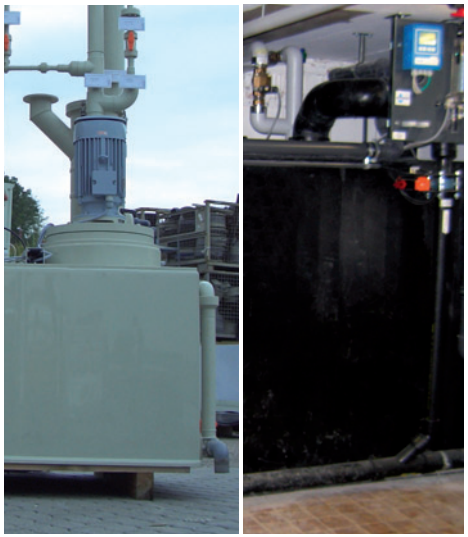
SIMONA.report SIMONA AG Technical Publications 3/2008

SIMONA® Twin-Wall Sheet

Second generation with enhanced properties



Jet scrubber made of PP-HKP (left)
Overflow water tank made of PE-HKP (right)

The SIMONA® Twin-Wall Sheet is a lightweight module that is both unique and innovative in design. The sheet was particularly developed for use in chemical equipment and tank construction, featuring properties which are specially matched to this application. The aim is to deliver a solution for the efficient construction of tanks without the need for steel reinforcement. The Twin-Wall Sheet has an optimised weight-to-rigidity ratio and excellent sound and heat insulation properties.

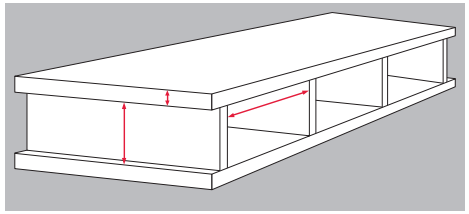
SIMONA® Twin-Wall Sheet offers a wide range of benefits:

- Rectangular tank design without steel reinforcement
- Lightweight construction with rigidity comparable to that of solid sheets
- Excellent sound insulation (in accordance with DIN ISO 140-3)
- Good slip properties and minimal wear
- High break resistance and flexural strength
- Thermal insulation (U-values based on ISO 8301/ EN 1946-3)
- Electrical insulation
- High chemical resistance
- Many different fabrication capabilities
- Available in SIMONA® materials PE-HWU-B, PP-DWU AlphaPlus, PPs and PP-C-UV

The SIMONA® Twin-Wall Sheet consists of two outer skins and a variable number of welded webs.

Committed to providing an all-embracing portfolio with end-to-end solutions, we also supply ready-made corner elements available ex stock which are butt-welded on a specially developed welding machine.

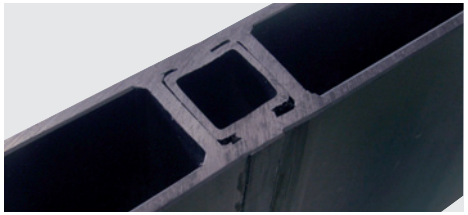
This type of welding not only ensures maximum strength but also allows maximum cost-effectiveness. By using prefabricated corner elements, customers can save time and reduce fabrication costs.



When processing SIMONA® Twin-Wall Sheets, the following requirements have to be met, depending on the particular product:

- For heated-tool butt welding the height of the filament must be at least 70 mm.
- The clamping distance of the butt-welding bench must be at least 60 mm.
- When creating the base by means of extrusion welding, it is necessary to pre-weld a root seam with a 3 mm welding rod.
- When making a butt joint as part of extrusion welding, the cavity has to be filled (see photograph right).

Various tests have been conducted in order to investigate the mechanical properties of SIMONA® Twin-Wall Sheets. The 3-point bending test is of particular relevance to practical applications.



Extrusion weld filled with PE profile 40 mm x 40 mm; alternative: 40 mm PE-HWU sheets

It allows conclusions to be drawn concerning the deformation behaviour of the sheet in both possible directions. Test results point to rigidity equivalences in comparing the Twin-Wall Sheet with a solid sheet, thus making it possible to make structural estimates. The diagram on page 2 shows the result for a Twin-Wall Sheet with outer skins 6 mm thick and 19 webs.

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In future, SIMONA will also be offering structural analyses for rectangular tanks to be made with Twin-Wall Sheets. The analytical tool required for this will be based on FEM calculations (Finite Element Method) which are compiled by LGA Bautechnik GmbH in Nuremberg, a department of TÜV Rheinland. Analytical tool programming is also performed by an external partner. Numerous FEM-based investigations into various tank sizes have already produced reliable empirical results.

At present, further practical experience is being gained from sample tanks which are also used for the purpose of validating analytical results.

The SIMONA® Twin-Wall Sheet is a highly flexible product with a wide range of applications (construction industry, apparatus, equipment, machinery, agriculture, environmental engineering, etc.).

The Twin-Wall Sheet supplied by SIMONA is a complete system covering not only sheets made of various materials and corner elements but also qualified technical service.

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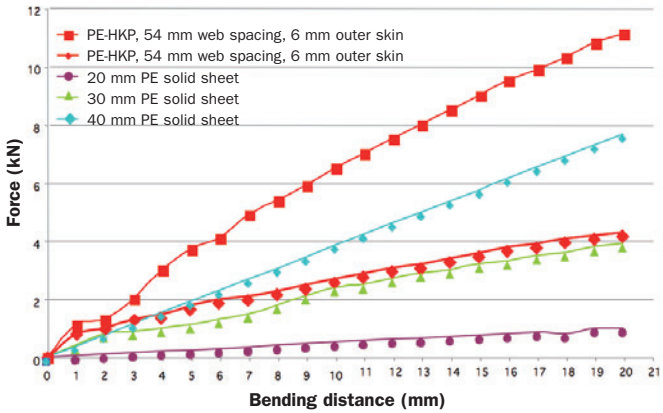
3-point bending test



The diagram shows that the Twin-Wall Sheet being tested has a higher level of rigidity than a PE-HWU-B solid sheet (weight per unit area: PE-HKP: 20.4 kg/m², PE-HWU-B 40 mm: 38.2 kg/m², factor 1.9).

Range of SIMONA® Twin-Wall Sheets

PE-HKP, black

Height mm	Web height mm	3000 x 1000 kg each	Web spacing mm	Number of webs pcs.	Material thickness mm
54	41	51.0	54	19	6
54	41	43.2	108	10	6
58	41	62.4	54	19	8

PP-HKP, grey

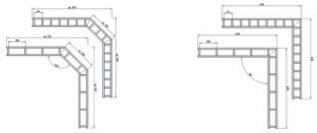
54	41	49.0	54	19	6
54	41	41.4	108	10	6
58	41	59.8	54	19	8

PPs-HKP, grey

54	41	43.2	108	10	6

Other geometries available on request.

Corner Elements 45°/90°



Your contact

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Technical Service Center

Marco Stallmann has been working for SIMONA AG as a qualified engineer (University of Applied Sciences) in process engineering since 2007. His field of responsibility at our Technical Service Centre in Kirn comprises the structural analysis of DVS tanks and providing technical support for SIMONA® products used in the advertising sector (PVC foam sheets and transparent materials). In addition to general customer consultation on technical issues he is accompanying the market rollout of SIMONA® Twin-Wall Sheet. Within the scope of technical support for Twin-Wall Sheets he not only provides our customers with application-specific advice but is also responsible for the systematic determination of parameters, qualification of suitable methods of product testing and coordination of projects with external partners, focusing on the development of a tool for structural analyses.

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SIMONA® PVC-C

Sheets made of post-chlorinated PVC (PVC-C) – extruded and pressed

Applications made of PVC-C CORZAN Industrial Grade

SIMONA AG has been offering extruded sheets and welding rods made of PVC-C in two qualities since 2004:

- **PVC-C CORZAN Industrial Grade (colour grey) for chemical tank and apparatus construction**
- **PVC-C CORZAN FM 4910 G2 (colour white) for applications in the semiconductor industry**

Apart from their colours, the main difference between the two types is their heat distortion temperature.

Since 2008, SIMONA's PVC-C Industrial Grade has also been available as pressed sheets in a thickness range from 15 mm to 50 mm.

The use of PVC-C is worth considering wherever the properties of standard PVC or other standard thermoplastics fail to meet the requirements – e.g. in terms of continuous service temperature or chemical resistance – and a particularly cost-effective alternative is required. Since the chlorine content is approximately 10 % higher than that of conventional PVC (PVC-U), post-chlorinated PVC has an extended service temperature range and higher corrosion resistance. The limiting oxygen index (LOI) in the event of fire is 6 %, so it is higher than that of PVC-U. PVC-C is self-extinguishing and produces non-burning droplets.

In most cases PVC-C sheets are used in composite construction, i.e. as liner material in GRP tanks, but also in solid thermoplastic tank construction in isolated cases.

PVC-C CORZAN FM 4910 G2 is chiefly used for making wet benches in the semiconductor industry. In this application the fire properties have to meet very high standards (approval in accordance with FM standard 4910).

The favourable properties of PVC-C, especially its high resistance to acids, alkalis and oxidising chemicals such as chlorine, ozone and nitric acid, plus a service temperature range of –40 °C to +95 °C, open up a wide range of applications for the material: for bleaching lye in the paper industry, in hot-dip galvanising and in the electroplating industry. In addition, PVC-C is used in the chlorine alkali industry, in fertiliser manufacture and for discharging hot brewery effluent containing a mixture of various detergents. Post-chlorinated PVC is also used as a structural material in contact with highly aggressive black liquor (pulping liquor containing lignin) occurring as a waste product in cellulose manufacture up to a temperature of +80 °C. In the chlorine alkali industry PVC-C is used for the headers, which take away the chlorine resulting from electrolysis. Owing to its low flammability and corrosion resistance, PVC-C is a genuine alternative as a material for ventilation ducts, for example where waste air contains chlorine dioxide (28 mg/m^3); in this case PVC-C has thermal resistance up to a temperature of +60 °C.

However, in any specific case it is necessary to carefully consider media properties, temperature and pressure load in order to assess the type of application, service life and hence the cost-effectiveness of the system as a whole. At its Technical Service Centre SIMONA offers users advice with regard to chemical resistance and design issues.

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Tank made of PVC-C CORZAN Industrial Grade

Expertise in Plastics

PVC-C (post-chlorinated polyvinylchloride) and PVC-U

Overview

Post-chlorinated polyvinylchloride (PVC-C) was developed at the Bitterfeld factory of IG Farben from 1930 onwards. In those days PVC was post-chlorinated in solution, whilst the processes nowadays use an aqueous suspension (B. F. Goodrich, now Lubrizol, USA) or the fluidised bed process (Rhône-Poulenc, now Arkema, France).

Like PVC-U, PVC-C is an amorphous thermoplastic and takes the form of a white, colourless, odourless powder. Its chlorine content is between 62 % and 69 % (PVC-U: 56 % to 57 %). Density is 1.50 g/cm^3 to 1.55 g/cm^3 depending on the chlorine content (PVC-U: 1.44 g/cm^3). The higher the chlorine content, the higher the heat distortion temperature and tensile strength and the lower the elongation at break and impact strength. A high chlorine content also creates a higher level of chemical resistance to acids, alkalis and oxidising media than that of PVC-U, plus better fire properties.

Most PVC-C is processed to make pipes, fittings and sheets. These are used wherever a high distortion temperature is required and challenging demands are made in terms of chemical resistance or fire rating. Examples are to be found in the electroplating industry, chlorine alkali electrolysis, the paper industry, heating systems, waste water systems and ventilation ducts.

Processing PVC-C

As with PVC-U, semi-finished products made of PVC-C are ideal for machining, e.g. sawing, turning or drilling. On account of its high surface energy, the material is excellent for gluing and painting. One special aspect worth mentioning is the very good lamination capability of PVC-C with GRP or other base materials, which makes the material ideal for use in composite design and as a lining material (so-called "inliner").

In shear strength tests conducted on GRP composites with polyester resin much higher average strengths were achieved than the figures for PVC-U, over 16 N/mm^2 and 7 N/mm^2 respectively. The very good weldability of PVC-C is a basic requirement for use in tank construction. Although the process of developing DVS guidelines for welding PVC-C has not yet been completed, thus making assessment based on standardised welding parameters difficult, empirical data is available which can be used to correlate the figures for PVC (PVC-U, PVC-RI) with normal impact resistance and PVC with enhanced impact resistance. Welding requires great care, the main aspects being thorough preparation of the surfaces to be welded ("smoothing") and exact compliance with the confined temperature window, air flow and the velocity in hot-gas string bead welding.

Conclusion

Owing to its special properties and cost-effectiveness PVC-C closes the gap between standard thermoplastics (PVC, PP and PE) and partially or fully fluorinated materials (PVDF and E-CTFE) for a wide range of applications.

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Material Specifications

	PVC-C CORZAN Industrial Grade extruded	PVC-C CORZAN Industrial Grade pressed	PVC-CAW (PVC-U)
Density, g/cm^3, ISO 1183	1.520	1.500	1.440
Yield stress, MPa, DIN EN ISO 527	60	55	58
Service temperature range, °C	–40 to +95	–40 to +95	0 to +60
Elongation at break, %, DIN EN ISO 527	35	> 20	15
Tensile modulus of elasticity, MPa, DIN EN ISO 527	2400	2600	> 3000
Notched impact strength, kJ/m^2, DIN EN ISO 179	⩾ 7	>9	4

Project

SIMONA sponsors floating pontoons for first land-based trip around the globe

The international "Expedition Paris/New York-Transcontinental 2009" team will travel round the world in vehicles over land for the first time, in the tracks of migrating peoples, the aim being to promote carbon dioxide neutrality, the use of renewable energy, and energy efficiency.

One of the most daunting prospects of the expedition is crossing the Bering Strait, which involves navigating across open water. For this purpose, SIMONA has developed a float system designed to meet particularly demanding requirements.

The toughest challenge when designing the vehicle float system was that of combining maximum robustness with lightweight construction. SIMONA's engineers developed sheets made of SIMONA® PE-HWU, a material which meets precisely those demands.

SIMONA® PE-HWU has excellent weather resistance and has proved ideal for many different applications in a service temperature range from –50 °C to +80 °C.

SIMONA is fully committed to promoting the guiding principles behind this transcontinental expedition. Environmental protection and sustainable use of resources are important corporate objectives of SIMONA. Our products have been free from lead and cadmium for many decades, which makes us pioneers within our industry. We recover well over 95 % of our waste and return it to the production cycle. In addition, our products, e.g. in the automotive industry, help to reduce weight and hence scale back emissions.

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REACh Regulation at SIMONA

The new European chemicals regulation, REACh (Registration, Evaluation, Authorisation and Restriction of Chemicals), came into force on 1 July 2007.

SIMONA's portfolio comprises semi-finished products, pipes and fittings which are solely made of polymer materials and as such are not subject to the REACh Regulation (1907/2006/EC). The regulation applies to chemicals and preparations; polymers are explicitly excluded. There are no plans to remove products from the SIMONA range because of REACh. If the availability of individual raw materials is limited by REACh, REACh-compliant alternatives will be used.

As far as we are aware, it is not necessary to take into consideration the various fields of application in which our products are used because as a manufacturer of semi-finished products we are unable to register our products. On the other hand, we have to ensure that our raw material suppliers take our field of application into consideration (manufacture of semi-finished plastics, finished parts, pipes and fittings by means of extrusion and pressing) when registering the raw materials.

SIMONA® products do not contain any substances in concentrations in excess of 0.1 % (w/w) which are included on the Candidate List of Substances of Very High Concern, SVHC) issued by ECHA.

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