SIMONA.report

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A thermoplastic with many qualities

Polyvinyl chloride (PVC)

PVC – or polyvinyl chloride – is now more than 100 years old. German chemist Fritz Klatte was granted the patent for it on 4 July 1913. In terms of volume, PVC is the third most important thermoplastic material worldwide after polyethylene and polypropylene.

In 2009, worldwide consumption was around 32.5 million metric tons, of which 23 % (7.4 million metric tons) was used in Europe. The forecast for 2015 is 43.6 million metric tons, equivalent to a mean annual growth rate of 5 %. *(Source: Plastics Europe)*

At around 60 %, the construction industry is by far the largest consumer of PVC, with window/structural profiles and pipes accounting for 24 % and 28 % respectively. In building applications, the excellent durability and fire resistant properties of PVC come to the fore: thanks to its high chloride content, PVC contains only around half as much energy as polyolefins, i. e. in the event of a fire it releases only half the thermal energy. Together, PVC sheets and rigid films account for almost 11 % of global demand. *(Source: Plastics Europe)*

PVC sheets are classified according to their mechanical properties and subdivided into different groups. At an international level, these classifications are defined in ISO 11833, while ASTM D 1784 is applicable predominantly to the US market. The five groups defined in ISO 11833 are as follows:

- Group 1: General-purpose grade
- Group 2: Transparent grade
- Group 3: High-modulus grade
- Group 4: High-impact grade
- Group 5: Heat-resistant grade

SIMONA manufactures products from all the above categories using the PVC materials available to it. SIMONA® PVC-CAW covers the general-purpose range (Group 1), although some product properties far exceed the requirements of the standard. SIMONA® PVC-GLAS corresponds to Group 2, transparent, and SIMONA® PVC-MZ-COLOR is a high-impact strength PVC in accordance with Group 4. The high-modulus (Group 3) and heat-resistant (Group 5) grades can be achieved as required by making adjustments to the properties.

Product group SIMONA® PVC rigid

PVC production at SIMONA

There is scarcely another thermoplastic material whose properties can be varied as widely as PVC: from rubberlike to highly rigid or foamed in various densities. Operating its own blending shop, SIMONA has the flexibility to apply its extensive know-how in formulas to meet customer specifications for new or customised PVC products. For around 20 years, SIMONA has been producing PVC without lead and cadmium and generally does not use plasticisers in its PVC products.

Unlike the polyolefins PE and PP (and almost all other thermoplastics), pure PVC (raw PVC) cannot be processed without various additives. On the one hand this means that it is easier to process, on the other properties such as impact strength, rigidity, etc. can be specifically added.

Your contact

Dr. Wolfgang Frings
Head of Research and Development

Wolfgang Frings has been at SIMONA AG for over ten years. He qualified as a chemist at RWTH Aachen and then completed his doctorate on the topic of reactive extrusion at the university's Institute of Plastics Processing.

Mr. Frings then spent almost ten years in various roles at HT Troplast AG in Troisdorf, where his last position was as Head of Material Development Plastic Window Profiles.

In 2003 he joined SIMONA AG. He was initially in charge of material development PVC and now heads the R&D department.

Phone: +49 (0) 67 52 14-381
E-mail: wolfgang.frings@simona.de

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Our in-house PVC blending lab allows us to develop new material properties

Before it is processed PVC therefore undergoes an additional hot/cold mixing step in SIMONA's own PVC blending lab, which has an annual capacity of around 50,000 metric tons of PVC mix. Here, the individual constituents of the wide range of different PVC formulas are thoroughly mixed and then transferred via intermediate holding bins for processing into sheets, solid rods and welding rods. In addition to the raw PVC as main ingredient, a PVC formula can contain more than 20 other components. By introducing new mixing and dosing methods we have managed to develop products with new compositions in the last two years and thus exploit new areas of application.

Compact, foamed, coloured: PVC varieties that meet your needs

Alongside the above-mentioned compact PVC types (Groups 1 to 5) with densities of 1.37 to 1.46 g/cm³, foamed PVC also plays a significant role. It offers a density range of 0.46 to 0.75 g/cm³, although there is a distinct trend towards using increasingly lighter materials with a focus on energy and material efficiency.

At SIMONA, this light material group is covered by the SIMOPOR product family. The most important product in the SIMOPOR range is SIMOPOR-LIGHT, which has a density in the range of 0.52 to 0.55 g/cm³. SIMOPOR-ULTRALIGHT is the lightest product at 0.46 g/cm³. These products come in white as standard. For coloured foam sheets the SIMOPOR-COLOR range offers the standard colours red, blue, yellow, green, grey and black. Other colours can be provided from a specific minimum volume. SIMOPOR-COLOR has a density of 0.65 g/cm³.

The main areas of application for foamed PVC are in advertising, display and exhibition stand design. The products are often printed in colour, increasingly using digital printing processes. SIMONA-DIGITAL has been developed to meet the special requirements of the digital printing process. Thanks to its special colour settings, this product provides especially rich colours in digital printing. An additional UV protection prevents the yellowing that results from the UV lamps used in UV curing systems.

SIMONA® COPLAST-AS is suitable for applications where a smooth, glossy finish is required instead of the semi-matt finish typical of PVC free foam. It combines a lightly foamed core with compact, smooth and hard outer skins. SIMONA offers two standard products in this range: SIMONA® COPLAST-AS consists of high-quality outer skins and a white foam core, while SIMONA® COPLAST-AS-X has a grey foam core. Because the sheets are coextruded, i.e. using a binary nozzle, the outer skins can have different colours. They can also feature different material properties, e. g. COPLAST-AR-X with anti-slip surface on one side. By comparison, integral foam produced using the Celuka process comes in only one material, and therefore only one colour and one material characteristic are possible.

Despite its impressive age, PVC remains a contemporary material that shapes our day-to-day lives due to its wide range of applications.

▶ SIMONA PVC Product Range

Dr. Wolfgang Frings
Head of Research and Development

Exhibition stand made of PVC foam sheets

From natural products to high-quality plastic solutions

SIMOGREEN – Bio-based plastics by SIMONA

Growing environmental awareness is also making its mark on plastics markets and is intensifying the development projects undertaken by companies. SIMONA, too, is responding to the growing interest on the part of customers and markets by processing and manufacturing bioplastics.

At the K 2013 plastics industry trade fair held last autumn in Düsseldorf, SIMONA AG showcased bio-based polymers for the first time.

Bio-based polymers are not new, however, but are among the oldest plastic materials in the world. As far back as 1887, a plastic produced from cellulose was used to make toys, office supplies, spectacle frames, etc. However, the improved cost efficiency of petroleum-based plastics supplanted bio-based products for a very long time. Nowadays, bio-based polymers are more in demand than ever thanks to concerns about environmental protection and sustainability. At present, they account for around 0.1 % of global plastics production, but with annual growth rates of 30 % they represent the fastest-growing product group in this market.

Positive carbon footprint extends areas of application

Most plastics are based on petroleum, a raw material that is becoming increasingly scarce. In addition, as a fossil fuel, oil has a greater impact on the carbon footprint than renewable resources, as a comparison of the two CO_2 loops shows (Fig. 1).

Bioplastics are very important wherever there is a need to manufacture products with a relatively short life cycle or for applications where a better carbon footprint will afford significant competitive advantages compared with the conventional product. Such applications are found, for example, in areas like exhibition stand and display design, automotive, garden and landscaping, medical technology, orthopaedics, transport technology, thermoforming and last but not least the food processing industry.

In particular, new forms of biopolymers like PLA (polyactide) have long since reached a development stage that provides a good basis for commercial applications. The growth rates for such products confirm this trend, which is set to continue due to concerns about sustainability.

Future prospects for bio-based polymers from SIMONA

Generally, plastics based on renewable raw materials help to secure future energy supplies because they are very much capable of replacing petroleum-based plastics. The manufacture of petrochemical polymers will become increasingly expensive due to the shortage of oil, which is why shifting to bio-based polymers is also important from an economic perspective.

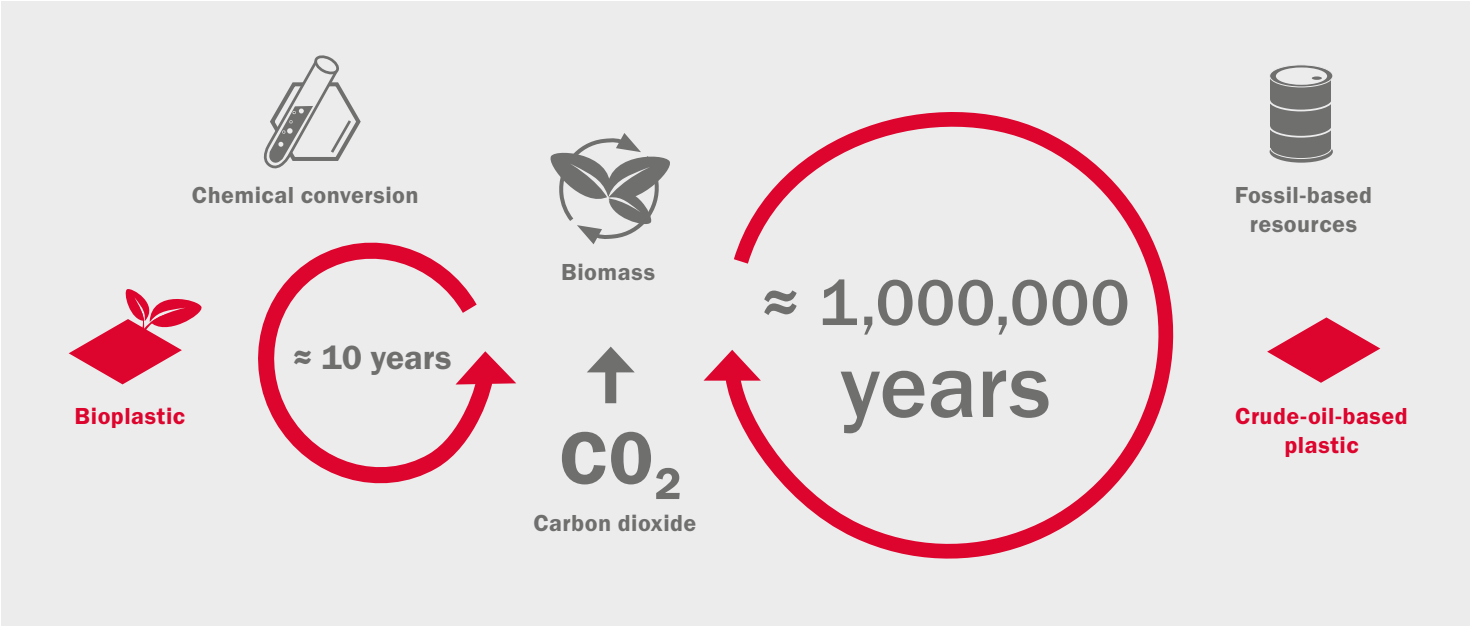

Fig. 1: *CO_2 loops compared*

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Bioplastics are therefore very much in demand as an alternative to conventional polymers, also with a view to ensuring the future use of plastic as a material.

In SIMOGREEN, SIMONA has established a new product range for the biopolymers PLA, PA 6.10, Bio-PE and ECOZEN® showcased at K 2013 and is now set to enter the sampling phase with customers. Initial thermoforming testing on specific types of PLA has already demonstrated the excellent processing capabilities of this group of plastics.

SIMONA is building a technology centre to continue its research in this area. The centre will enhance SIMONA's innovative capabilities and thus create more scope for additional development projects and new process techniques. As a result, progress will also be made with innovations in bio-based polymers. The proximity between production and development will promote the exchange of professional expertise and accelerate our product development processes.

Marco Stallmann

Product Manager BU Industry, Advertising & Structural Engineering

Plastics expertise

Bioplastics – What are they?

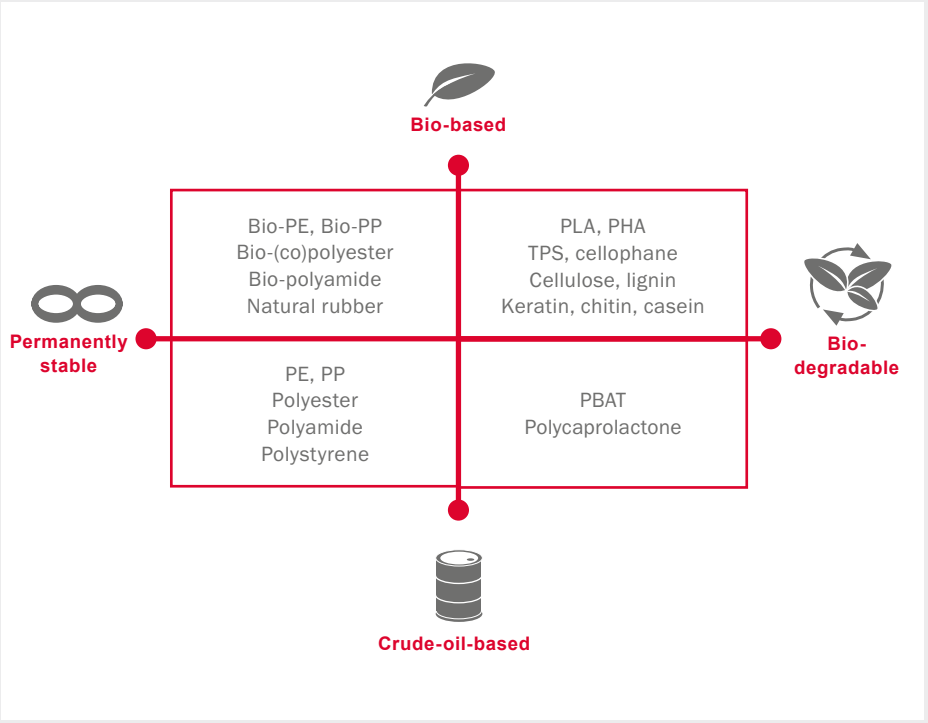

Fig. 2: *Degradability of bio-based plastics*

The term "bioplastic" is not clearly defined. Generally, polymers are called bioplastics if they are largely produced from renewable raw materials.

In this context, a distinction is made on the one hand between plastics based 100 % on renewable resources, e. g. TPS (thermoplastic starch), PLA (polyactide) or Bio-PE, which are made from starch, sugar or plant residue. On the other hand, there are also polymers that are not based completely on renewable resources but only to a large extent, for example PA 6.10 or ECOZEN® (bio-based PETG).

A further distinction is made between durable and biodegradable plastics (Fig. 2).

Bio-based polymers are not only sustainable because they are recovered from organic substances and therefore consist of renewable resources; they also exhibit an excellent carbon footprint. The CO_2 occurring in the production of the polymers can largely be converted to oxygen during the plant growth of the raw materials. Typical examples of this group are PLA, Bio-PE, ECOZEN® and cellulose-acetate.

Biologically degradable plastics are those that disintegrate automatically in a biological decomposition process without further intervention. Having said that, it is not yet possible to say how long this disintegration process takes. However, DIN EN 13432 and ASTM D 6400 do stipulate the conditions to be met by a plastic to be called "compostable". Due to their sheet thickness alone, the semi-finished products manufactured by SIMONA are not generally compostable without mechanical comminution, even though they are made from raw materials that are theoretically compostable.

Dr. Uwe Gleiter

Head of Applications Technology/TSC

Nominal diameter-matched connections to valves and fittings

New SIMONA® PE 100 Special Flange Connections

From left to right: Slotted holes allow the flange to be rotated when connecting to the valve and so make it easier to align on site; the special flange connection enables a nominal diameter-matched connection to valves

SIMONA has introduced a refinement in the area of special flange connections: PE 100 special flange connections with PP/steel backing flanges. This means that nominal diameter-matched flanged connections with durable corrosion protection are available for the first time. They were modelled on the standard loose flanges with glass-fibre-reinforced polypropylene coating proven in use among customers for decades. This combination guarantees full corrosion protection and optimum protection against mechanical surface loads.

Conventional special flanges either use a galvanised or Rilsan coated steel flange. The lack of durable corrosion protection in galvanised steel is well known. This is why most utilities preclude its use for drinking water applications. Although Rilsan coating is admissible for drinking water use, it does have several drawbacks in respect of mechanical effects. Even slight knocks during transport and assembly can cause the coating to quickly peel off. Due to the manufacturing process, the coating is not uniformly thick, with the area around the holes particularly susceptible. The thinner coating in this area can be scratched off very easily especially when tightening the screws. Corrosion damages the strength of steel and so impairs its function.

With its new PP/steel flange SIMONA has created an absolutely impact-resistant product with a uniform coating. The flanges are injection-moulded and therefore provide the benefits of high quality and low manufacturing costs.

Pressure pipe applications usually require metal fittings. Conventional flange connections with loose flange and stub flange always necessitate the use of fittings with the same borehole pattern as the loose flange.

However, this causes an offset of the inner pipe wall (Fig. 3), which can result in sediment deposits and turbulence.

The SIMONA® special flange allows a nominal diameter-matched connection. Smaller fittings with matching borehole patterns are used, reducing costs considerably. This also produces a perfect transition without offset (Fig. 4), flow problems or deposits.

Clemens Timm
Product Manager Fittings

Comparison of standard and special flange connection (OD) with corresponding valve/fitting connection (DN)

Standard flange connection (Stub flange + loose flange)		Special flange connection	
Stub flange OD	**Valve DN**	**Special flange OD**	**Valve DN**
250	250	250	200
315	300	315	250
355	350	355	300
400	400	400	350
450	500	450	400
560	600	560	500

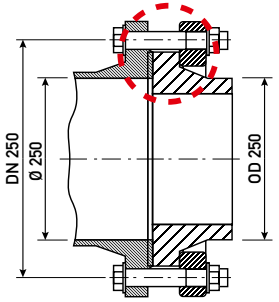

Fig. 3: *Flange connection with offset of inner pipe wall (red marking) and DN 250 valve*

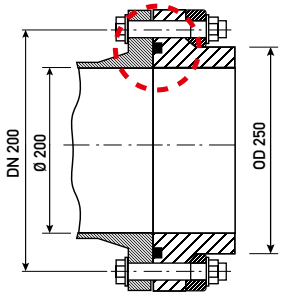

Fig. 4: *Special flange connection with no offset of inner pipe wall (red marking) and small DN 200 valve*

SIMONA® products for the very best in chemical resistance

High-purity systems for semiconductor production

From left to right: automated wet-processing unit; interior view of the chemical supply system; distribution systems for equipment ports

atp GmbH specialises in end-to-end concepts developed for applications in the semiconductor industry, including the production of high-purity media distribution and disposal systems, as well as plant and process equipment. Sheets, pipes and fittings from the product groups SIMONA® PP white, SIMONA® PVC-GLAS, SIMONA® PVDF and SIMONA® PP-H AlphaPlus® were used for the production of two wet-processing units and ten chemical supply systems.

Initial situation

With the aim of expanding its production and research capacity, Vishay Siliconix Itzehoe GmbH was looking to secure the services of an experienced and proficient supplier to provide support during the planning stage and in the production of high-purity equipment systems for semiconductor production.

This technically and chemically demanding field of application meant that extremely stringent requirements were specified in terms of the purity and reliability of the materials to be used.

Task

The materials used had to comply with specific mechanical and chemical standards for the production of the various system sectors:

- Superior chemical resistance to high-purity acids and alkalis
- High resistance to stress cracking and corrosion
- Excellent processing properties
- High rigidity
- High surface quality
- Purity specifications
- UV stability

Solution

Within the area of body production, the high surface quality of the sheets made of SIMONA® PP white meant that these components met the clean-room conditions essential for semiconductor technology; they also impressed due to their high levels of rigidity and excellent processing properties. The pipes and fittings made of SIMONA® PVDF and SIMONA® PP-H AlphaPlus® provided a key advantage when used for media-transporting components thanks to their high levels of chemical resistance and reliable corrosion resistance. The transparent sheets made of SIMONA® PVC-GLAS were the perfect solution for applications involving inspection and operational monitoring. The high quality of the materials used and the possibility of procuring all necessary materials for the various components from a single source – i. e. from SIMONA – meant that the units could be produced quickly and efficiently.

The project at a glance

Project

Two automated wet-processing units (L x W x H = 3.40 x 1.40 x 2.20 m) as well as ten chemical supply systems with piping and distributors (L x W x H = 2.40 x 1.50 x 2.10 m)

Products used

Bodies:
- SIMONA® PP white Sheets

Doors:
- SIMONA® PVC-GLAS Sheets

Media-transporting components:
- SIMONA® PVDF Sheets, Pipes and Fittings
- SIMONA® PP-H AlphaPlus® Pipes and Fittings

Properties SIMONA® PP white 9002
- Permanent-heat stability
- High chemical resistance
- High corrosion resistance
- High surface quality
- High rigidity even at high temperatures
- UV stability

Imprint

SIMONA AG
Teichweg 16, 55606 Kirn, Germany

Responsible for content
Eric Schönel
Phone: +49 (0) 67 52 14-997
E-Mail: eric.schoenel@simona.de

Editor-in-chief of this edition
Pia Leonard

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