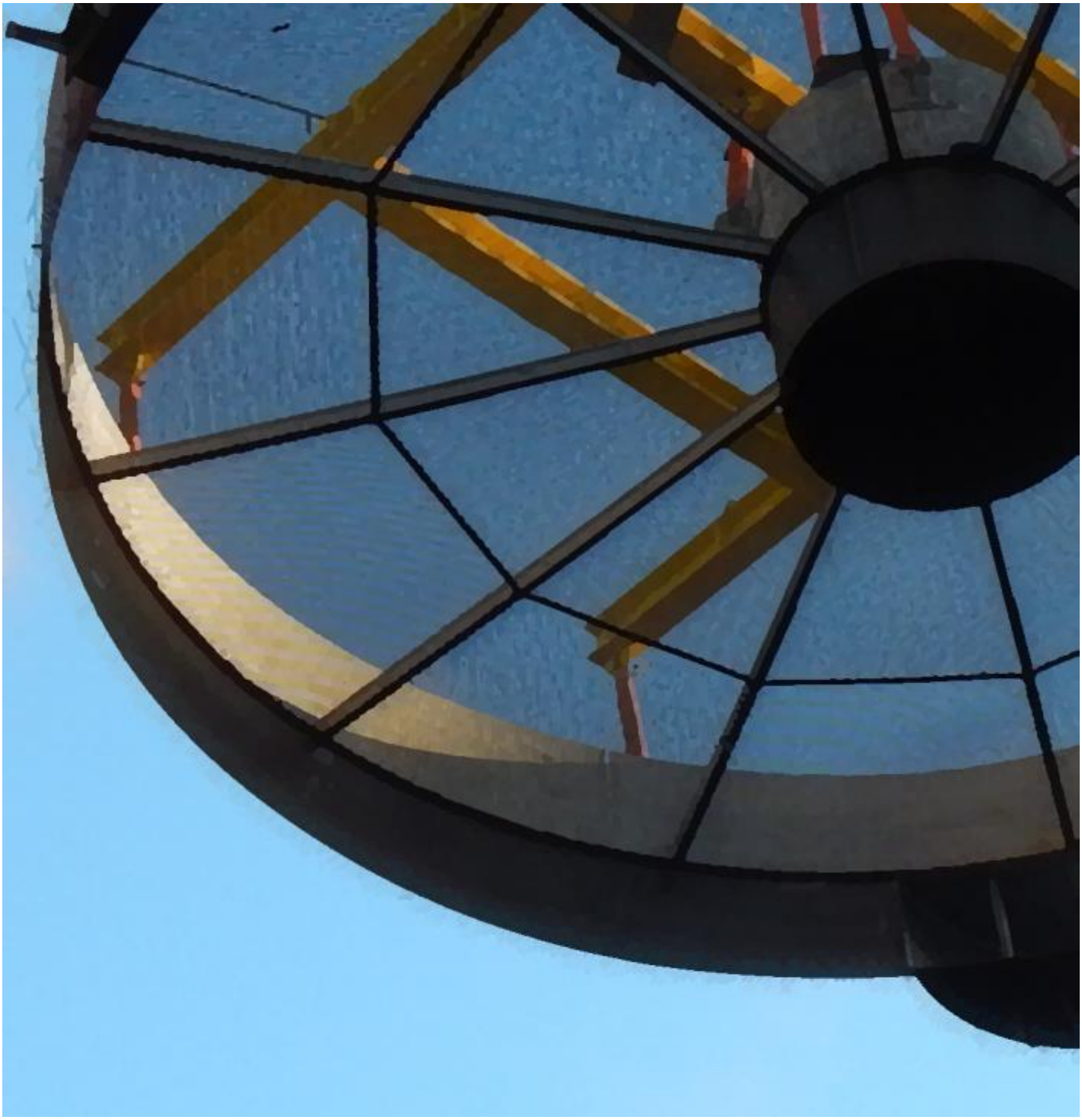

HUGO PETERSEN
Verfahrenstechnischer Anlagenbau

PETERSEN-CONVERTER-DESIGN
The long-living Heart

www.hugo-petersen.de

The company

HUGO PETERSEN GmbH located in Wiesbaden, origins from the renowned engineering company Hugo Petersen, founded in 1906, in Berlin. HUGO PETERSEN is part of the Chemieanlagenbau Chemnitz (CAC) group and as such, can provide full support and security for the development and implementation of small to large scale installations.

Initially, using the expertise gained in the classical production of sulphuric acid, from off-gases generated in the refining of metallurgical ores, the company HUGO PETERSEN specialized in the field of manufacture of sulphuric acid, hydrochloric acid and gas cleaning.

Figure 1:
Hugo Petersen 1906

HUGO PETERSEN has more than 110 years of experience in the design and operation of sulphuric acid plants and their equipment. Today, HUGO PETERSEN offers a vast range of technology to this industry. The design, whilst incorporating HUGO PETERSEN's extensive experience, has been developed and optimised through a comprehensive research program, conducted using HUGO PETERSEN´S own pilot plant facilities. This, together with its 50 years know-how in the design and operation of gas cleaning equipment and plants processes, offers further advantages through the experience from both worlds.

The initial sulphuric acid tower technology invented by Mr. Hugo Petersen required since these days systems for irrigation of acids in the towers. Thus, from the very beginning the company was designing its own irrigation distributors.

About 50 well trained process technologists and engineers contribute their knowledge and expertise in the fields of mechanical and electronic engineering, as well as material science, to their design work.

Accurate Planning - the basis for our work

The scope of the tender, for a custom designed plant, is solely defined by the task, operating requirements and the requirements of our customer.

he thorough evaluation of the ecological and economic factors ensures the best plant specific solution. Proven technology, combined with HUGO PETERSEN´s site specific developments, leads to the construction of a plant suitable for the respective application.

HUGO PETERSEN has installed more than 400 turnkey plants and plant components for the manufacture of sulphuric acid, oleum and SO_2/SO_3.

Every plant is unique and all plant components have to be finely adjusted. Hence, it is of great advantage when a single company designs all components.

SO_2/SO_3-Converter the Heart for Long-Life-Operation

Innovation for our Clients

HUGO PETERSEN as one of the companies with most experience in sulphuric acid technology offers a stainless-steel converters coping with today's requirements like:

- long-life time due to low stress-design
- high material liability first supplier introduced AISI321-material family for converters
- combining membrane / grid technology for most advantageous performance

Figure 2: 3D-Modell of a Grembane-Converter

In Detail:

HUGO PETERSEN has introduced in 2003 a new patented Converter-Design with reduced mechanical stresses on the casing and/or on the central pipe of a fully welded tray of a contact vessel by avoiding the radial forces and radial stresses without departing from the membrane tray design on the one hand, and on the other hand to keep the overall height of the contact vessel as small as possible, despite retaining the design advantages of trays frames.

The fully welded embodiment allows even easy implementation in revamp / expansion projects and of course in greenfield plants as well..

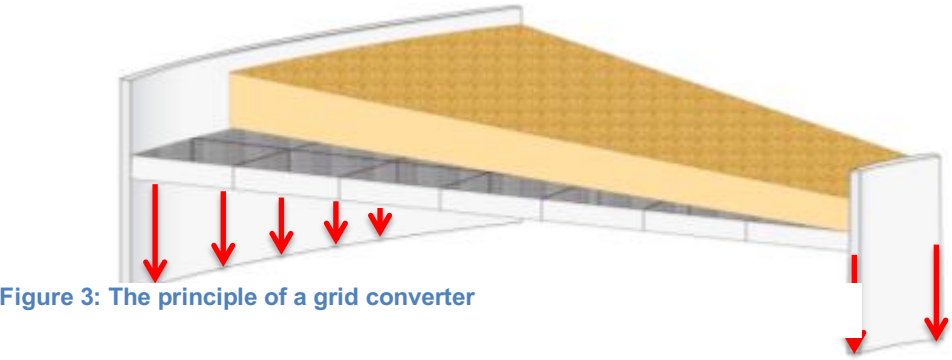

Figure 3: The principle of a grid converter

The classical grid converter with its sturdy trays and support structure has some pros but some severe cons.

This construction principle was one of the first designs for tray converters.

But is today totally outdated!

✓ **Vertical loads only**

✓ **Operation in the range of elastic loads and tensions**

✓ **Relatively simple structural calculation**

✗ **Supporting grid occupies vertical space (200 to 400mm each bed/mass)**

✗ **Greater weight**

✗ **Higher cost of materials**

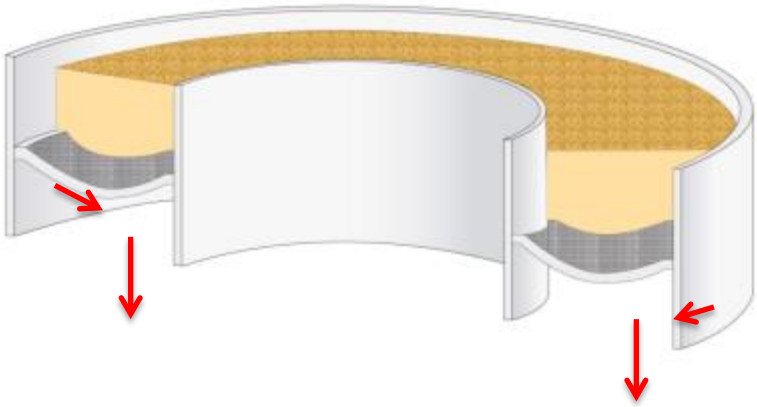

Figure 4: The principle of a membrane converter

The known light membrane types are most likely constructed in the here shown manner. The design derives from the 1980's and is in use by most of our competitors.

This construction principle has some enormous advantageous and of course still some defects, as shown hereafter

- ✓ **Lower weight**
- ✓ **Lower height**
- ✗ **Complex Structural Calculation**
- ✗ **Reforcement of shell necessary**

as shown below

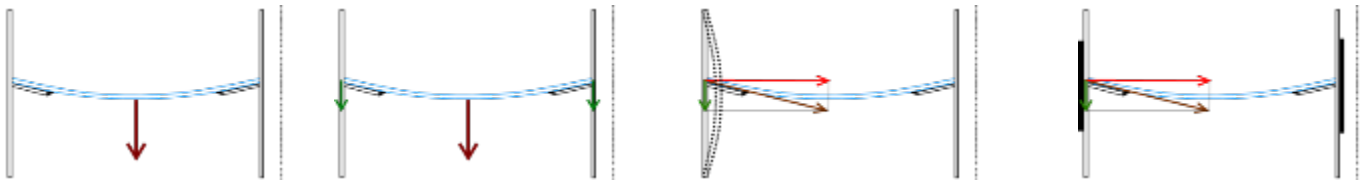

Figure 5: Forces in a classical membrane converter!

The Innovation

HUGO PETERSEN combined the advantages of grid converters with membrane converters by avoiding the disadvantageous!

HUGO PETERSEN achieved these objects in a surprisingly simple way by providing segment-based converter forming a membrane bottom for a contact vessel, in particular for the oxidation of SO2 to SO3. While the segments are formed by radially orientated support beams.

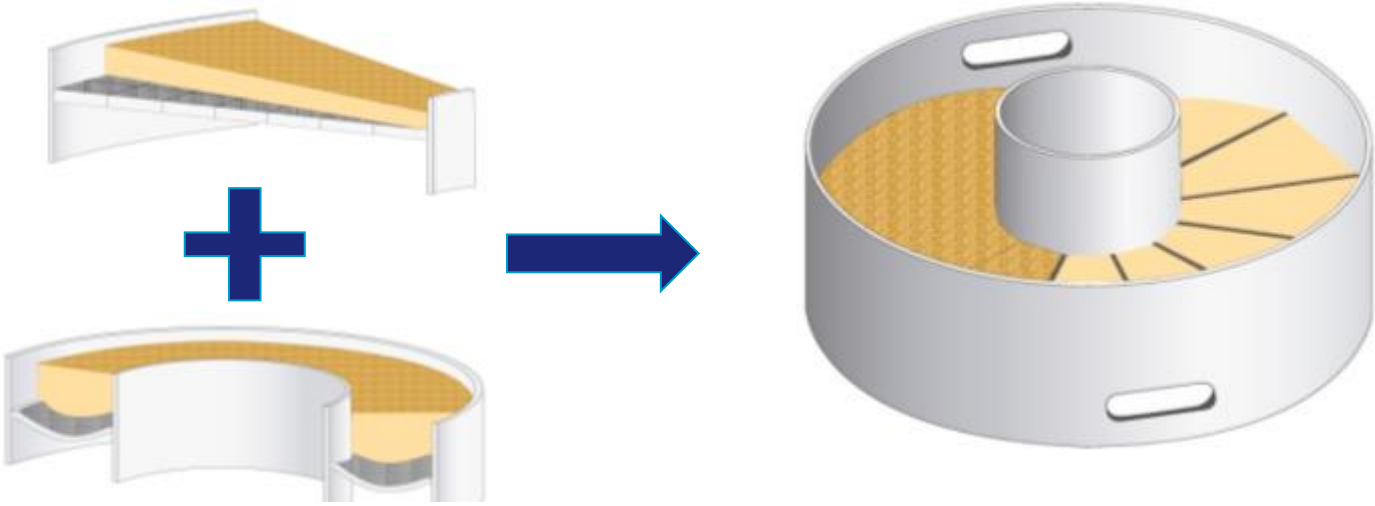

Figure 6: Combination of Grid and Membrane Converter leads to the PETERSEN-Grembrane Converter

- ✓ **Radial symetric**
- ✓ **Circunferencial forces are nullifying**
- ✓ **Elimination of risk of buckling of shell**
- ✓ **Structural Modelation (FEM) reduced tothe calculation of a few segments**

This makes it possible to build a membrane bottom or a so-called "tray" in a manner so that forces acting on the membrane bottom during operation do not load the surface of the membrane bottom on which the catalyst is supported, neither circumferentially with respect to the longitudinal axis nor radially with respect to the longitudinal axis. By avoiding radial forces and stresses in the configuration of a contact vessel, it is possible to save material and thus weight and costs.

Due to the segmental design of the tray plate, the circumferentially directed tensile stresses cancel each other out with the tensile stresses resulting from the adjacent segments during operation. In this way, it is ensured in a structurally simple manner that there are substantially no circumferential tensile stresses.

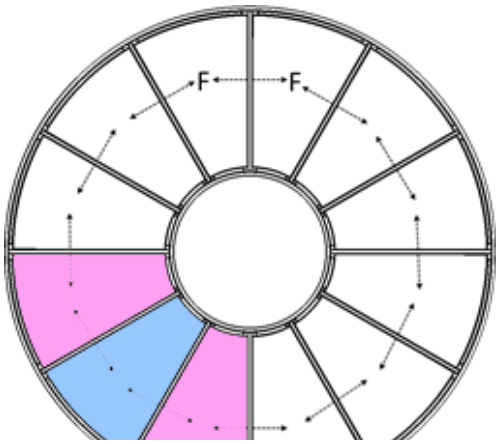

Figure 7: Elimination of Forces in a Grembrane-Converter

Material

Introducing as the first one the AISI321-Material family for converter construction completed the quality boost of the Grembrane-Converter Design for better corrosion resistance and higher design temperature

Figure 8: Segment of a Grembrane Converter in the worksh

In the context of the invention, the contact vessel is advantageously designed for use in a temperature range of up to 650 °C and thus also allows using catalysts with a high efficiency range above 600 °C, such as special vanadium pentoxide catalysts.

Features like radial or lateral gas distribution are features that allows highest conversion and lowest pressure drop.

Converters are highly pre-fabricated in the workshop to guarantee high quality and low risk in the assembly at site

Figure 9: The segments on its way to site

Figure 10: Tray element under assembly

The same segment moved in the converter hall for assembly

The picture shown hereafter is the related tray in the process of filling

The ceramics at the grid and the catalyst on top.

Figure 11: Catalyst gets in

The space/height saving construction allows converters with comfortable access even in quite limit space arrangements.

A comparison of the before mentioned systems are shown in the following table:

Type of System	Buckling	Uncontrolled stresses	Risk of Corrosion	Low Weight	Low Height	Ranking
GRID-CONVERTER	**+ +**	**+ +**	**+ +**	**-**	**O**	**3**
MEMBRANE-CONVERTER	**-**	**+**	**+ +**	**+ +**	**+ +**	**2**
GREMBRANE-CONVERTER	**+ +-**	**+ +**	**+ +**	**+ +**	**+ +**	**1**

Table 1: Comparison of Converter Designs

LEGEND:		
	+ +	excellent
	+	good
	O	satisfying
	-	insufficient
	- -	very insufficient

The before mentioned facts demonstrate again the first class design of HUGO PETERSEN's Technology.

The Detail makes the Difference!

HUGO PETERSEN
Verfahrenstechnischer Anlagenbau

Selected References:

Figure 12: 1,500 tpd Mh Sulphur Burning Plant

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Figure 14: 400 tpd Mh Mo-Roasting Plant

Figure 15: 1,800 tpd Mh Sulphur Burning Plant

Figure 16: 620 tpd Mh Sulphur-Burning Plant as Revamp

Figure 17: 1,000 tpd Mh Pyrite/Sulphur-Burning Plant

HUGO PETERSEN
Verfahrenstechnischer Anlagenbau

HUGO PETERSEN GmbH
Rheingaustr. 190-196, Geb. K330
65203 Wiesbaden
Deutschland

Tel.: +49-611-9627820 Fax: +49-611-962 9099
E-Mail: contact@hugo-petersen.de Web: www.hugo-petersen.de

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