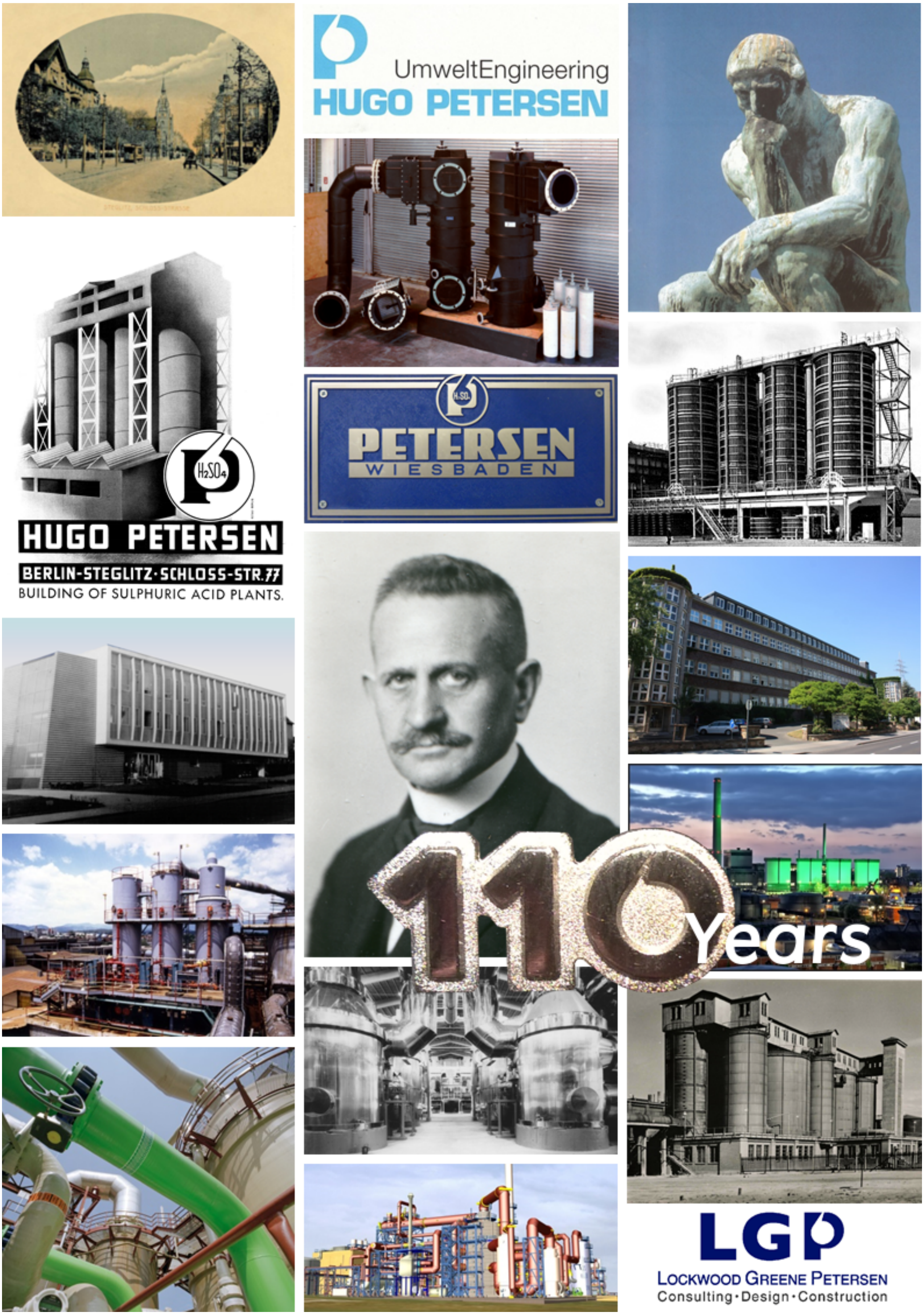

UmweltEngineering
HUGO PETERSEN
HUGO PETERSEN
BERLIN-STEGLITZ·SCHLOSS-STR.77
BUILDING OF SULPHURIC ACID PLANTS.
PETERSEN
WIESBADEN
110 Years
LGP
Lockwood Greene Petersen
Consulting·Design·Construction

110 Years

Hugo Petersen

1906 - 2016

A Commemorative History on the Occasion of

the 110th Anniversary of

the Founding of

Hugo Petersen

in 1906

researched and written

by

Mr. Axel Schulze

Wiesbaden, 2016

FOREWORD

Dear reader,

I put together this historical outline, not just to highlight the technological achievements of Hugo Petersen, as a scientist and engineer, but also to reflect on the multifaceted nature of his deeds.

When viewed from a distance, his life was filled with a creative spirit, in thought and deed.

Whether it was in his early literary works and plays, his pioneering technological achievements, or his musings in political philosophy, Hugo Petersen was a man of socially motivated change with the conviction that the current situation was always in need of review.

He remained true to the motto, "Perfect is the enemy of the good", and his son, Dr. Gerd Petersen, always took this attitude to heart. Some ideas had such ground-breaking effects, that these are still applicable today. HUGO PETERSEN, as a company, views the responsibility, thinking and actions of its founder, as their guiding light, to carry them forwards, into the future.

I hope that this review will enthral you, just as I was enthralled, whilst collecting these facts.

The following text informs you of the many setbacks and renewed successes, in the 110 year history of HUGO PETERSEN, without ever forgetting its partners and customers, in this period.

At this point, I would also like to thank Uwe Petersen, the grandchild of Hugo Petersen and nephew of Dr. Gerd Petersen, for his enthusiastic support, as well as for the many photos and items of information, about the lives of his grandfather and uncle, that he contributed to this project.

I would also like to thank Mr. Christoph Knüppel, who reviewed the works of literature and political philosophy, as part of his doctoral thesis and made these available to me.

For this, my very special thanks.

Axel Schulze

Wiesbaden, September 2016

HUGO PETERSEN, Pioneer and Visionary in Technology and Society

The development and construction of sulphuric acid facilities was a pioneering achievement by Hugo Petersen (1863-1957), who founded his company, as a chemist and engineer, in Berlin-Steglitz in 1906.

Through his ideas, Hugo Petersen comprehensively revolutionised sulphuric acid technology.

This process began over 150 years ago, with the birth of Hugo Petersen, in Mecklenburg.

Hugo Petersen, born 14 December 1863, in Klein Schwiesow (Mecklenburg), was the son of Carl Albrecht Petersen and Johanna Laura Lisette Raven.

Carl Petersen (1835-1909) was an agriculturalist, who became known as the "patron of German agriculture".

Illustration 1: Birthplace in Klein Schwiesow

Hugo Petersen attended grammar school at Rendsburg, where he discovered his passion for social dramas and chemistry. During this time, he wrote a tragedy called Herzog Gothland (first published in 1900), which he closely based on Christian Dietrich Grabbe's, "Herzog Theodor von Gothland". Grabbe's tragedy is amongst the most original, but also one of the most gloomy debuts of a German dramatist. Petersen's penchant for lyricism also laid the foundation for his drama, "Kulturfiende", some years later. After leaving grammar school, Hugo Petersen studied chemistry at the Royal Bavarian Ludwig Maximilian University of Munich. (Ludwig-Maximilians-Universität, 1889)

Around 1889/1890, he became a chemist and later the superintendent of the "Lazy" refinery, which belonged to the mining industrialist, Hugo Graf Henckel von Donnersmarck in Radzionków (Silesia).

For the first time he came in touch with the industrial production of sulphuric acid as manager of the zinc roasters, which processed sphalerite and generating SO2 waste gases, which were converted into sulphuric acid.

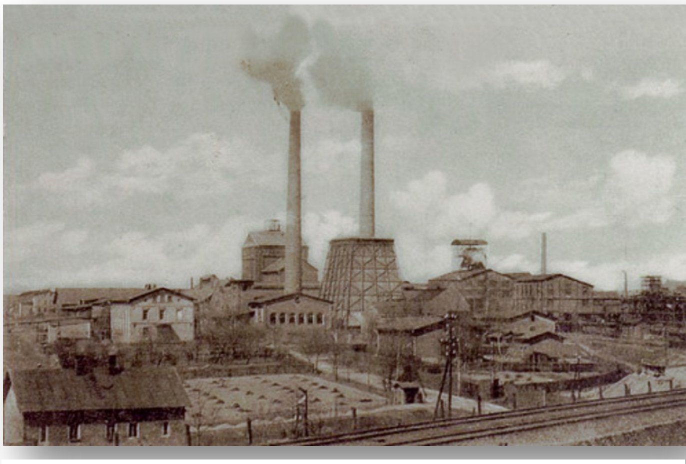


Illustration 2: Radzionków Lazy Metal-Refinery in Bytom (Beuthen) 1900

The usual method for producing sulphuric acid was the well-known lead chamber process,

a process which consisted largely of Glover towers, the lead chamber itself and the Gay-Lussac towers.

Note:

Gay-Lussac (1827) and Glover (1859) developed methods and devices for recovering nitrogen oxides and returning them to the lead chamber for re-use. The combination of the Gay-Lussac and Glover tower made it possible to produce sulphuric acid in a continuous flow.

He was fascinated, but at the same time disappointed by the inefficiency of the process, specifically, the high loss of NOx with fluctuating SO_2 gases were an economic problem. Naturally, they were an ecological problem as well, but at this time little importance was assigned to that.

By establishing three towers after the last chamber of a lead chamber system, so his idea, he could produce sulphuric acid by means of an acid which absorbs nitric oxides exactly as easily as it releases it. That way, nitric acid losses could be reduced and consequently, emissions of nitric oxides would be reduced. (Waeser, 1930) (Waeser, 1930)

By 1902, Hugo Petersen constructed a tower system consisting of 3 internally irrigated towers, taking waste gases containing 2 vol% SO_2 from a contact system, together with the 0.5 vol% discharge from the final chamber of a chamber system, from the Lazarus smeltery. He set out the theoretical underpinnings of a tower system, for normal gases, in a patent application from 1905. However, this idea was not implemented until 1923, with the development of the rotary pump. (Petersen, 1948).

This way of combining contact and tower systems was covered in relevant literature, many times, in later years. (Fattinger, 1986)


Klasse 75 a.

KAIS. KÖNIGL. PATENTAMT.

Ausgegeben am 25. Oktober 1909.

Österreichische

PATENTSCHRIFT Nr. 39350.

HUGO PETERSEN IN WILMERSDORF BEI BERLIN.

Verfahren zur Verhinderung der Denitrierwirkung im Gay-Lussac-Absorptionsapparat.

Amongst the large number of patents awarded to Petersen, for his developments in ramping up and improving lead chamber facilities, it was the "chamber regulator", patent DRP 208 028, which achieved the widest distribution. This chamber regulator is an intermediate tower which is irrigated with strong nitrosylsulphuric acid at 55-58° Bé, located between the last chamber and the first Gay Lussac. It was built in 1905, in the Lazarus smeltery, in Upper Silesia and was originally intended to serve only to retain the last remnants of SO_2 and to compensate for the fluctuations of the chamber's operation with a changing gas supply (Patent from November 29, 1905 "A method for preventing the denitration in Gay Lussac-absorption apparatus"); thus, the chamber regulator acts as a production tower.

On 16th December 1906, Petersen patented another method for improving the chamber's function by adding a tower (DRP 219 829, EP 27 738/1906), which was placed in front of the first chamber and also irrigated with nitrous acid at 54 – 58° Bé. While the chamber regulator had its own irrigation, the nitrogen-bearing acid discharge of the pre-tower in DRP 219 829 went to a Gay-Lussac tower for re-enrichment. By retaining the normal outer ring of Glover and Gay-Lussac towers, the foretower, which proved itself as an acid enricher here as well, formed a special inner ring with the Gay-Lussac tower.

With the introduction of these two towers, irrigated with nitrous gases at 54-58° Be, the groundwork for the development of tower systems was laid down.

On October the 6th, that very same year, 1906, he founded his company under the name, "Hugo Petersen – Engineering Office for the Chemical Industry". It was initially reliant on United Brickyards and Industry, in Berlin-Charlottenburg. A few years later, it was an independent company in Schloss St. 77, in Berlin-Steglitz.

Plants with the chamber regulator, would also soon be realised, when 1911 brought the first order from China, with the construction of a plant with an intensified chamber system using the Falding process in the Mansfeld copper smeltery, which went into operation in 1912.

The activities of Hugo Petersen, were strongly influenced by the turmoil which ensued, the outbreak of the first World War.

The first technologically driven war and one which showed the full extent of inhumanity, of which, humanity was capable. The chemical industry was one of the winners of the war and it made increasing military R & D, a priority;

Illustration 3: An intensive chamber system using the Falding process at the Mansfeld copper smeltery, 1912

Sulphuric acid was the chemical needed for explosives. The demand for an increase in production was great. Between 1914 and 1918, the total number of military and civilian casualties was over 38 million. There were more than 17 million dead and 21 million wounded. This war ranks amongst the deadliest conflicts in human history. But during this time, in 1916, Hugo Petersen received his first commission, for a complete sulphuric acid plant, at the Berlin gasworks.

By his own account, it was ultimately the catastrophe of the First World War and the decline of the empire that also provided the motivation Petersen needed to become a member of the Commission to Prepare for the Socialisation of Industry in the Independent Social Democratic Party of Germany (USPD) and Chair of the "Association of Socialist Technicians". He published the brochure, "The German Soviet Republic: a proposal for its constitution" (1919), in the press of Adolph Hoffmann, the chair of the Berlin Free Religious Congregation at the time, as well as the Prussian Culture minister. A little later, "The Conditions for the Dictatorship of the Proletariat: An exhortation to the workers and the middle class" (1920), appeared. A booklet on, "The technician in the new state", was also published, in 1919.

Illustration 4: Hugo Petersen's writings on the political development of Germany

In his writings, he explained that after the lost war and with Germany experiencing an economic, political and social catastrophe, the dictatorship of the proletariat, seemed to be the solution needed.

Hugo Petersen was active in the literary world until his death.


Illustration 5: Tower system at the Magyarovar copper smeltery, 1923

With the use of rotary pumps, to distribute large quantities of acid, it became technologically possible to complete the tower system. Under unfavourable operating conditions, the tower system at the Magyarovar copper smeltery, in Hungary, achieved an output of 40 t/24h of acid at 60° Bé (78%).

Plants soon followed, at the Unterweser Nordenham Metalworks in Germany, at Hoboken in Belgium, at the Mansfield "God's reward" smeltery and in Polevskoje in the Soviet Union. Even plants in Athens and Japan were to follow.

In 1932, Hugo Petersen wrote, "The Wake-Up Call", a lyrical exhortation to politicians and to the general public, especially the Jews, to renounce all established religions, seek reconciliation with France and the Soviet Union and to settle the dispute between the Nazis and the Communists.

Illustration 6: The Wake-Up Call, 1932

He saw this as the only way that peaceful coexistence was possible. As we all know, it fell on deaf ears.

Illustration 7: The World God, 1935

In 1935, he also wrote his own draft of a belief system, "The World God". A creed, a scripture, which pronounced a thoroughly modern, mystically influenced, but scientifically tenable concept of God, situated in a Christian pacifist tradition with no ethnic traits.

Dr.Gerd Petersen joined the company in 1923, at the age of 26. He had studied chemistry and brought new ideas to the company, which in time, he was to place his own mark on.

Illustration 8: Advertisment, 1939

His father had already begun the development of contact systems, beginning with the tube contact system. Special contact boiler designs, as Horde contacts, with indirect and direct temperature control for achieving the highest possible turnover, were implemented in complete sulphuric acid contact systems, based on pyrite, nonferrous metallurgical processes or elemental sulphur.

In 1938, the first simple catalysis, from HUGO PETERSEN, went into operation in Romania;

by the end of the decade, Hugo Petersen would have built 50 plants across the world.

The Second World War was yet another harsh disruption to the company's development.

In 1941, Dr.Gerd Petersen took over management of the company, while the founder made a gradual retirement.

From 1906 until 1944, HUGO PETERSEN was located in Berlin-Steglitz, until the building was destroyed by a direct bomb strike. After that, it moved to Möhrenbach, in Thuringia and remained there until October 1945. After the area was transferred, from its brief American occupation, into Russian hands, HUGO PETERSEN moved back to Berlin in October 1945 and remained there until the end of 1948, finding its final place, in Wiesbaden, in 1949.

The most important drawings and technical documents were kept safe through the chaos of war. Some workers were lost, and others were commandeered by the Russians.

In 1948, Dr. Gerd Petersen wrote a comprehensive lecture on "the theory of the NO method for sulphuric acid production", which became known around the world, for Applied Chemistry A / 60 1948 / No. 7/8


Theorie des NO-Verfahrens zur Schwefelsäureherstellung

Von Dr. GERD PETERSEN, Berlin-Steglitz

Illustration 9: Treatise on the theory of the NO method for producing sulphuric acid, Dr. Gerd Petersen (1948)

The tremendous achievements of HUGO PETERSEN, particularly the personal connections of the founder and his son, Dr. Gerd Petersen, helped to re-establish foreign relations, which had been torn apart during the


Illustration 10: Dr. Gerd Petersen

The son, Dr. Gerd Petersen, took over management as sole proprietor in 1950. Under his leadership, the company also expanded its portfolio to include air purification, a field of activity which assumed particular importance in the 1980s and 1990s.

With the move to Wiesbaden, there was an immediate boom in the market, which initially had to be dealt with, by just two engineers. The office on Goldgasse 5, in the centre of Wiesbaden, first had to be restored with the energetic support of the Petersen company.

HUGO PETERSEN´s staff numbers rapidly increased, thus requiring a larger office. They moved to 25 Richard-Wagner St.

Abb. 11: Broschüre aus den 1950er Jahren

Their own office building went into construction in 1956, which HUGO PETERSEN footed the bill for, thanks to its successes in the redevelopment, following the second world war.

HUGO PETERSEN

WIESBADEN • DANTESTRASSE 4-6

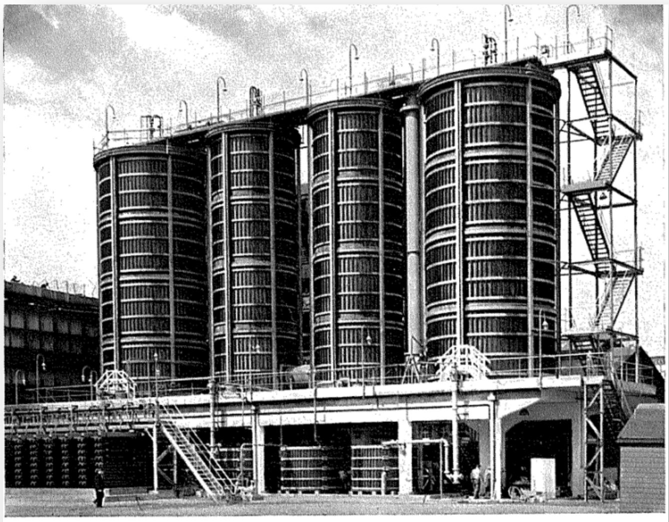
Illustration 12:Office building in Dante St. 1956

Shortly before his death, Hugo Petersen wrote a new version of the aforementioned book under the title," The Nature and Meaning of the World: The new life faith", but he named 'Frederick William Petersen' as the author. He seemed to want to prevent anyone from recognising the connection to "The World-God", from the Nazi era.

Hugo Petersen plants were built, not just in the far-flung corners of the globe, but also in Wiesbaden itself; such as the Albert Chemical Works, where along with a tower system, a tower and chamber system and a contact plant were installed.

On March 7 1957, Mr. Hugo Petersen died, in Wiesbaden, at the age of 93. The company and the industry lost a luminary in sulphuric acid.

Processing de-dusted, hot, highly fluctuating, but unwashed gases to retain a less pure acid at approx. 60°Bé, remain to this day, the primary application of the nitric acid process, particularly tower systems., whereas contact systems produce purer and more concentrated acids.



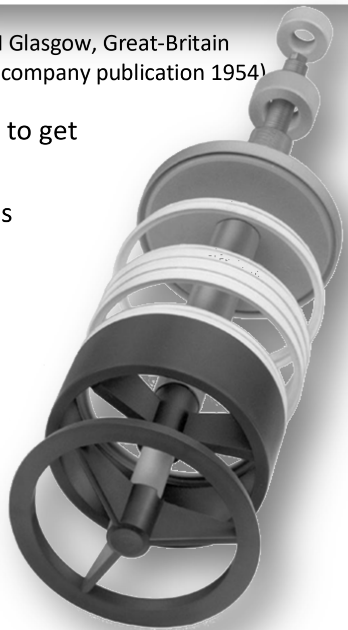
Here are the Petersen Towers which are at once more elegant, more compact and more efficient.

Illustration 13: St. Rollox ICI Glasgow, Great-Britain (Picture from the ICI's own company publication 1954)

By the end of the 1950s, more than 100 nitric oxide plants had been built by Hugo Petersen.

1960 arrived and at the beginning of this decade, there were several decision points ahead of the company.

Through emerging environmental awareness, particularly for visible emissions and so on, the single catalytic systems which were de rigeur up until that point, needed an additional, final, gas purification step, against the tower system's poor conversion rate with contact systems.



Therefore, HUGO PETERSEN saw itself as forced to get involved in eliminating these problems. In the 1950s and 1960s it was discovered that gas propellants were causing physical reactions. For this reason, in 1960 HUGO PETERSEN invented the PETERSEN PRESSURE JUMP SEPARATOR, called the DSA for short. Its usefulness as an aerosol precipitation and absorption apparatus, was established, in extensive testing.

In the following years, this precipitator was well received and many other patented precipitators followed, such as the:

PETERSEN TURBO BOOSTER - PTB

PETERSEN CENTRIFUGAL AGGLOMERATOR - PZA

PETERSEN TURBO AGGLOMERATOR - PTA

PETERSEN SPRAY ABSORBER - PSA

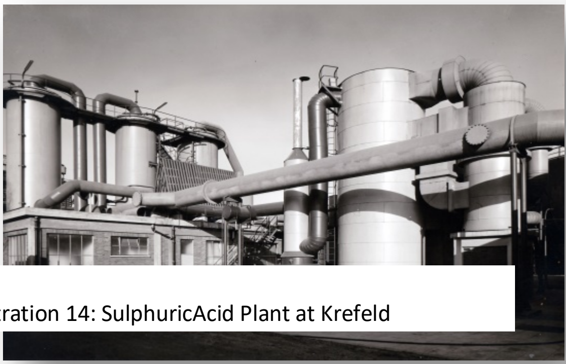


Illustration 14: SulphuricAcid Plant at Krefeld

And of course the wet electrostatic precipitators, which metallurgic plants can no longer imagine doing without. The current generation of PSTAT is characterised by high separation efficiency combined with moderate energy consumption and a robust design.

Ilustration 15: Mist-Elimination at the Krefeld works

All of the precipitators mentioned above are able to efficiently precipitate aerosols and particles in the submicron range.

The DSA was also often used as a retrofit, in sulphuric acid plants, such as when the contact plant at Krefeld, built 1956, had a final gas purification system added in 1962 to reduce SO2emissions.

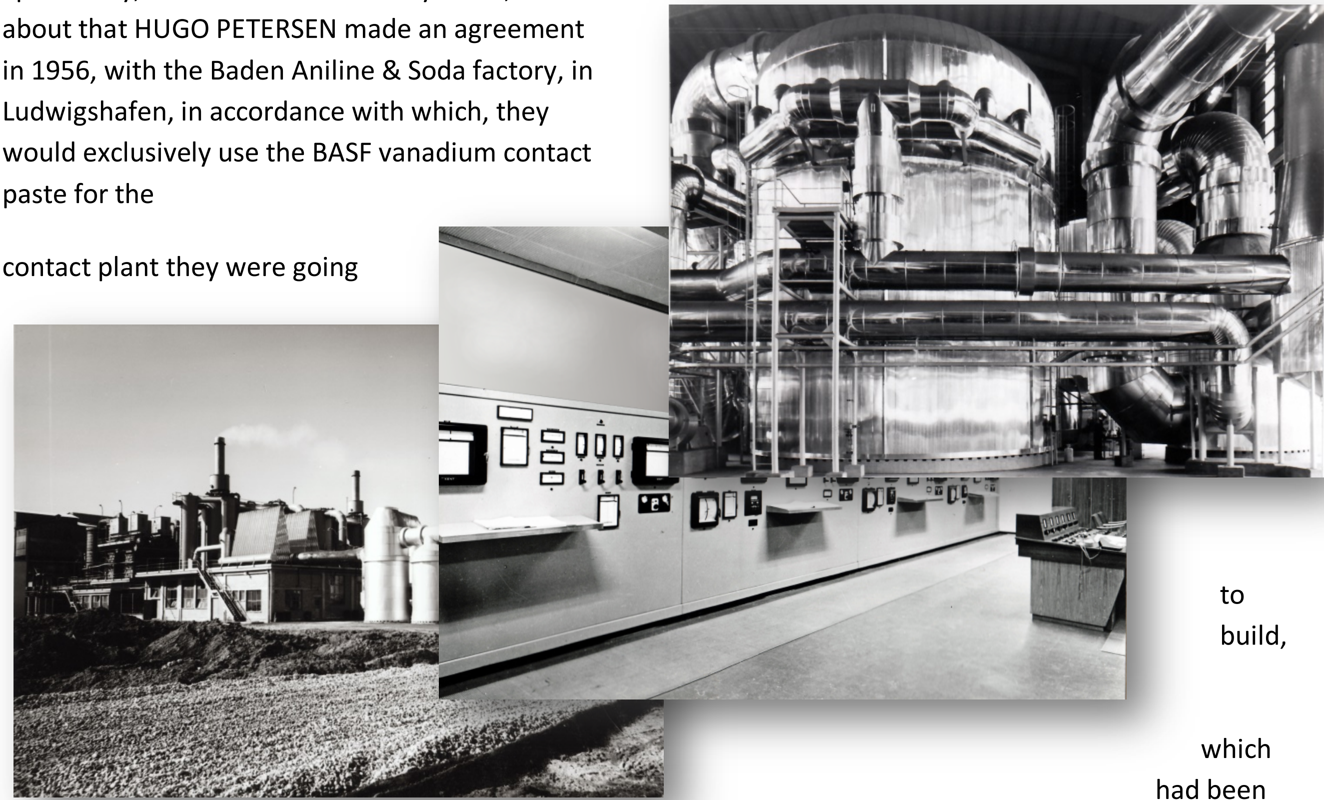
Along with these epochal developments, new markets had opened up.

Contacts were made with companies in Yugoslavia and Finland, some of which last until this day.

In Yugoslavia, plants were built for RTB Bor, Cinkarna, Celje, for stations in Kosovska Mitrovica, and many more. In Finland, plants were acquired for the Rikkihappo Oy facilities in Siilinjärvi, Kokkola, Harjavalta and Uusikaupunkki.

HUGO PETERSEN concluded a license agreement with Bayer Dye Works, in 1965, which allowed them to use the Bayer double contact process and gave them a special licence for the 3/1 circuit.

Specifically, in the field of contact systems, it came about that HUGO PETERSEN made an agreement in 1956, with the Baden Aniline & Soda factory, in Ludwigshafen, in accordance with which, they would exclusively use the BASF vanadium contact paste for the contact plant they were going to build, which had been time-tested for more than 50 years and was well proven.



In comparison to the single contact process, the conversion rate could now be raised from 98% to about 99.5%. A production increase of 1.5% was not decisive, but 75% emission reductions, helped the process to break through.

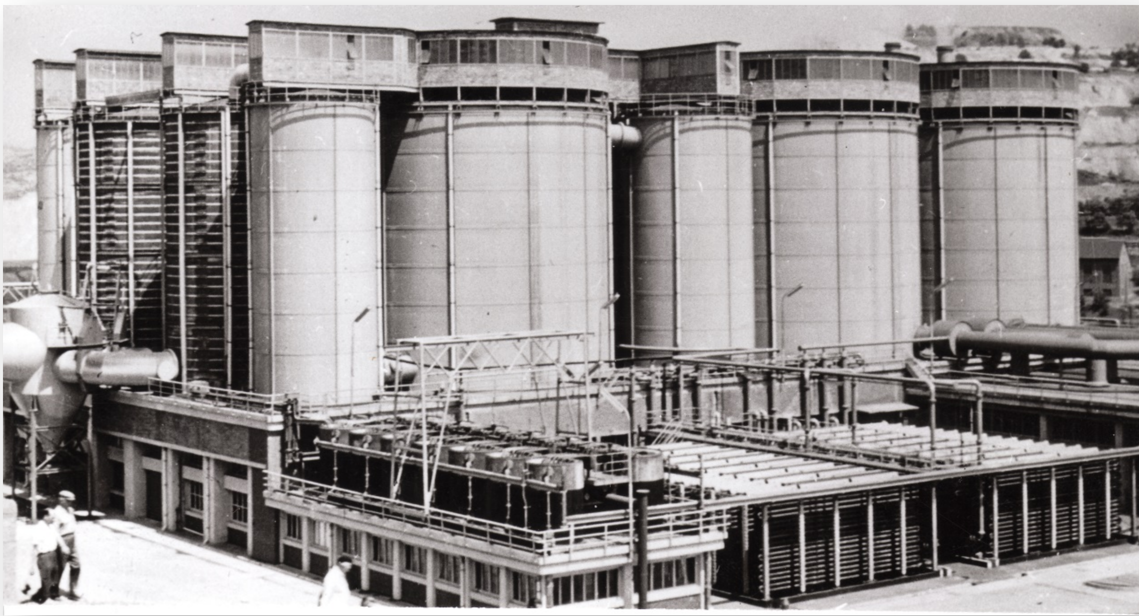


Illustration 16: The largest tower plant ever built 900 t/d 60° Bé for RTB Bor, Yugoslavia

n 1967, Hugo Petersen put the first double catalysis for Rikkihappo Oy in Kokkola in production with a production capacity of 800 t/d Mh, processing the gas from a sphalerite furnace.

In 1969, the last plant using the nitric oxide process, was put into operation for the Fabbrica Interconsorziale Marchigiana in Porto S. Elpidio, Italy.

With this plant came the end of an era – at Hugo Petersen and its customers, the contact process had superceded .

In the future, the tower or tower chamber method, would no longer be a substitute for the contact process.

The table below, ought to make the differences in the processes quite clear.

	Nitric oxide process Petersen tower system	Single contact system	Double contact system 3/1 circuit 1975	Double contact system 3/2 circuit today
Min SO_2 concentration	0.5 vol%or temporarily less	2.5 vol%-%	6 Vol%-%	6 Vol%-%
SO_2 conversion	>> 99.99%	At 2.5 vol%99.4% At 6 vol%-% or higher 97.5%	> 99.8%	> 99.92%
SO_2emissions at 10 vol%SO_2	< 20 ppm	2.945 ppm	236 ppm	94 ppm
Prod. Acid concentration	78%	98.8%	98.8%	98.8%
NOx emissions	> 1000 ppm	< 50 ppm	< 50 ppm	< 50 ppm

Table 1: Comparison of standard sulphuric acid production processes

As Table 1 shows, the SO_2 conversion rate of the nitric oxide process is significantly better, but the NOx emissions and low acid concentrations, particularly the former, make the tower process obsolete.

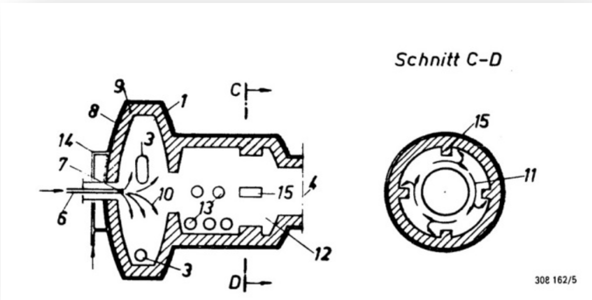


Illustration 17: Patent "Process and furnace for burning sulphur" DE2063021 (1972)

But the industry demanded an ever greater product scope from the plant builders, so HUGO PETERSEN added, not only, the Raschka and Dorr-Oliver fluidised bed furnaces, but also, incinerators for spent acid and H2S gases, to its portfolio.

But new changes cropped up – nothing is more reliable – so it became apparent that Pyrite would be replaced by elemental sulphur as a source of sulphur for sulphuric acid production, because of the significant environmental problems with FeO burning. Large amounts of the yellow substance accrued from the 'sweetening' of petroleum based fuels, so Hugo Petersen decided to develop a sulphur furnace, which boasts minimised NOx emissions. A patent was sought for the combustion chamber, which had been developed through elaborate tests and calculations, in 1970. The design, made at that time, is still in use today. The staged combustion was the inspiration for burners and furnaces, for many years into the future.

In 1975, Dr. Gerd Petersen had to decide, in the context of ever more risky and costly contracts, how to strengthen the finances of his company. Since he had no offspring, a suitable company with a good fit had to be found.His good friend, Dr. Lothar Jaeschke, was a member of the board at UHDE in Dortmund and at L&C Steinmüller in Gummersbach. These two companies held all sorts of charms for him; UHDE lacked sulphuric acid technology, for their line of fertilisers and Steinmüller, with its line of industrial boilers, could be a match for the increasingly common sulphur-based systems.

They were tremendously interesting.

He eventually sold the company to L&C Steinmüller. The idea of a match with the industrial boilers never came to pass, but they handled many other projects in the future.

He followed the company to Steinmüller, as a technical and commercial adviser, until 1983.

Illustration 18: ENVITEC 1977 Presentation of the Centrifugal Agglomerator

In 1977, HUGO PETERSEN revealed the newly developed PETERSEN centrifugal agglomerator (PZA), a high performance aerosol precipitator, which as a rotating precipitator, was a novelty at the time. Further developments of this kind were to follow, e.g. in 1982 with the PETERSEN Turbo Agglomerator (PTA), a rotating precipitator which, in contrast to the PZA, also has gas propulsion capabilities.

With increased environmental awareness, air protection became an increasingly dominant topic. Processes for retrofitting waste, hazardous waste and heating power plants were developed by HUGO PETERSEN, raising the bar. Standards which have, thus far, never been bested by any other process.

Increased environmental awareness had sufficient impact on HUGO PETERSEN, that when plants for Climax Molybdenum, Rozenburg (Netherlands), Th. Goldschmidt, Mannheim and Cinkarna Celje (Slovenia) had been completed at the beginning of the 1980s, the focus was all out on exhaust gas purification.

Illustration 19: Sulphuric acid plant of Cinkarna Celje Yugoslavia1982

So, in 1980, environmental protection projects were researched and worked on with renewed vigour. The array of processes offered by HUGO PETERSEN was extended, from initially being exclusively wet processes, to dry and catalytic processes.

Processes, such as, the Mining Research-UHDE process, were initially developed in cooperation with Mining Research and UHDE Dortmund. A method where formative coke (FAK) is supposed to adsorb all the components of the flue gases from power plants and waste incineration plants and then, in a second stage, the NOx is supposed to be catalytically converted to N_2 from NH_3. The SO_2 adsorbed, in the first stage, was to be fed into an SO_2-rich gas, by means of a desorption stage for further recycling. But soon this design proved too expensive and was killed through its usage of FAK. HP then decided to go its own way and applied the adsorption technique as a "police filter for fine separation after conventional gas purification methods".

As it turned out, this was the right decision.

Within 4 years, large-scale pilot plants were built in Berlin, Dusseldorf Garath, Mainz and Mannheim to put the technology through its paces.

Other methods have been tried for generating SO_2 rich gas. The Erga-Petersen method is also worth mentioning, in which SO_2 is adsorbed in a wet chemical process and then SO_2 gas is desorbed, through steam, for further commercial processing out of solution.

Years of intensive attempts were made to make the process ready for acceptance. It was only several years later that it met with success.

The 1980s brought the ACCR process, to market, as a "police filter" for incinerators. In 1987, the thermal power station at Dusseldorf Garath was equipped with the new Petersen ACCR process. Plants for Dusseldorf Lausward and Flingern followed in quick succession, as well as many others such as the Cologne waste incinerator, until 1996, when the wave of retrofitting, for German incinerators, ended.

Illustration 20: District Heating Plant Düsseldorf Garath

HUGO PETERSEN's basic ideas were so convincing, that even their competitors tried to copy the technology, but were often unable to match their efficiency.

Together with L&C Steinmüller, heating, refuse and hazardous waste incinerator power plants were kitted out. The technology found applications in large power plants as well.

The ACCR technology could even be used for denitration of gases.

Despite its higher efficiency, the cheaper entrained flow process, which still generated a considerable amount of waste products, won over the market, so that HUGO PETERSEN added that technology to its portfolio and redeveloped it along the lines of their own design philosophy.

Illustration 21: Power Plant Lausward with illuminated Adsorbers

In order to round out its offerings for NO_x, N_2O, dioxins/furans and CO, HUGO PETERSEN then offered SCR systems, still based on the IHI license. The technology was used in waste and hazardous waste incinerators. Recently, HUGO PETERSEN has been equipping nitric acid plants with an adapted technology.

More than 600 plants have been equipped with HUGO PETERSEN technology worldwide and these have proved their performance.

In 1991, HUGO PETERSEN became "Hugo Petersen Environmental Engineering", by selling L&C Steinmüller to Philipp Holzmann, also a member of the global construction group. The financial backing, derived from the reputation of the group, at the time, also supported the in-house activities of HUGO PETERSEN.

After the retrofitting wave of the 17th Federal Immission Protection Act, orders petered out in 1996. L&C Steinmüller, because of its orientation towards large power plant construction and the associated gas purification, was no longer a strategic partner for HUGO PETERSEN. Therefore, it was logical to reconsider the membership of HUGO PETERSEN. A tighter focus and a return to chemical and metallurgical projects had begun in 1993, as the development of legally mandated retrofits, was on the cards. Therefore, equipment for the chemical and metallurgical industries was also being built in the 1990s.

One of the Cinkarna KKČ plants in Celje went from single to double catalysis and a countless number of existing plants were rebuilt or extended.

Facilities in Norway, Finland, Belgium would be further examples, but also in Australia and Indonesia.

Illustration 23: Gas Cleaning Plant of Spent-Acid Plant of Rhone Poulenc Rhieme Belgium

Illustration 22: Cinkarna KKČ plant, Celje (Slovenia) after conversion to double catalysis

Illustration 24: RWE Umwelt gas purification plant, Zapfendorf

Here there was also a strong focus on process gas handling and emission purification, as in the gold industry.

The gradual increase in the height of plants was therefore, seldom an obstacle. The complexity of the plant design was an essential motivation for action. To represent this, one could mention the exhaust gas purification systems for Nukem Hanau, Alkem and Hanau, and later for KNFC in South Korea (today KEPCO) or RWE Umwelt in Zapfendorf.

In the former, the radioactive dust was deposited from the production of the fuel assembly. The challenge was that the separated dusts should cause no nuclear chain reaction. Even today, the process developed, finds successful application. The plant in Zapfendorf included the incineration of contaminated waste wood, here specifically kyanized woods. The chosen method was the dry gas purification process, which they themselves had recently developed.

In 1997, the foundations were laid for a new direction for HUGO PETERSEN. As previously stated, the years of widespread retrofitting with exhaust gas purification systems were fading or had just finished and HUGO PETERSEN Environmental Engineering had to think back to its origins. It became Hugo Petersen – Engineering Office for the Chemical Industry once again. So, this motto became the guiding principle for the new direction.

Part of the Philipp Holzmann group included, LOCKWOOD GREENE Inc., with its headquarters in Spartanburg SC USA, active worldwide with approximately 3,000 engineers and 30 offices.

Lockwood Greene was founded in 1832 and thus claimed to be the oldest company in America, providing professional services for engineering, construction and consulting.

Due to HUGO PETERSEN's new direction, they saw an ideal fit for integrating with Lockwood Greene. Therefore, HUGO PETERSEN Environmental Engineering became LOCKWOOD GREENE PETERSEN in 1998. LOCKWOOD GREENE held a 75% stake and L&C Steinmüller 25%.

Illustration 25: Gas Cleaning Plant for PMC Phalaborwa RSA

In the previous year, together with Steinmüller Africa Pty, the southern African market had been opened up. Initial studies and audits would later prove to be a potent basis for design projects.

To begin with, various revamp projects were carried out with the PMC Palabora Mining Corporation, in Phalaborwa, South Africa.

In the first year, at a new site, the basic engineering for the new line of catalysers at CRI KataLeuna was booked in, and executed sometime later. The technology design was provided by the customer and LGP had the task of converting this into a functional and efficient plant.

At the same time, at the construction of the sulphuric acid plant at ANGLO PLATINUM, Rustenburg there was a combined process using contact and tower systems. The technology was developed by Dr. Volker Fattinger and Mr. Walter Jäger, both former members of Petersen and followed a system design, which

Illustration 26: Overview of the sulphuric acid plant AngloPlatinum RSA

Hugo Petersen had seen as the ideal combination in 1902 and even continually published, until his death, conceived and then implemented by the engineers at Lockwood Greene Petersen. Here too the motto was: *No job too large.*

A plant which, at different times, was to process SO_2Gases based on an ISASMELT design and Pierce Smith converters with Ni/Pt-smelting operating over varying concentrations from 0.5 to 24 vol%, which indeed it ultimately did.

At the same time, in 1999, Philipp Holzmann went bankrupt. Fortunately, this did not interfere with LGP's success, because LGP was affiliated with the American line of the PH group.

On 22.12.2002, Dr. Gerd Petersen died in a tragic accident, just 2 days after his 91st birthday. He will always be remembered by those staff, who were lucky enough to have known him, as a masterful company director with limitless capabilities.

A few years after the PH bankruptcy, a similar fate befell Lockwood Greene's parent company. In 2003, J.A. Jones in the USA, entered a crisis and filed for Chapter 11.

Subsequently, LOCKWOOD GREENE was sold to CH2M HILL minus its German branches, a major drawback for the operation of LGP, as it now lacked the financial backing of its parent company. Therefore, LOCKWOOD GREENE PETERSEN decided to find a new parent company. However, since 2004 was not an optimal year for this undertaking, in the end, the only offer on the table was Steuler Höhr- Grenzhausen's: to support a skeleton team of 10 engineers, until a partner could be found for them.

Illustration 27: Michael Steuler, CEO of Steuler

Meanwhile, the new company, PETERSEN ENGINEERING (PE) was established as a spin-off of LGP, released from all legacy issues through LGP's planned insolvency.

The integration into the Steuler Group, however, also had the consequence that the majority of employees were integrated into Steuler Plant Construction (SAB). Mr. Axel Schulze became deputy CEO of DAB alongside his responsibilities as CEO of PE.

When in the following year (2005), PE received an inquiry about supplying equipment for a new 1818 tpd Mh S plant, for Krimsky Titan Armjansk (Ukraine), they initially decided to clarify this issue with the customers in the Ukraine. During this discussion it became apparent that at least one continuous plant and equipment engineering project would have to be undertaken, as this was not yet available to date.

While still on Krimsky Titan's grounds, Mr Axel Schulze received a call from Mr. Hans-Dieter Winkler, from Chemical Plant Construction Chemnitz (CAC), who had also received this inquiry. After a short discussion it was felt that more details should be discussed, about this project, back in Germany.

Contact already existed between LGP and Chemical Plant Construction Chemnitz in 2002, when it was still operating as Lurgi Life Science Chemnitz.

The conversation resulted in them combining forces and offering their services as CAC/HP.

At the beginning of the project, it was not clear, to all participants, what kind of adventure they had set off on.

When a particular competitor from Germany found out about this project, Steuler, as well as CAC and PE, were denigrated with opinions, which sometimes crossed the line to defamation.


Illustration 28: Joachim Engelmann CEO of Chemieanlagenbau Chemnitz GmbH

During the project, Joachim Engelmann – CEO of CAC – Michael Steuler and Axel Schulze from Steuler, who all stood to lose from this intrigue, protected themselves against it, by deciding to found the new HUGO PETERSEN company under the aegis of CAC, with CAC as the majority shareholder and Mr. Axel Schulze and Mr. Jürgen Stauss as minority shareholders. Now the Petersen employees had hope for the future, once again. On 1.10.2005, the company returned to Wiesbaden with 9 employees.

Despite all the wrangling, CAC/HP were able to win the contract for the basic engineering on the Krimsky Titan sulphuric acid plant, in December of 2005. A brilliant start!

More jobs were not long in coming, despite the continued negative PR from our German competitors, but as they say: *bad publicity is better than no publicity!* We thank our old and new customers alike, for the trust they placed in us.

Our most loyal customer, CINKARNA Celje, had never lost faith in us, even in the transitions from LGP to PE and on to HP.


Illustration 29: BASF Antwerp 2011 World-largest Oleum plant 1.200 t SO_3/d

In fact, in 2007 CINKARNA and HP completely renewed the S-Incineration Plant (IBN 1982), which had been stalled for 4 years.

Whereas, the first years were strongly impacted by Krimsky Titan and the revamp projects, in 2008, another joint project started up for a new oleum plant, for BASF, in Antwerp.

In 2011, the BASF Oleum plant was put into production and turned over to the customer.

Because of the financial problems arising from the financial crisis of 2008/2009 and the ailing economy which followed, Krimsky Titan's acid plant couldn't be successfully put into operation until 2012, the following year.

Illustration 31: Inauguration by Victor Yanukovych on Mai 7th 2012

Illustration 31: Krimsky Titan 1818 t/d Mh S-Basis

Now, having pursued our ambitions of supplying the market with excellent technology together for 11 years, one can rightly argue that HUGO PETERSEN, with CAC's help, has established itself in the international market.

Illustration 32: Santiago de Chile

In 2014, a new branch office was founded in Santiago de Chile, on behalf of HP, in order to supply Chileans and CONOSUR with HP and CAC technologies.

HUGO PETERSEN, based in Wiesbaden / Hessen, has more than 110 years of experience in designing systems for gas purification and sulphuric acid production.

Especially, in the years since its reestablishment, new and further developments in HP technology have only served to underline HP's status as first choice.

Under the new environmental directive, in 2014, HP secured a contract for the first plant, for final gas cleaning, for Chile, specifically for the CODELCO Ventanas division's sulphuric acid plant. It uses the SUPER^{OX} process, perfected by HP.

In 2016 this plant went into operation and exceeded all expectations.

So far, the company has built more than 300 sulphuric acid plants and 600 gas purification plants.

Today, its technology portfolio ranges from the production of high-grade sulphuric acid and oleum, to the production of gaseous and liquid sulphur dioxide and sulphur trioxide from elemental sulphur, metallurgic waste gases, gases from acid cleavage, H_2S combustion, etc.

HUGO PETERSEN is also known for its expertise in gas purification, applying the

- Wet process
- Dry process

and

- Catalytic process

Now HUGO PETERSEN is even in a position to be building tower systems for the lowest of SO_2-Concentrations (0.5 vol%),although the method has been losing its relevance against the contact process. In 2001, the last tower system planned by HUGO PETERSEN was put into operation in South Africa.

Hugo Petersen, engineers for the chemical industry, was founded in Berlin in 1906 and focused primarily on building plants for the production of sulphuric acid and oleum. At first the company's operation was dependent on United Brickyards and Industry , Berlin. A few years later, the engineering firm became independent.

With the double contact process, we can now reach a conversion rate of 99.92%, according to the performance like the planned plant at BASF Antwerp, which in turn means a reduction of emissions by 84%.

It's not just process developments, which have been refined over the years gone by.

We've been able to chalk up many improvements, with the goal of improving efficiency, lifecycle and especially, energy usage.

As some examples show

Illus

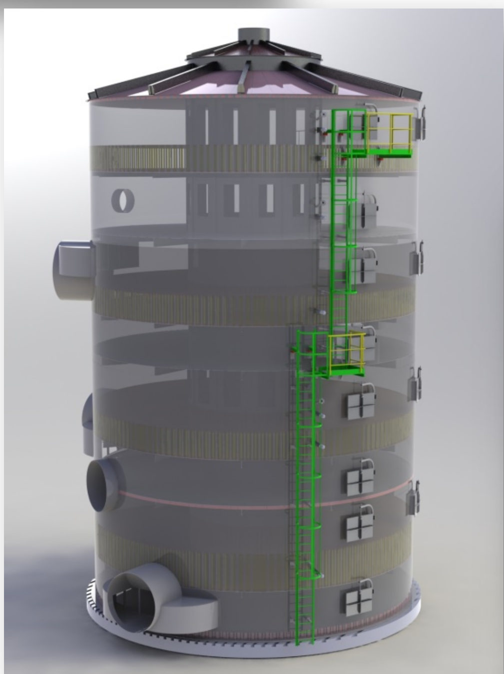


Illustration 34: SO_2-Converter fully welded version

The technologies described in the first two points are based on dry catalysis, i.e. with the exclusion of moisture in the gas.

Even here, HUGO PETERSEN was able to prove that with the right improvements to the process and the long-term know-how of its employees, both increases in efficiency and the lifetime of the equipment could be extended.

As already mentioned in the introduction, more than 300 sulphuric acid plants have been built by HUGO PETERSEN, which can, in particular, be distinguished by their long lifespans.

On the basis of the comprehensive knowledge acquired from wet gas purification, HUGO PETERSEN has also worked on the production of muriatic acid from HCl gases, such as, from the Mannheim process. In 1996, the first plant based on burning VCM gases for LVM Tessenderlo, Belgium, was brought into operation. There, the already tried and tested precipitators were used for precipitating aerosols.

The technology here was also characterised by robust equipment, efficiency and low emissions.

HUGO PETERSEN has successfully achieved 110 years of technology development, often ground-breaking development, with pride and has also motivated others to develop efficient, clean technology.

HUGO PETERSEN
Verfahrenstechnischer Anlagenbau

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