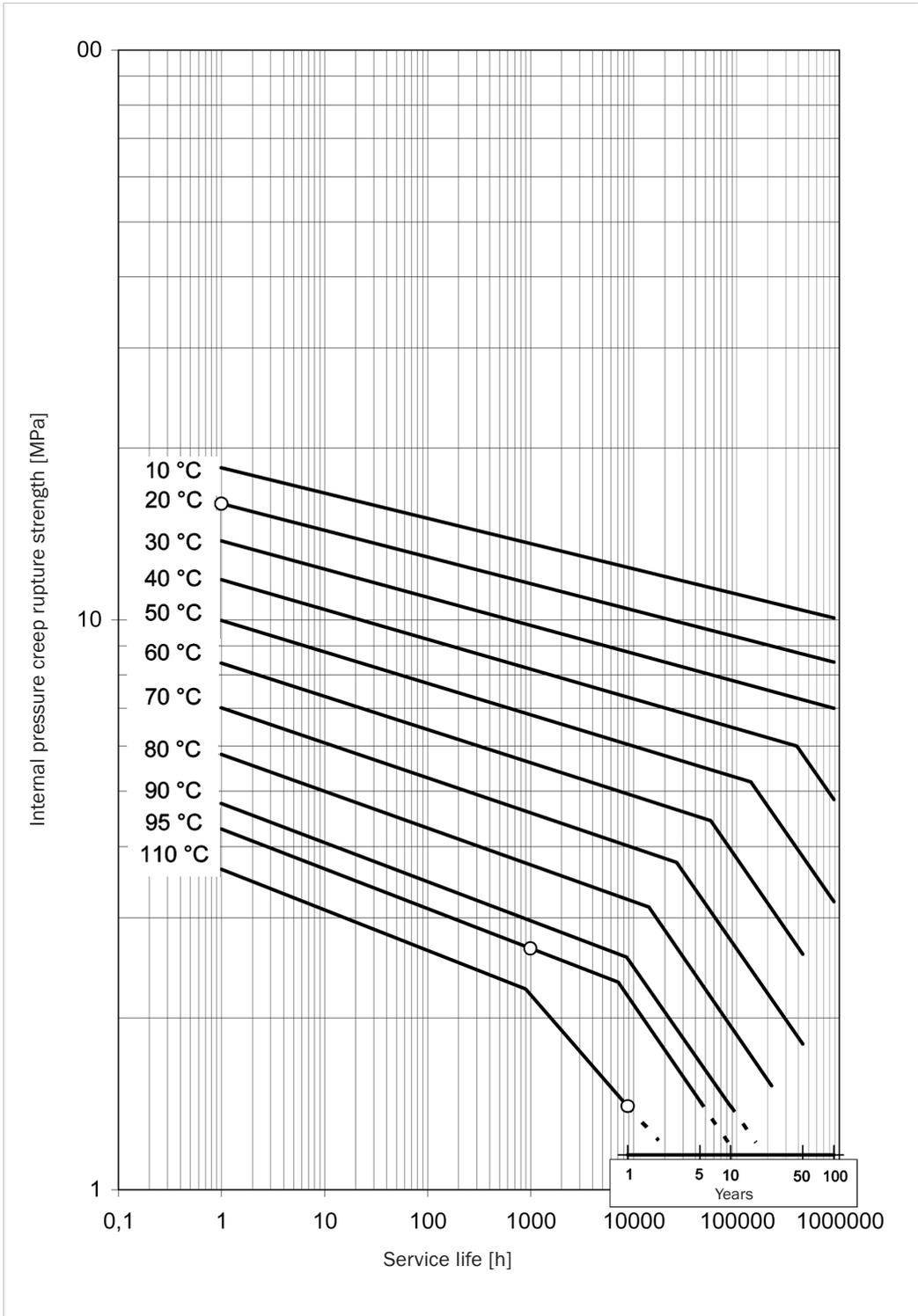
According to the German Institute of Building Technology (DIBt) in Berlin, SIMONA® PP-H AlphaPlus® is suitable for use in tank construction requiring mandatory test certificates.

On the following pages you will find the creep values required by DIN 8078 for PP homopolymer and copolymer for the calculation of tanks and components in accordance with DVS Guideline 2205 Part 1. With the aid of this creep curve it is possible to determine the amount of load for a specified service life and service temperature of a component.

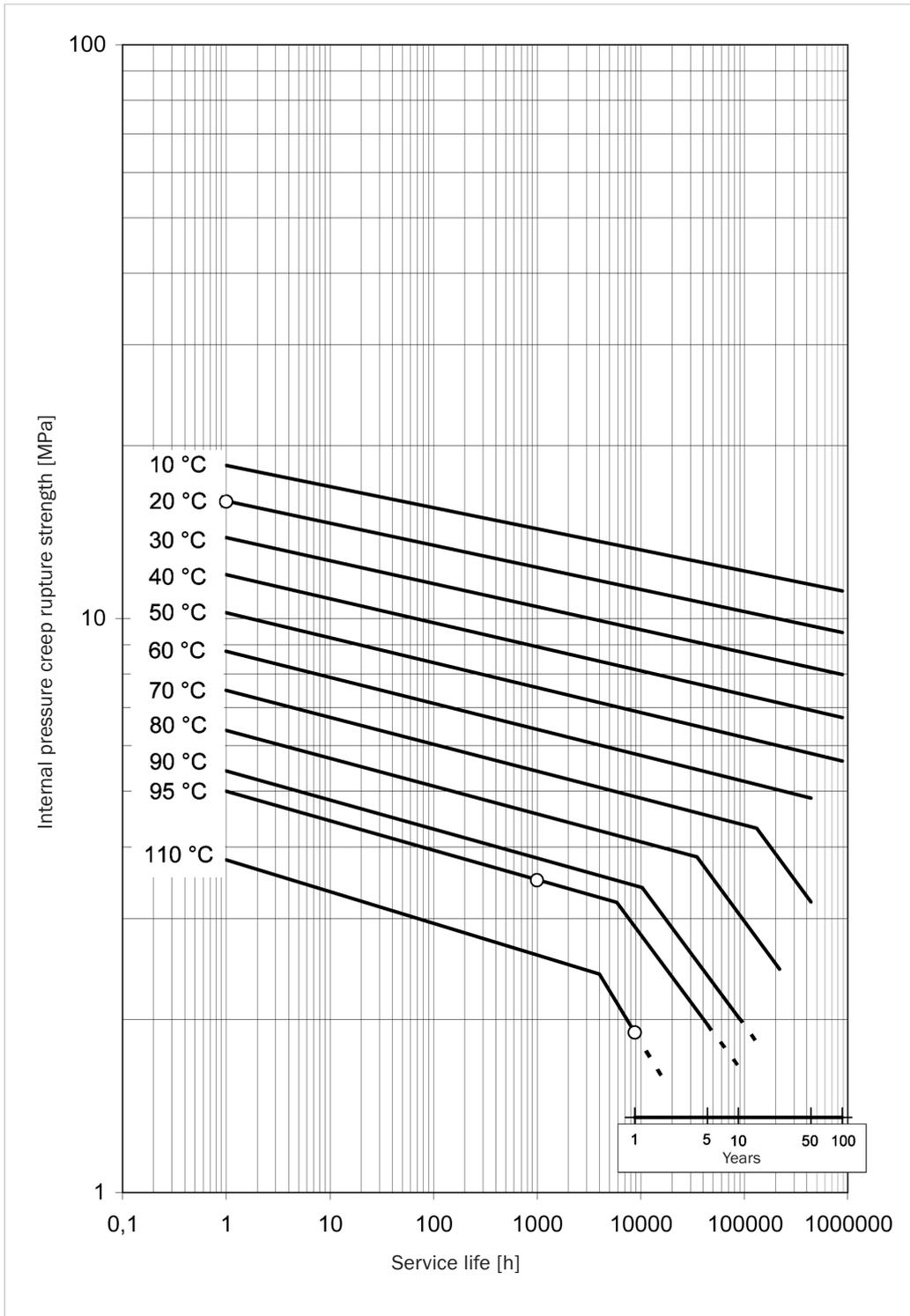
However, the stress values found do not take into account the actual loads in practice, brought about by more or less aggressive media and welding processes. These must be determined separately (see also DVS Guideline 2205 Part 1, media lists issued by the German Institute of Building Technology, Berlin).



Reference characteristics of the internal pressure creep rupture strength (minimum curves) of pipes made of PP-H



Reference characteristics of the internal pressure creep rupture strength (minimum curves) of pipes made of PP-B



Reference characteristics of the internal pressure creep rupture strength (minimum curves) of pipes made of PP-R

2.11 Composite construction and internal tank lining

We have been supplying backed sheets made of homopolymeric polypropylene for processing in the field of composite construction and internal tank lining for many years. The standard product SIMONA® PP-H AlphaPlus®-SK is provided with a three-dimensionally stretchable thermoplastic polyester fabric. Our product range also includes the following liner materials:

- SIMONA® PP-H AlphaPlus®-GK
- SIMONA® PP-C-PK
- SIMONA® PP-C-SK
- SIMONA® PP-C-GK

As a liner, this material facilitates processing and offers benefits relating to applications technology:

- Removal of backing for weld seam preparation is unnecessary because the PP fabric is also melted by warming – therefore, it cannot have any detrimental effect on weld seam quality
- Higher flexibility than PP-H facilitates joining up to curved steel surfaces
- Chemical resistance of sheets and backing is identical
- Insensitivity of the PP backing to hydrolysis

You will find further information about SIMONA® liner materials in the work.info "Lining and Composite Construction".

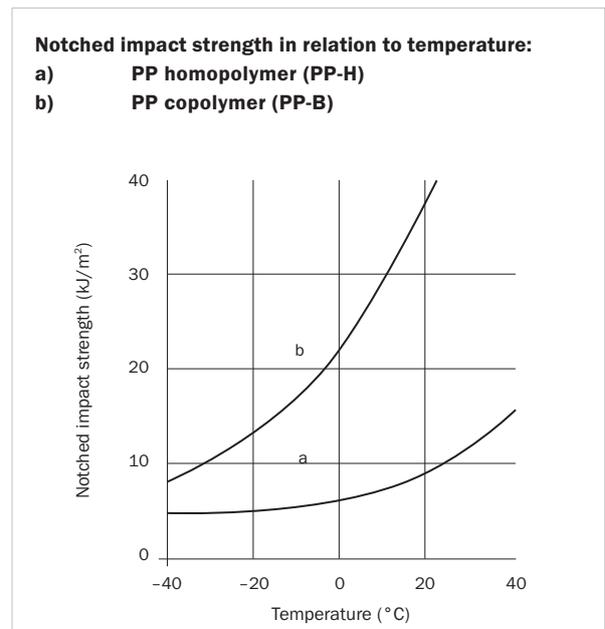
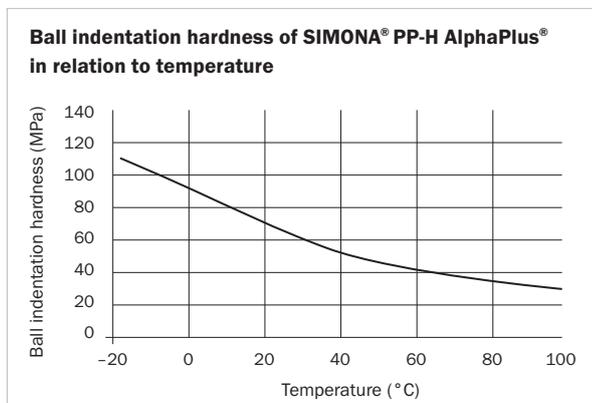
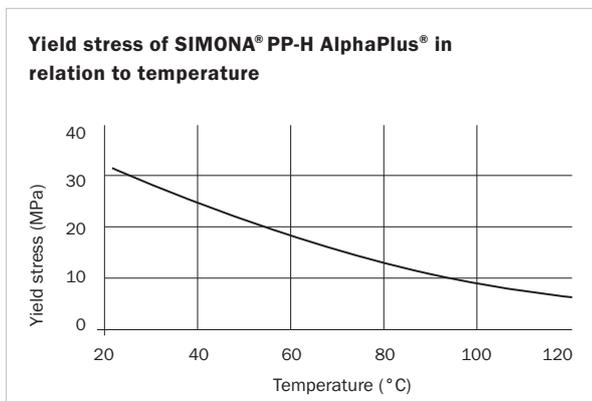
2.12 Comparison of physical properties

Below you will find a comparison of the important properties of the homopolymers and copolymers of polypropylene.

Material properties comparison

	SIMONA® PP-H AlphaPlus®	SIMONA® PP-H	SIMONA® PPs	SIMONA® PP-C
Density, g/cm ³	0.91	0.90	0.95	0.91
Yield stress, MPa	33	32	32	26
Tensile modulus of elasticity, MPa	1,700	1,400	1,600	1,200
Notched impact strength, kJ/m ²	9	7	6	45
Temperature range, °C	0 to +100	0 to +100	0 to +100	-20 to +80

The figures below show mechanical behaviour as a function of temperature. They illustrate the high mechanical performance, even in the upper temperature range.



3 Processing instructions

Our work.infos provide further information on:

- Welding
- Thermoforming, hot forming, bending
- Machining
- Gluing
- Lining and composite construction

You can obtain these and other publications free of charge from our download centre at

www.simona.de/download.

4 Storage

General information about the storage of SIMONA® semi-finished plastic parts

- The storage of SIMONA® semi-finished plastic parts should always take place in a building devoid of moisture, sudden temperature fluctuations and direct sunlight.
- Packaging straps should, if possible, be removed after transport. In the event of repackaging it is better not to use steel straps.
- One-sided heating by a heat source should be avoided.
- PVC products, welding rods and electrically conductive plastics should be protected against moisture.
- Non-UV-stabilised materials should be protected against direct sunlight.
- In storage it is advisable to use plastic film for dust protection.
- Sheets should be stored on a stable, flat pallet that provides adequate support and is at least as large as the sheet itself. Individual sheets should be stored flat.
- It is recommended that an intermediate liner (e.g. cardboard) be placed between the pallet and the semi-finished plastic product.
- In block storage with multiple pallets stacked on top of one another we recommend using a pallet upside down as an intermediate liner in each case in order to ensure a better distribution of load.
- Special caution is required in block storage if the items are relatively thin sheets and/or foamed material.

5 Legal note and advice

Legal note

Upon publication of a new edition all previous editions shall become void. The authoritative version of this publication can be found on our website at www.simona.de.

All information furnished in this publication reflects our current scope of knowledge on the date of publication and is designed to provide details of our products and potential fields of application (errors and omissions excepted, including typographical mistakes). This shall not be deemed as constituting the provision of legally binding guarantees or warranties as to specific properties of the products or their suitability for specific areas of application.

We provide warranty for the faultless quality of our products solely within the framework of our Standard Terms and Conditions of Business and only within the scope specified therein.

We shall assume no liability for the application, utilisation, processing or other use of this information or of our products. Furthermore, we shall assume no liability for any consequences related thereto. The purchaser is obliged to examine the quality and properties of these products; he shall be responsible in full for selecting, applying, utilising and processing said products as well as applying any information relating thereto, which shall also include all consequences associated with such actions. Third-party property rights shall be observed accordingly.

Any reproduction of this publication or any unconnected use of specific content taken from this publication are strictly prohibited; legal action will be taken in the event of an infringement. Exceptions hereto will require our prior approval in writing.

Advice

Our applied technical advice is given according to our best knowledge and is based on the information you have provided and the state of the art known to us at the time such advice is furnished. The advice shall not constitute a guarantee or warranty of specific characteristics or qualities and shall not establish an independent contractual legal relationship.

We shall only be liable for cases of intent or gross negligence. Under no circumstances shall we be held liable for the correctness or completeness of information you have provided or the advisory/consulting services rendered by us on the basis of such information. Any information provided by us shall not release you from your obligation to conduct your own assessments and evaluations.

We reserve the right to update information without notice as part of our continuous research and development programme.

Our staff at the Technical Service Centre and Customer Service will be pleased to advise you on the processing and use of semi-finished thermoplastic products and the availability of our products.

Technical Service Centre
Phone +49 (0) 67 52 14-587
tsc@simona.de

Customer Service
Phone +49 (0) 67 52 14-926
sales@simona.de

6 EC Safety Data Sheet

according to 1907/2006/EC Article 31

Trade names: **SIMONA® PP-H AlphaPlus®, PP-H natural, PPs, PP-C**

1. Identification of substance/preparation and company

- Manufacturer details:
SIMONA AG
Teichweg 16
55606 Kirn
Germany
Phone +49(0)67 52 14-0
Fax +49(0)67 52 14-211

2. Hazards identification

- none known

3. Composition/information on ingredients

- Chemical characteristics:
 - Polymer of propylene (PP-H AlphaPlus®, PP-H natural)
 - Polymer of propylene with flame protection (PPs)
 - Copolymer of propylene (PP-C)
- CAS number: not applicable

4. First aid measures

- General comment: medical aid is not necessary
- First-aid measures: none
- Routes of exposure: none
- Symptoms /effects: none

5. Firefighting measures

- Suitable fire-fighting appliance: water fog, foam, fire fighting powder, carbon dioxide
- Hazard warning notice: not applicable

6. Accidental release measures

- Person-related measures: none
- Environmental protection measures: not applicable
- Cleaning equipment: not applicable
- Unsuitable cleaning products: not applicable

7. Handling and storage

- Handling:
no special regulations to be complied with
- Storage:
storable for an unlimited period

8. Exposure controls/Personal protection

- Special design of technical processing plants:
not required
- Tolerance levels: none
- Exposure assessment: none
- Respiratory protection: not required
- Eye protection: not required
- Body protection: not required

9. Physical and chemical properties

Physical and chemical properties

	PP-H AlphaPlus®	PP-H natural	PPs	PP-C
Physical state	Solid state, semi-finished product			
Colour	Grey	Natural	White, grey	Grey, natural, black, white
Odour	Not applicable	Not applicable	Not applicable	Not applicable
Crystalline melting range	160 - 165 °C	160 - 165 °C	160 - 165 °C	160 - 164 °C
Flash point	Not applicable	Not applicable	Not applicable	Not applicable
Density	0.91 g/cm ³	0.90 g/cm ³	0.95 g/cm ³	0.91 g/cm ³

10. Stability and reactivity

- Thermal decomposition: above approx. 300 °C
- Hazardous decomposition products:
Besides carbon black also carbon dioxide and water as well as low molecular parts of PP will develop during the burning process. In case of incomplete burning also carbon monoxide may arise. PPs also develops hydrogen halide at excessively high temperatures.
- Use of stabilisers: none
- Exothermic reactions: none
- Notices regarding state of aggregation: none
- Conditions to be avoided: none
- Substances to be avoided: none

11. Toxicological information

No hazardous effects on health were observed over several years of usage.

12. Ecological information

No biodegradation, no solubility in water, no hazardous effects on the environment are to be expected.

- Mobility: not applicable
- Accumulation: not applicable
- Ecotoxicity: not applicable

13. Disposal considerations

Can be recycled or can be disposed of together with household rubbish (acc. to local regulations).

- Waste key for the unused product: EAK-Code 120 105
- Waste name: waste of polyolefine

14. Transport information

No dangerous product in respect to/ according to transport regulations.

- Notice/symbol transport containers: none
- Special marking for containers: none

15. Regulatory information

- Marking according to GefStoffV/EG: no obligation for marking
- Water danger class: class 0 (self classification)
- Domestic requirements to be observed: none

16. Other information

This information solely describes the safety requirements of the product(s) and is based on the current state of our knowledge. It does not give any assurance concerning the product(s) described within the meaning of statutory warranty regulations.

SIMONA worldwide

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