SIMONA.report

Technical Newsletter from SIMONA AG 2/2009

PE Sheets

SIMONA® PE Sheets for tank and apparatus building

SIMONA has many years of experience when it comes to selecting best-in-class materials (such as polyethylene), providing technical advice and performing specialist calculations within the area of tank construction. This article outlines the various classification standards for polyethylene. At an industrial level, polyethylene is usually classified according to three principal criteria: density, molecular weight and creep behaviour. Within this context, it is possible that various types of PE display different properties with regard to one of the aforementioned criteria, while they are identical in the two other areas.

1. Density (= specific weight)

The density of PE is directly related to the crystallinity of the material. The higher its crystallinity, the greater the density. In turn, crystallinity is dependent on the structure of the molecular chain (e.g. the number and length of branches). Table 1 shows the various density ranges together with the classification used for PE types.

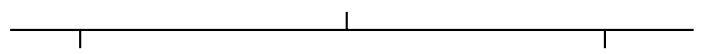
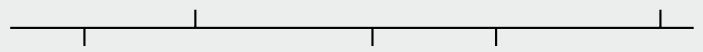
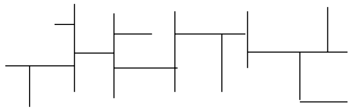
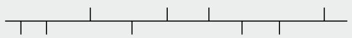
Abbreviation	Description	Density range g/cm³	Molecular structure
PE-HD	High density	0.945 – 0.970	
PE-MD	Medium density	0.935 – 0.945	
PE-LD	Low density	0.915 – 0.935	
PE-LLD	Linear low density	0.915 – 0.935	
PE-VLD	Very low density	0.89 – 0.915	

Table 1: The density figures may vary depending on the sources used.

2. Molecular weight

The molecular weight offers an insight into the “length” of specific molecular chains. In view of the fact that the molecular chains within a specific material may differ, the figure specified is the mean molecular weight or mean molar mass.

Description	Molar mass g/mol	SIMONA® products
PE-300	approx. 300,000	PE-HWST, PE-HWU, PE-HWU-B, PE 100
PE-500 (PE-HMW)	approx. 500,000	dehoplast® PE-500, PE-HML 500
PE-1000 (PE-UHMW)	> 1,000,000	dehoplast® PE-1000
	approx. 5 to 7 Mio.	dehoplast® PE-1000-13
	approx. 8 to 10 Mio.	dehoplast® PE-1000-15
	> 10 Mio.	dehoplast® PE-1000-17

Table 2: The figures relating to molar mass may vary depending on the method used.

Within the area of plastic sheets, we can distinguish between the following groups. Group PE-1000 is usually subdivided into further categories (cf. Table 2).

As regards some properties and processing methods, not only the molecular weight but also the molecular weight distribution (relationship between the molecular chains of different length) is of importance. However, there is no separate classification system within this area.

3. Creep behaviour

The most important classification method when it comes to calculating and constructing tanks made of polyethylene is that relating to creep behaviour. Within this context, DIN 8075 distinguishes between various categories. In this case, creep testing is performed on the basis of the internal pressure of pipes. The pipe is exposed to stress at a predefined temperature. During this test, the time is measured until the pipe fails, i.e. breaks. This test is conducted at various temperatures and stress levels, and the results are presented in creep curves on the basis of statistical analysis and extrapolation. As regards classification, the key figures are permissible stress exposure/requisite minimum strength at 20 °C and 50 years without accounting for reduction factors. The creep curves provide a basis for structural tank calculations, as well as delivering data on the required wall thickness of a tank. DIN 8075 uses the material-specific designations listed in Table 3.

Designation	Application	Required min. strength at 20 °C/50 a
PE-HD	non-pressurised appl.	~ 8.0 MPa
PE 63	non-pressurised appl. and pressure pipes	≥ 6.3 MPa
PE 80	non-pressurised appl. and pressure pipes	≥ 8.0 MPa
PE 100	non-pressurised appl. and pressure pipes	≥ 10.0 MPa

Table 3

Page 1 continued

SIMONA® PE Sheets

SIMONA® PE Sheets for tank and apparatus building fall within the categories outlined above. As regards density and molecular weight, all materials supplied are classified within the groups PE-HD and PE-300. However, they differ with regard to creep behaviour. According to DIN 8075, SIMONA® PE-HWU-B corresponds to the classification PE 80. SIMONA® PE 100 falls into the category PE 100. Both materials have been furnished with general technical approvals from the DIBt (German Institute for Construction Technology) – registration no. Z-40.26-410 and Z-40.26-411. They are only manufactured from compounds that have been granted DIBt approval. Both of these products can be used for the purpose of tank construction requiring mandatory test certificates. The third SIMONA® product within this group – which is classified as PE-HD or PE 63 according to DIN 8075 – is SIMONA® PE-HWU. This material has not been approved for tank construction requiring mandatory test certification. All three products within the PE-HD and PE-300 material categories are assessed as to their chemical resistance (based on the official DIBt list of substances) and can be welded with each other in accordance with DVS 2207. The melt indices (MFR figures) of the respective materials lie within the permissible melt index range defined within DVS.

When it comes to tank and apparatus building, two components are essential: the material designed to meet your requirements and the partner entrusted with the task of assisting you with everything from product selection to on-site project planning. SIMONA offers you the best of both worlds – premium quality and unrivalled expertise.

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Plastics Expertise

DIBt approval for SIMONA® PP-DWU AlphaPlus®

At the end of February 2009, we were granted a general technical approval for SIMONA® PP-DWU AlphaPlus® by the DIBt (German Institute for Construction Technology). Thus, we are the first and, at present, only manufacturer with certification for a PP compound. The official approval process was arduous, requiring extensive testing in order to meet the challenging demands of the DIBt. These include tests relating to mechanical properties as well as long-term behaviour and suitability for welding. The majority of these tests are conducted and assessed by an independent technical testing body. The DIBt also stipulates extensive quality testing in parallel with production as well as regular external monitoring. Owing to the exceptional properties of SIMONA® PP-DWU AlphaPlus®, complemented by DIBt approval for the compound, our PP semi-finished products are particularly well suited to applications within the area of chemical tank and equipment engineering.

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Bernhard Westermann is a qualified engineer within the field of chemical process engineering and joined SIMONA AG in 1986.
Having worked in various roles within the area of research and development, he is familiar with all products supplied by SIMONA AG. At present, he is employed within the company's Technical Service Center, where his responsibilities include the implementation of development projects and the qualification of raw materials and additives relating to polyolefins. The development projects include the modification of existing products as well as the introduction of new materials. In addition to these areas of responsibility, he is also involved in standardisation processes in the respective DIN working committees, focusing on semi-finished thermoplastics and pressure pipes. Finally, he oversees procedures relating to official registrations and external test certification for SIMONA semi-finished products within the area of foodstuffs, drinking water, fire protection and tank building.

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Project Report

Pickling line made of SIMONA® PP-DWU AlphaPlus® delivered to Rasselstein GmbH

Left: General view of the pickling line and the various tanks. Right: Delivery of the pickling tanks to the Rasselstein steel plant.

The entire process section of the sulphuric acid hot-strip pickling line at Rasselstein GmbH in Andernach, one of the largest tinplate manufacturers in the world, had to be rebuilt. Kunststoffbau Langschede GmbH convinced Rasselstein that SIMONA® PP-DWU AlphaPlus® was the material of choice.

As part of the overall design process, the structural parameters as well as the expansion and connections of the various pickling tanks had to be taken into account. An essential prerequisite: top-quality materials.

Initial situation

In 2006 Rasselstein GmbH, which specialises in the cold rolling and treatment of steel strip, had to rebuild a pickling line with a length of approx. 150 m. The steel and metal structures of the four pickling tanks and the final rinsing section were being subjected to high chemical and mechanical stresses on account of the aggressive chemicals being used (e.g. sulphuric acid), high service temperatures and the various speeds of the steel strips passing through. Although the surfaces of the pickling tanks were pretreated and advanced surface finishing had been performed, the metal and steel construction used until recently was not permanently resistant to corrosion under on-site operating conditions.

Task

A material had to be found which would ensure a long service life on account of its high resistance to aggressive chemicals and its high thermal resistance. Kunststoffbau Langschede, which has 10 years of experience designing and manufacturing industrial installations, convinced Rasselstein GmbH that when selecting materials for the construction of its new pickling lines it would be advisable to take a new approach and – instead of selecting steel as in the past – use PP and PVDF.

Solution

The exceptional material properties of SIMONA® PP-DWU AlphaPlus® ensure an extremely long service life and avoid the need to constantly replace process sections. The line was designed and computed using CAD 3D models, taking PP reduction factors into account. The use of high-end measurement technology, including 3D laser scanning, for the purpose of implementing the new process element within existing plant structures provided the basis for efficient assembly within just 20 days.

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Project Report

SIMONA® large-diameter pipes in special dimensions for XXL project

Left: The reducing tool brought down the circumference of the SIMONA® PE 100 pipe from 1060 mm to approx. 970 mm. Middle: The 500 m long pipeline was drawn into the old pipe in a single feed. Right: The entire pipeline was transported to the access trench with light.

Approximately 500 tons of SIMONA® PE 100 pressure pipes in a special dimension were used for the rehabilitation of a grey cast iron pipeline of DN 1000 mm. Berliner Wasserbetriebe chose the innovative swagelining process, a very quick and cost-effective method.

Initial situation

In Greater Berlin, Berliner Wasserbetriebe (BWB) operate a 1127 km long waste-water pressure pipe network, 147 pump stations and 6 waste-water treatment plants. The reconstruction of these pipelines presents a considerable challenge.

Task

In the district of Rudow in Berlin-Neukölln, an old grey cast iron pipeline of DN 1000 mm required reconstruction. The restrictions for the residents needed to be kept to a minimum.

Only one trench was planned at the start and end of the over 500 m long construction section, plus 40 hours of feed-in time. The pipe material needed to offer the following advantages for this rehabilitation project:

- Long service life of up to 100 years
- Easy handling thanks to low weight
- Extreme bending capacity due to high flexibility
- Absorption of all load influences by the new pipe
- Excellent corrosion resistance
- No formation of incrustation
- Permanently leak-proof and tight weld connections

Solution

Swagelining is a cost-effective method for trenchless rehabilitation of pipelines with SIMONA® PE 100 pressure pipes without permanent annular space. After installation, the new solid-wall pipe lies closely-fitting against the old pipe. This position and the excellent hydraulics of the pipes guarantee the necessary flow capacity. The cross-section of the new pipe was reduced from 1060 mm to approx. 970 mm for the duration of the feed-in. For this purpose, the pipe was pulled through a reducing tool at a speed of 40 to 60 m/h. During the feed-in process, the pipe was constantly subjected to a maximum tensile stress of 202 tons. After reaching the exit trench, the tensile force was relieved and the outer diameter increased again. The result was a perfect pipe reconstruction with minimal environmental impact.

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