ISSUE 2016

PURE EXPERTISE

Magazine of Chemieanlagenbau Chemnitz GmbH

HUGO PETERSEN: Pioneers in sulphuric acid technology

I PAGE 4

ABOUT THIS WEBSITE

Publisher:

Chemieanlagenbau Chemnitz GmbH
Augustusburger Straße 34
09111 Chemnitz, Germany
Phone: +49 371 6899-0
Fax: +49 371 6899-253
Email: info@cac-chem.de

Editing:

Chemieanlagenbau Chemnitz GmbH
Madeleine Megyesi-Lukaß
(Marketing Manager)

C&G: Strategische Kommunikation GmbH
Ronja Wildberger, Sandra Ziemons (Text)
Sabine Hafner, Katja Klesper (Graphics)

Idea, layout, text and implementation:

C&G: Strategische Kommunikation GmbH
Hoffnungsthaler Straße 1
51491 Overath, Germany
www.c-g-gmbh.de

The Board of Management (from left to right): Joachim Engelmann, Jörg Engelmann

Dear Readers,

Tradition and progress need not be contradictory. The opposite in fact, progress can be part of the tradition – and our HUGO PETERSEN subsidiary is a good example of this. When the engineer Hugo Petersen founded the company in Berlin in 1906 he was a pioneer in the field of sulphuric acid technology. The tower systems formed the basis for his success, but Petersen never stopped developing the technology further and thinking in new directions. Today, 110 years later, HUGO PETERSEN is still the leader in the field of sulphuric acid technology and has developed a further area of expertise with industrial gas purification. We are proud to have this company in the CAC Group and congratulate HUGO PETERSEN warmly on its anniversary.

Naturally, technological progress is a theme that is omnipresent at CAC. In this issue of PURE we introduce a key innovation: zero gap electrolysis. With the bridging of a small gap, chlor-alkali electrolysis can be conducted in a significantly more energy efficient manner.

CAC displays its traditional punctuality and adherence to schedules in the report on the new butadiene plant of OMV of Burghausen. Commissioning was undertaken during a one-month shutdown of the entire plant. Precise timing ensured that all columns were ready for the final spurt in good time.

With this third issue PURE has also taken a step towards establishing itself as a company tradition. We hope that you will find exciting reading material and interesting topics in this issue!

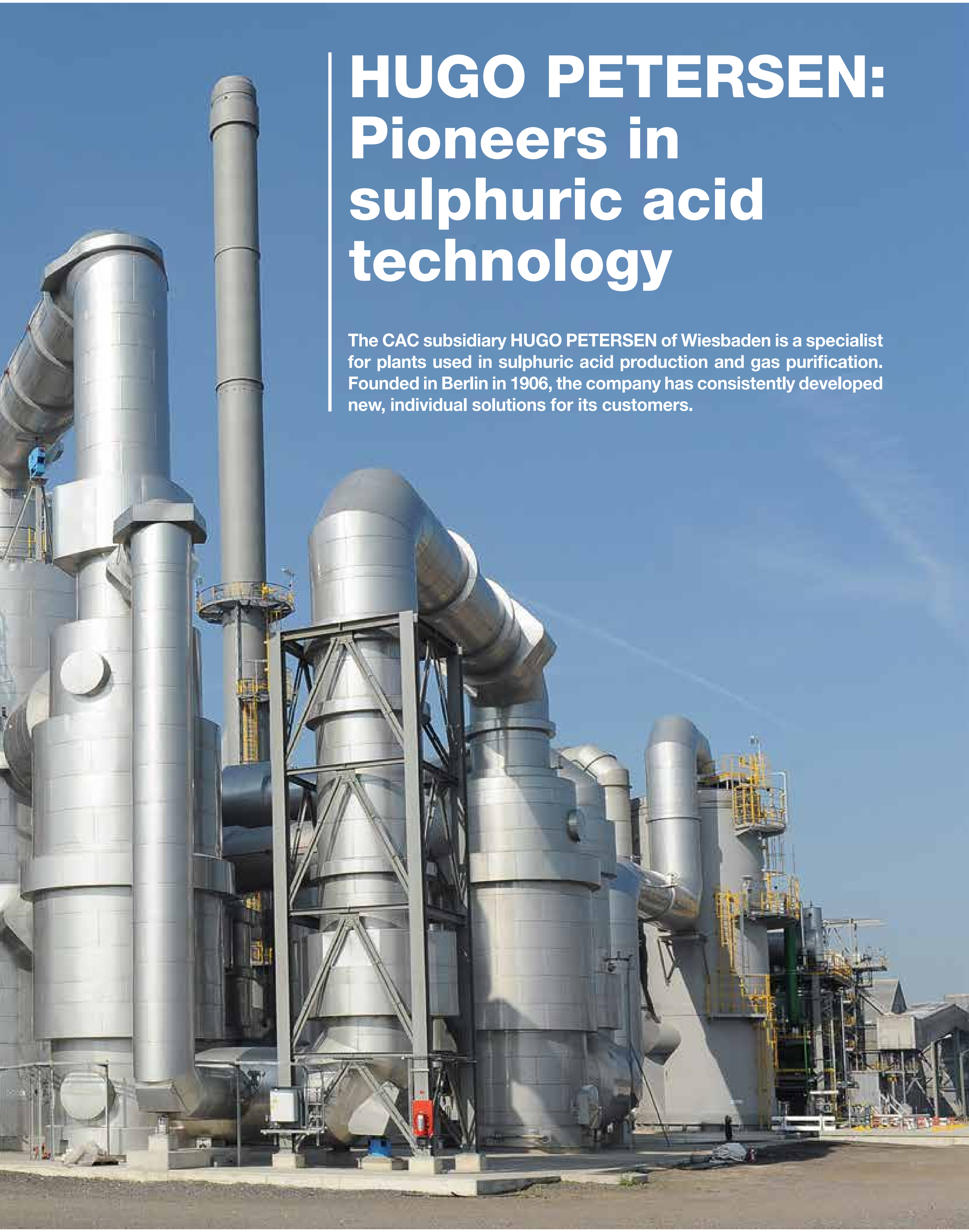
Jörg Engelmann

Joachim Engelmann

HUGO PETERSEN constructed the world's largest oleum and sulphuric acid plant for BASF in Antwerp.

HUGO PETERSEN: Pioneers in sulphuric acid technology

The CAC subsidiary HUGO PETERSEN of Wiesbaden is a specialist for plants used in sulphuric acid production and gas purification. Founded in Berlin in 1906, the company has consistently developed new, individual solutions for its customers.



Economic success can be measured, i.e., in continuous growth of business. And this is something that HUGO PETERSEN GmbH has been enjoying for some time now. The company has a consistent order situation. That is rather unusual when it comes to plant engineering: the Wiesbaden-based company achieves the majority of its sales via so-called revamp projects, with budgets of between one and eight million euros.

Naturally, acid producers want their plants to last as long as possible. But whilst on the one hand the companies acknowledge that plants need to be modernised for improved energy recovery, on the other hand an older plant is often also being nibbled away by the passing of time – or the sulphuric acid itself. “We work in a technology segment that literally eats itself,” explains Managing Director Axel Schulze. However, when a modernisation is called for, customers are happy to turn to HUGO PETERSEN again: “We recently received a revamp order from a company whose sulphuric acid plant we built in the 1960s.” Close contact to the customers therefore pays off for the company.

For the globally-active fertiliser manufacturer YARA, HUGO PETERSEN modernised the gas purification unit of the sulphuric acid plant at the site in Siilinjärvi, Finland.

Experience from tradition

This customer satisfaction has a specific reason, of course. The workforce at HUGO PETERSEN has a wealth of experience in handling sulphuric acid. Everything began in 1905 with a novel idea: as plant manager of the Lazy Works near Bytom (Beuthen), Hugo Petersen wondered how the historic lead chamber process could be revolutionised. The engineer developed the so-called chamber regulator, an intermediate tower that had a balancing effect in the event of a nitrogen oxide deficiency when used in conjunction with the then-standard Gay-Lussac or Glover towers. Hugo Petersen registered a patent for his invention in the same year. With the Petersen tower plant process that he also developed, he succeeded in setting new standards in the production of sulphuric acid.

In 1906 Hugo Petersen subsequently founded the eponymous plant engineering company in Berlin and soon received his first orders. The company‘s own technology remained the driver for growth at the firm, and HUGO PETERSEN has since succeeded in selling over 250 plants worldwide based on the process of the founder. What began as pioneering work in the early 20th century was supplemented over time by the addition of complementary technology. For example, HUGO PETERSEN has long offered sulphuric acid plants that work on the basis of dry catalysis and wet catalysis or oxidative wet purification for various SO_2 sources. In addition, the company has also developed its own equipment for these processes, such as jet scrubbers, wet electro-filters, sulphur oxygen reactors, SO_2 converters and gas/gas-heat exchangers, to name just a few.

According to Axel Schulze, these developments will by no means be the last: “We are looking beyond our established technologies to the broader surroundings, in the long term we aim to be considered a system supplier.” In the course of the 110-year history of the company the Wiesbaden-based firm has laid the foundations for this and is now a specialist for process plant engineering, particularly in the field of sulphuric acid processes and gas purification. In co-operation with CAC as its main shareholder, HUGO PETERSEN realises turnkey plants, from consulting to commissioning. Beyond this, the company also offers its customers the revamping and renewal of existing plant systems.

High demand for gas purification

In recent years gas purification has joined sulphur technologies as a key area of activity at HUGO PETERSEN. When environmental protection issues began to emerge in the 1960s, the company started to expand this field: the employees were able to utilise their experience of aerosol separation in the production of sulphuric acid to construct plants for industrial waste gas purification. This was joined later by the development of further expertise, such as the company‘s own catalytic processes. Today, the experts cover the entire spectrum of gas purification.

Enquiries for gas purification plants not only come from the metalworking industry, but also from the field of fertiliser production and other areas. “As a rule, we are always required wherever gases occur,” sums up Axel Schulze. 85 percent of the technology used by the engineers in the projects is developed in house. In the 1990s, HUGO PETERSEN achieved 75 percent of its turnover with gas purification plants. At that time the production of acids made up just one quarter of sales. Today it is the other way round again. However, HUGO PETERSEN does not follow every trend that emerges in the field of plant engineering – quite the opposite. “We aim to have continuity in our business,” says the Managing Director, describing the long-term goal.

Also for YARA, at the Finnish production site in Siilinjärvi HUGO PETERSEN extended the existing sulphuric acid plant – for the purpose of increasing capacity – to include sulphur incineration.

Individual, tailor-made plants

One way in which the company generates this continuity is via its custom plant solutions in both the field of sulphuric and hydrochloric acid production and gas purification. “We specialise in projects beyond the standard type,” adds Schulze. For example, in 2011 HUGO PETERSEN constructed the world‘s largest oleum and sulphuric acid plant for BASF in Antwerp in cooperation with CAC. Construction of the plant took two and a half years and was highly challenging. Despite the enormous production volume of up to 1,200 tonnes of SO_3 per day, the plant has a maintenance-friendly design.

The construction of a catalyst factory with several auxiliary buildings for CRI KataLeuna GmbH in Leuna is one reference for the special solutions of the Wiesbaden plant engineering company. With a gross area of 200 by 300 meters, the complex is designed quite generous, to allow for uncomplicated repairs and modernization works. HUGO PETERSEN is currently working for CRI KataLeuna again in the scope of the expansion of the reduction plant.

One project in Switzerland was quite of a different nature: In the case of a hazardous waste incineration plant in Switzerland, in which radioactive waste is incinerated, the gas expertise of the plant engineering specialist proved of particular use. The gases are cleansed of radioactivity with the help of HUGO PETERSEN technology. The residual ash is vitrified, with the resultant radiating glass balls subsequently being stored in a space-saving manner.

Another special feature is a NO_x separation solution developed by HUGO PETERSEN. The company offers a mobile gas purification system for customers facing a temporary problem with NO_x separation from active carbon arising from the fact that they need to open a plant or where there are problems with extraction. This mobile system is located in a hire container and can be used during the down time of the normal exhaust air purification plant or when the latter needs to be opened for repairs. “This means that the customer still has the emissions under control and no problems with local residents or authorities,” explains Axel Schulze.
In addition to the competency and technologies for such highly-specialised plant engineering projects, the lean company structures are a further factor for the enduring economic stability of HUGO PETERSEN. Approximately five to six engineers support the individual projects in small teams. This means that the personnel costs can be kept down and the customer has a small circle of specific contacts. Compared to larger project teams, this means that no information is lost.

Intercultural workforce

With the goal of remaining competitive in the long term and growing further, the company is not just focusing on its own technology, but also on versatile employees that can be utilised in a variety of fields. HUGO PETERSEN currently has a workforce of around 50, drawn from 13 countries. The plant engineering company is proud of this diversity and benefits from the multilingual capabilities and intercultural skills of its experts. “In our dealings with our international customers it has proved useful that we can communicate with them in their native language – our cultural understanding is a further advantage,” says Managing Director Axel Schulze.

HUGO PETERSEN also displays flexibility with regard to invoicing matters, offering a range of different models – depending on the type and scope of the project concerned. Customers frequently choose the “reimbursable” or “open book” options. The customer then receives a transparent list of all individual costs. In rare cases, fixed sums are agreed for job orders. In other cases HUGO PETERSEN acts as general contractor in the scope of an Engineering Procurement Construction (EPC) or Engineering Procurement Construction Management (EPCM), undertaking all procurement – in addition to its own products and services – on behalf of the customer ▸

Heat exchangers are key components of gas purification systems.

and managing the project for him. In addition, HUGO PETERSEN also offers framework agreements for year-round support of a plant that it has constructed itself, or that has been constructed by third parties.

The need for expertise

HUGO PETERSEN is also appreciated for its specialised know-how. For example, on request the experts draw up concepts for maintaining the cleanliness of metallurgical plants, or develop complete studies, such as those on dioxin treatment following the Belgian dioxin scandal of 1999. These consulting services and its close co-operation with customers serve to distinguish HUGO PETERSEN from its competitors. “The consulting is often the starting point for mutual projects,” says Axel Schulze. For example, during the concept phase the company even developed six different energy concepts for a Ukrainian acid producer, enabling the maximum possible amount of energy to be produced with the same feed stock. And this proved successful – energy utilisation could be increased by 50 percent. As a rule, at the beginning of a project HUGO PETERSEN strives to achieve a holistic view, including the aspect of energy generation and recovery. The aim here is to integrate the plant into the overall concept, as the combustion of sulphur and purification of gas generate energy that can be used for other parts of the plant. With ENER^{REC}, HUGO PETERSEN has even developed its own procedure for recovering and utilising energy from sulphuric acid plants.

Within the company itself, the overall perspective is always key: instead of developing specialised experts in the field of engineering, Managing Director Axel Schulze prefers each engineer to be able to work as generalist with technological competencies within projects: “We try to create overall responsibilities in everyday business.” As a result, in future HUGO PETERSEN will continue to look beyond the production of sulphuric and hydrochloric acid and gas purification. “If we do not evolve further, we will become replaceable,” says Schulze. “Consequently, from a technological viewpoint we are always open for new things. This is also what drives us to approach completely different processes. For example, this year we have developed two or three plant concepts that have nothing to do with our standard portfolio – this gives rise to new ideas.”

For some time now HUGO PETERSEN has been working with a co-operation partner, the Institut für Energie- und Umwelttechnik (IUTA) in Duisburg, on new processes. The company can test new technologies in the technology centre there. In addition, junior staffs are also expected to provide fresh input – the option of dual studies and practical semesters means that HUGO PETERSEN has succeeded in attracting young employees. This means that the company is open to a future in which its engineers expand their expertise beyond the company’s own technology to include all processes and interrelationships of a plant, thereby generating new business.

Axel Schulze
Managing Director
HUGO PETERSEN GmbH

axel.schulze@hugo-petersen.de

On course for success – for 110 years

Over 300 sulphuric acid plants, more than 600 gas purification systems and countless modernisation and expansion projects – these are the successes that HUGO PETERSEN GmbH can look back on today. 2016 sees the company celebrate its 110th birthday.

The company was founded by Hugo Petersen in Berlin-Charlottenburg in 1906. Born on 14 December 1863 in Klein Schwiesow, Mecklenburg, he studied Chemistry after leaving high school. In 1886 the young graduate began work at the Lazy Metal Works of Hugo Graf Henckel von Donnersmarck in Radzionkau (Upper Silesia). As the later manager of the works, which processed sphalerite into sulphuric acid, he developed his own ideas for optimising the production process, implementing these here before founding his own enterprise. His company – initially just a small engineering office – began by focusing on plant engineering for the production of sulphuric acid and oleum. These areas were later joined by gas purification systems. As a consequence, in the 1990s HUGO PETERSEN realised numerous projects in the field of dioxin and NOx separation.

Difficult times during the Second World War

Following the destruction of the company premises by a bomb, in 1944 the firm relocated temporarily to Thuringia, before returning to Berlin in 1945. In 1949 the company made its final move, to Wiesbaden. In the turbulent post-war years it proved possible to save the most important drawings and technical documents, but many of the employees had been lost or were prisoners of the Russians. Hard work and personal contacts meant that foreign contacts that had been interrupted due to the war were quickly re-established.

Hugo Petersen's son Gerd joined the company in 1938 and subsequently managed the firm after 1945. Following the death of his father in March 1957 Dr. Gerd Petersen successfully guided the fortunes of the family company, finally selling the enterprise to L&C Steinmüller GmbH (LCS) in 1975. He himself remained at the company as a technical and commercial consultant until 1983.

Change of parent company

After a change in the ownership structure, which brought with it name changes, in 2005 Chemieanlagenbau Chemnitz (CAC) took a majority stake in the company and made the decision to restore the old name of HUGO PETERSEN, some 100 years after the firm was originally founded. Axel Schulze, an experienced HUGO PETERSEN engineer, became the new Managing Director, a position he holds to this day. A small, eight-man team grew into a workforce of over 50 employees. Together with the approximately 250 employees at CAC, they form an accomplished centre of excellence for sulphur production and processing.

Meticulous planning of commissioning

For the new butadiene plant of OMV of Burghausen a total of 750 workers assembled 250,000 cubic metres of structures, laid 145 kilometres of cable and 1,200 tonnes of piping. They also moved 111,190 cubic metres of earth. From an idea to commissioning, the project took four years. During this time workers and engineers worked a total of one million hours.

The butadiene plant at the Burghausen site has been producing consistently since spring 2015.

These impressive figures illustrate the size of the project. CAC of Chemnitz was assigned with the detail engineering, construction supervision, commissioning, training of personnel and procurement services. When CAC joined the project in 2013, the pre-planning had already been underway for two years. Butadiene is a gaseous, unsaturated hydrocarbon that is produced in the petrochemical section of the refinery from the C_4 by-product of the ethylene plant during the cracking process. It is a key basic material for the synthetics industry, and is very difficult to replace with other materials. Butadiene is used as an intermediate product in the tyre industry in particular.

In total, CAC realised three sub-projects: in addition to the establishment of the butadiene extraction itself with several columns, storage tanks were also required for the feed material C_4 and the end product butadiene. The two C_4 tanks had a total length of 91 metres and a diameter of six metres with a weight of 278 tonnes, as a result they were each supplied in two sections with a heavy goods transporter and finally welded together on the actual construction site.

i

A component of numerous synthetic products

The gas butadiene is formed in the oil refining process. The unsaturated hydrocarbon (C_4H_6) is an elementary component of synthetic rubber, making it a key material in the tyre and automobile industries, amongst others. In combination with other materials butadiene influences tyre characteristics such as grip, wear and rolling resistance. Butadiene also finds regular use in synthetics, for example as synthetic fibre in clothing and shoes, paints and coatings as well as carpets and furniture.

Butadiene extraction had to be completed on time for shutdown.

The smaller butadiene tanks (length 45 metres, diameter six metres, weight 139 tonnes) came along the Danube to Passau by ship. The tank farms also featured an extension of loading facilities via rail. In addition, CAC also planned and constructed a new boiler house for steam generation.

All projects required the expansion and adaptation of existing refinery infrastructure which, in addition to pipe and cable networks, included instrumentation and control equipment. This required additional modifications to the existing equipment to enable connection of the new control circuits. The construction of the tank farm capacity including assembly of underground piping required extensive excavation work and the retrofitting of pipe bridges.

Extensive pre-dressing of columns

In order to enable the efficient construction of the new plant, CAC pre-dressed the columns. Steel steps, platforms, lighting, cables and pipes were fully assembled whilst the 60 to 82-metre-high columns were lying horizontally. “Beforehand we had to calculate the surface load for the columns and cranes and compact the soil accordingly, to ensure a solid surface for the heavy-duty cranes,” explains Matthias Anders, Senior Project Manager at CAC. Various different columns are required in the butadiene extraction process. Extraction occurs via two extractive columns with a height of 82 and 74 metres. Crude butadiene can be extracted as an overhead product from the second of these, the so-called

Key plant data:

- Four years from the idea to commissioning
- Over one million man hours
- 750 people involved at peak times
- 111,190 cubic metres of earth moved
- 8,360 cubic metres of concrete added
- 1,200 tonnes of piping
- 900 tonnes of steel structure
- 145 kilometres of cable in cable trenches
- Two butadiene tanks, each holding 1,200 cubic metres, 45 metres long, 6 metres in diameter, empty weight of 278 tonnes
- Two C_4 tanks, each holding 2,400 cubic metres, 91 metres long, 6 metres in diameter, empty weight of 139 tonnes
- Total of eight columns
- Highest column: 82 metres, 2.9 metres in diameter, empty weight of 200 tonnes

post scrubber. In two further columns this is first separated from propyne in a conventional distillation process before high-quality 1.3 butadiene is separated from higher hydrocarbons in the last system. Further columns are required for the degasification of the extraction solution and cooling of the resulting vapour prior to compression. The length of the degasser is 58 metres with a diameter of over two metres and a weight of 94 tonnes. Two cranes with load capacities of 1,250 and 400 tonnes were used in the assembly of the columns. Following the correct alignment of the respective columns with the aid of a theodolite, they were then fixed to the foundations.

Passivation process required

Preparation and realisation of passivation of the plant was supervised by CAC process engineer Thomas Weber. “We required considerable co-ordination for this, as various circuits were installed for different media and connected parallel to one another,” the graduate engineer recalls. “Prior to commissioning it was also necessary to clean the columns and the system.” In Butadiene extraction rust acts as a catalyst for undesirable “popcorn formation” and therefore needs to be carefully removed. “For this passivation process we flooded all of the columns twice, up to the full height of 82 metres.” In an initial phase a rinsing and degreasing solution was used, with the actual passivation solution applied in the second phase. Throughout the entire process it was necessary to monitor temperature, pressure and flow. “Following this the columns were emptied and subjected to nitrogen, thus ensuring that the complete plant system remains free of oxygen.”

Integration into existing infrastructure

Following successful conclusion of the passivation work the actual commissioning could be commenced. In this the system was integrated into the existing infrastructure and hydrocarbons could subsequently be introduced. This overall commissioning period needed to be planned down to the tiniest detail, Thomas Weber reports. “We had a window of four weeks in which to clean and inertize the pipe connections between the new and the existing plant.” During this time the entire production works were shut down for maintenance and inspection purposes, which is ideal for the connection of pipes and other media. On the other hand, this also gave rise to enormous time pressure, as the end date was fixed, regardless of the status of the project – the new butadiene extraction plant had to be ready for commissioning in time after the shutdown of the refinery. Pipes that could not be isolated during shutdown for operational reasons were connected using the hot tapping procedure.

Alignment of the columns has to be undertaken by hand.

A crane with a load-bearing capacity of 1,250 tonnes lifts a column into place.

During this special procedure a nozzle with flange and slide valve is firstly fitted. Drilling is undertaken using hot tap machines, which prevent the medium from escaping the pipe.

After drilling, the slide valve is closed to enable further work to take place at constant operational pressure. All connection work had to be carefully co-ordinated with the other maintenance work: a general shutdown of all process plants on a site typically only occurs every seven years. The co-ordination of the inspection, maintenance and connection work was highly demanding due to the large number of tasks involved and the time window available and presented the CAC project team with a number of challenges in the preparation and planning stages. “This stage required a lot of co-ordination. We had to plan our connecting logistics down to the hour and co-ordinate these with the maintenance and inspection tasks for the plant as a whole. Communication between OMV project management and us was excellent, however,” praised Thomas Weber.

Matthias Anders
Senior Project Manager

matthias.anders@cac-chem.de

Introduction of flushing and degreasing solution → Discharge of flushing and degreasing solution → Introduction of passivation solution → Discharge of passivation solution → Introduction of nitrogen

The passivation process

View of the cell hall.

No electrode gap, less energy loss

With zero-gap electrolysers chlor-alkali electrolysis is considerably more economical.

As from December 2017 the amalgam process will belong to the past in the European chlorine and caustic production. Because this is the date for the introduction of a ban on mercury cell technology in the European Union – the process is simply too hazardous and environmentally harmful. Membrane electrolysis processes offer an already proven alternative. Membrane electrolysis was originally developed with a gap between cathode and cation exchange membrane (finite gap). CAC recommends the use of zero-gap electrolysers, which offer the benefits of clear savings in expensive electrical energy and very high operational safety. In addition, cooling water is also saved, due to the fact that less heat needs to be removed.

In the case of standard membrane electrolysers with finite-gap cells the cathodes do not touch the membrane. There is a distance of approximately two millimetres to prevent the membrane and cathodes from damaging one another. The electrical resistance of these two millimetres results in higher specific electrical energy consumption, which is clearly reflected in the operating costs of a chlor-alkali plant: around half of the production costs of a chlor-alkali plant are created by the costs of electricity. Zero-gap technology enables energy requirements to be reduced by around ten percent, to approximately 2,050 kilowatt hours per tonne of sodium hydroxide (NaOH 100 percent) with a current density of six kiloamperes per square metre.

Higher power requirement due to electrode gap

In finite-gap electrolysers the anodes touch the membrane, but not the rough surface of standard coated cathodes. In the past, these coatings resulted in mechanical damage to the membrane and a chemical-related deterioration of the cathode surface. It is expressly forbidden for the cathodes to be touched by the membrane. As a result an approximately 40 millibar higher gas pressure is strictly required on the cathode side.

“The ohmic voltage drop results in an enhanced electrical energy requirement caused by the gap between the cathode and the membrane,” explains Dr. Klaus Reuhl, Senior Product Manager for Chlor-Alkali. In the new technology, the two millimetre gap is filled by a nickel material with excellent electricity conducting properties and elasticity. “The sponge-like nickel has a new type of coating and hugs the membrane without damaging it chemically or mechanically,” he continues.

Energy saving potential of the zero-gap technology

If we consider a daily production of 300 tonnes of NaOH 100 percent, 270 tonnes of chlorine and 7.7 tonnes of hydrogen: compared with the finite-gap technology, using the zero-gap technology reduces the electrical power requirement by about two megawatts. This corresponds to savings of around 17 million kilowatt hours of electrical energy per year. With this amount of saved energy it would be possible to continuously supply around 5,000 German households with sufficient electricity.

Proven technology

CAC has been designing and building chlor-alkali electrolysis plants since 1987 using the membrane process. Together with partner companies in the field of electrolyser manufacturing, CAC realises plants using both finite-gap and zero-gap technology. In addition to twelve new plants, the Chemnitz-based company has modified and updated numerous existing plants.

For example, at the Austrian company Donau-Chemie in Brückl, CAC integrated two additional electrolysers of the manufacturer Asahi Kasei Chemicals Corporation with zero-gap technology, which are operated ▸

With zero-gap technology energy requirements are reduced by around ten percent.

Block diagram of chlor-alkali membrane electrolysis

Salt dissolution: The crude salt (solar, evaporated or rock salt) is dissolved with water and recycled weak brine, resulting in an almost saturated crude brine (305 g/l NaCl).

Brine treatment: The crude brine is treated with chemicals to precipitate impurities (such as Ca, Mg, Fe, SO_4).

Brine filtration: The precipitated products, such as $CaCO_3$, $Mg(OH)_2$, $Fe(OH)_3$, $BaSO_4$ and $CaSO_4$, are filtered off with a suitable filter system. The filtered brine now only contains dissolved impurities totalling fewer than 4 ppm.

Brine fine purification: The fine purification of the brine is conducted with chelating ion exchangers, whereby the concentration of polyvalent cations is reduced to below 20 ppb. This high degree of purity is necessary to protect the electrolysis membrane against blockages.

Membrane electrolysis with transformer/rectifier: The cell hall comprises the required number of membrane electrolysers. Each electrolyser consists of multiple electrolysis cells, arranged electrically in series and hydraulically parallel. The transformer-rectifier system provides the electrolysers with electrical energy. The electro-chemical reaction in the electrolyser is:

$$2\,NaCl + 2\,H_2O \rightarrow 2\,NaOH + Cl_2\uparrow + H_2\uparrow$$

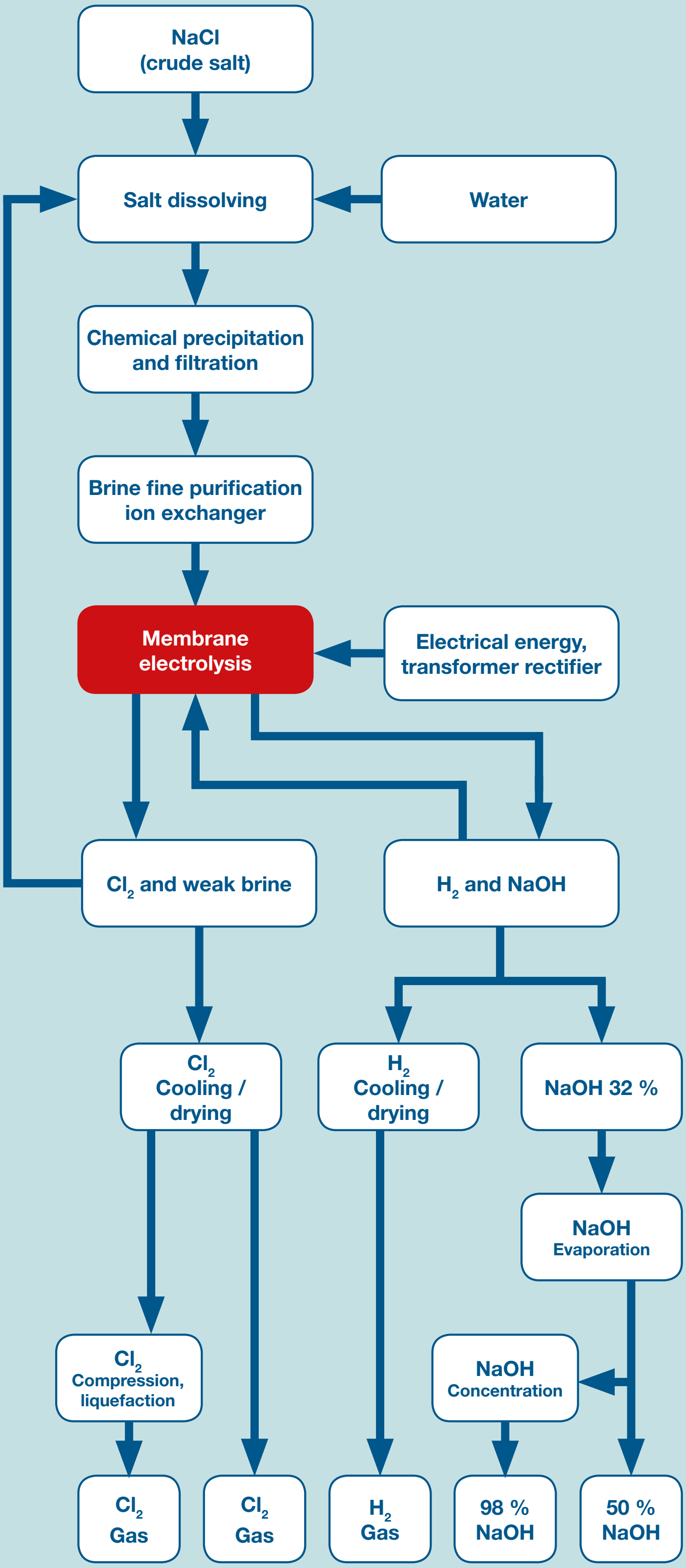
Processing of catholyte and hydrogen: The catholyte (sodium hydroxide solution, NaOH) coming from the membrane electrolysis has a concentration of around 32 percent NaOH. The hydrogen is separated from the catholyte and cooled. One part of the lye is rendered as product, the other part is diluted with water and returned to the electrolysis process.

Processing of anolyte and chlorine: The weak brine leaving the electrolysers is dechlorinated and pumped back to the salt dissolver. The chlorine gas produced is separated from the anolyte and cooled. Part of the heat from the chlorine can be passed on to the pure brine via heat exchangers. This method of heat recovery saves on steam.

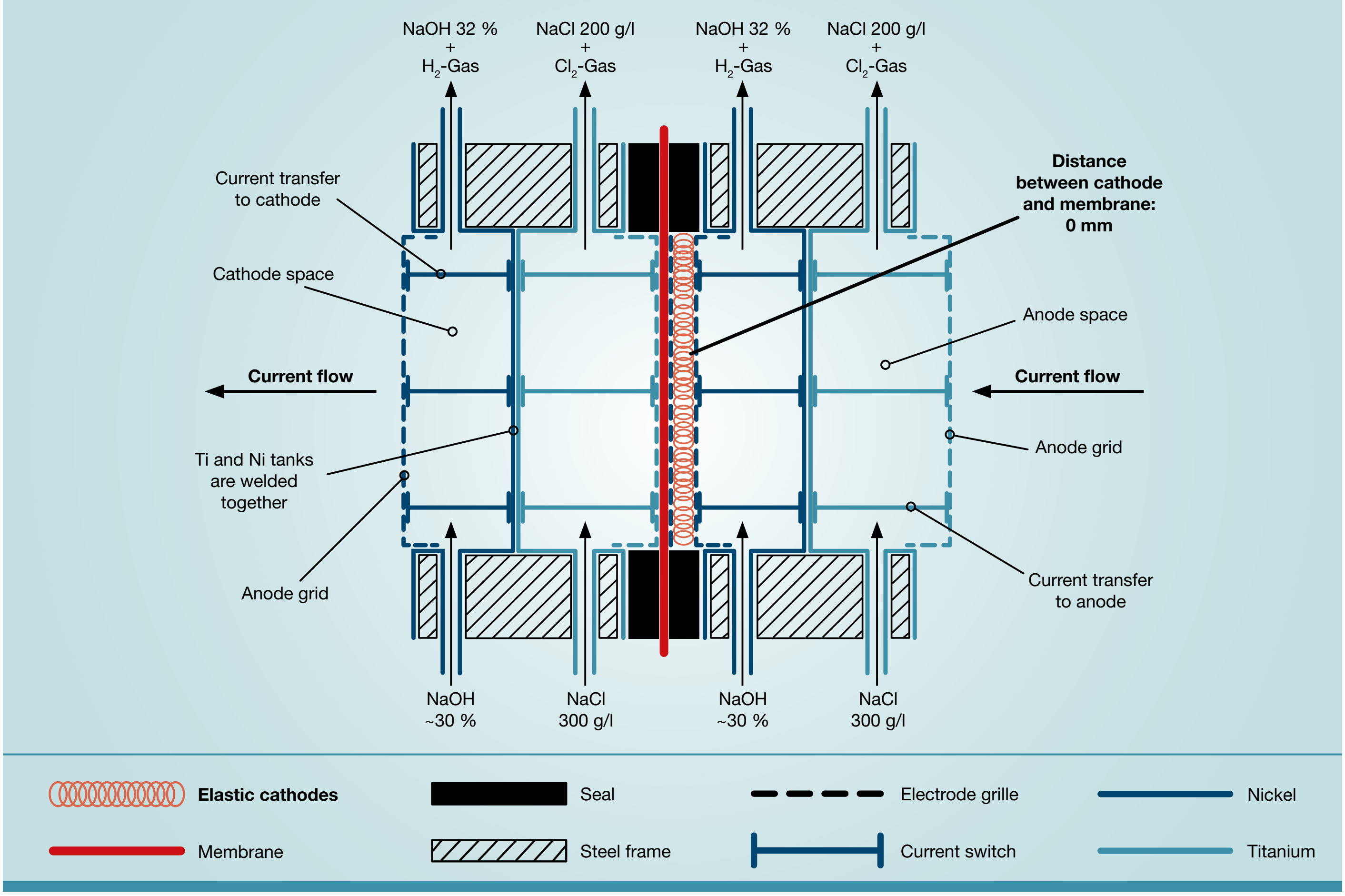
Drying, compression, liquefaction of chlorine: Where required, the chlorine gas is dried with concentrated sulphuric acid, compressed with turbo or liquid ring compressors and liquefied at a temperature in accordance with the pressure.

Lye evaporation: The 32 percent sodium hydroxide solution from the electrolysis is concentrated to a standard 50 percent lye if required. Production of NaOH flakes: Solid sodium hydroxide (NaOH) in the form of flakes can be produced with a final concentration of 98 percent.

Chlorine absorption/emergency absorption: Chlorine absorption occurs in packed columns and/or jet scrubbers. For the protection of the environment, all exhaust gases from the chlor-alkali plant that contain chlorine are absorbed with diluted sodium hydroxide solution.



Zero-gap electrolyser with no gap between cathode and membrane



parallel to older finite-gap electrolysers. This has served to increase possible production capacity and reduce operating costs due to lower electricity consumption. At the same time, the new zero-gap electrolysers also have lower requirements for cooling water, as less ohmic thermal loss needs to be removed.

New potassium chloride (KCl) electrolysis

The first zero-gap plant engineered by CAC in Germany is currently being built at AkzoNobel in Ibbenbüren. Customer is Neolyse Ibbenbüren GmbH – a joint venture of Evonik and AkzoNobel. The contract assignment comprises detail engineering, purchasing services, construction site management and support during commissioning, up to the performance testing of the plant. The membrane electrolysis in Ibbenbüren is to have an annual capacity of 130,000 tonnes of caustic potash (KOH 100 percent) and 82,000 tonnes of chlorine (Cl_2 100 percent). Production is scheduled to start in the fourth quarter of 2017.

This new plant is replacing an old plant that uses the amalgam process. Licensor of the four electrolysers with 136 cells each is Asahi Kasei Chemicals Corporation, already a proven technology partner of CAC. Zero-gap electrolysers from the Japanese company are already in use, for example at the AkzoNobel sites in Delfzijl and Rotterdam.

Best Available Technique, BAT

Modern membrane electrolysers correspond to the conclusions drawn by the BREF document (Best Available Technique Reference Document) for the chlor-alkali industry. Negative environmental impacts from mercury or asbestos emissions via the exhaust air from the cell hall, waste water or the electrolysis products are excluded with membrane technology.

As a consequence of the corrosive liquids and gases that are to be processed, materials with high resistance and quality are utilised, such as titanium (Gr2, Gr7), nickel, PVCC, PVDF, GFK and PTFE. Electrolysis takes place at a temperature of approximately 85° celsius and overpressure of from 20 to 450 millibars.

Dr. Klaus Reuhl
Senior Product Manager
Chlor-Alkali

klaus.reuhl@cac-chem.de

Expert compression

Compressors form part of nearly all process engineering plants. The precise selection and installation of these is a core competence of CAC.

Martin Rohleder, head of the Equipment department at CAC, is one of the specialists in the field of compressor technology. He has already conceived a large number of plants, designed these with potential suppliers and realised them in the scope of detail engineering. To begin with, the question is purely one of determining figures: “For our planning we need to know exactly which gas in which quantity or volume per time unit needs to be compressed at what temperature,” the expert explains. With the aid of these details it is possible to specify the compressor type, following an initial internal estimation of the performance data.

Due to model differences, not every compressor is suitable for every quantity/volume flow and every compression ratio. For example, single or multi-stage piston compressors are suitable for a combination of high pressure conditions and final pressures with relatively low volumes. Turbo compressors are able to process higher volume flows, but only at lower pressures. If the throughput is increased to over 10,000 standard cubic metres per hour, a single or multi-stage turbo compressor is advisable. At quantities above 100,000 cubic metres per hour and only relatively low pressure conditions, a multi-stage axial compressor is essential. In addition to pressure and quantity, the conclusive specification of compressor type is dependent upon numerous other boundary conditions.

An example: for the compression of natural gas, the initial calculation indicates that a turbo compressor would be the best form to use. The available data and necessary operating parameters can then be used to undertake an initial internal design of the machine. The operating points and their location in the characteristic zone are then optimised with potential suppliers. Possible parallel and series operation modes need to be taken into consideration, together with control concepts and availability. The characteristic zone limits the operating range of the compressor and indicates its operational boundaries. For example, it states the surge line, i.e. the unstable area in which the current on the impeller is interrupted due to insufficient throughput. With the resultant of mechanical instability, damage may be caused within the compressor. In addition, the characteristic zone also displays the optimal operating area with the best degree of efficiency, as well as the capacity limit.

Machine selection study

For Martin Rohleder and his colleagues, these initial considerations form the basis for the machine selection study, in which compressor type, size, number of stages, impeller diameter (for turbo compressors) and type of power unit are chosen. Electrical motors, gas turbines, gas motors or steam turbines may all be considered as power unit. The type of power unit ultimately selected is dependent on a range of boundary conditions. Each type of application is unique in its prerequisites: the availability of suitable operating media such as electrical energy, steam or natural gas has a decisive influence on the choice of power system, as do costs of operation and maintenance, compressor type and reaction times.

Following conception and specification of the compressor trains Rohleder and his colleagues evaluate possible suppliers and assess their offers. “In this we always follow the global sourcing approach. Different suppliers may be suited to different countries.” Further design of the machines is then undertaken by the suppliers. “In our experience, our internal estimates are not far off their calculations. We have so much experience in this area that we are able to depend on our figures.”

Detail engineering

In the subsequent detail engineering CAC undertakes interface management with the engineering disciplines, the suppliers and of course the customer. The interaction of the compressor with the rest of the plant is ▸

High-speed natural gas compressor with integrated electric motor and active magnetic bearings in a gas compression station.

very important here. In the detail planning, CAC pays attention to process engineering requirements as well as positioning and acoustic and structure-mechanical effects on the piping and foundation system. A further focus is obviously on the control and monitoring of the machine units. Manufacturing and quality controls are also included in the scope of supply.

Following delivery of the machines CAC supervises the installation and subsequent commissioning on the construction site. Experts monitor the foundations, check the alignment of the machines, supervise the assembly of all accessory systems from oil and seal gas systems to components for the control and monitoring of the machines. The individual assembly and commissioning stages are logged and documented. Together with the manufacturer and the customer, CAC employees carry out test programmes for the functional testing of all systems. After successful completion of a test run and proof of performance, the final acceptance is undertaken by the customer. The compressor is then ready for operational use and has a lifetime of at least 20 years - depending on correct maintenance and service.

Martin Rohleder
Head of Equipment

martin.rohleder@cac-chem.de

UGS Puchkirchen – RAG Austria

Year of construction	1995
Plant type	Underground natural gas storage facility: pore storage Process gas volume at time of commissioning of the gas compressor approximately 500 million Nm³
Compressors	2 turbo compressors, each of 115,000 Nm³/h injection and extraction capacity
Drive	Gas turbine
Distinctive features	Compressor plant designed for both storage and extraction operation

UGS Haidach I/II – Joint Venture RAG Austria/OOO Gazprom Export/WINGAS GmbH

Year of construction	2007 and 2010
Plant type	Underground natural gas storage facility: pore storage Process gas volumes at the time of commissioning of the gas compressor of the 2nd stage approximately 1.04 billion Nm³
Compressors	4 turbo compressors, each of 260,000 Nm³/h injection and extraction capacity
Drive	Electric motor
Distinctive features	–

UGS 7Fields I (UGS Nussdorf, UGS Zagling) – Joint Venture RAG Austria/E.ON Gas Storage GmbH

Year of construction	2011
Plant type	Underground natural gas storage facility: pore storage Process gas volumes at the time of commissioning of the gas compressor 1.16 billion Nm³
Compressors	3 turbo compressors, each with around 160,000 Nm³/h injection capacity and around 235,000 Nm³/h extraction capacity
Drive	Electric motor
Distinctive features	Magnetic bearing compressor

UGS 7Fields II (UGS Nussdorf, UGS Zagling) – Joint Venture RAG Austria/E.ON Gas Storage GmbH

Year of construction	2014
Plant type	Underground natural gas storage facility: pore storage Process gas volumes at the time of commissioning of the gas compressor 685 million Nm³
Compressors	1 turbo compressor, with around 240,000 Nm³/h injection capacity and around 360,000 Nm³/h extraction capacity
Drive	Electric motor
Distinctive features	Compressor with 2 process stages, operation of process stages in parallel or series

Go East!

CAC will be exhibiting in Moscow in September.

When the Khimia opens its doors from 19 to 22 September at the Expocentre Moscow, CAC will be present once again. Last year the Russian industry meeting point celebrated its 50th anniversary – with 391 exhibitors from 25 countries and 190 Russian companies.

Experts can inform themselves about the following themes at the Khimia:

- Chemical industry
- Raw materials
- Chemical production
- Green chemicals
- Analysis and laboratory equipment
- Chemical engineering and pumps
- Production of synthetic materials

In addition to the fair programme, 2016 will also see five special exhibitions take place: the Chem-Lab-Analyt, the Chemmash. Chemmash-pumps, the Green Chemistry and the Plastics Industry Show. All of the exhibitions will be held on the Expocentre site.

All fair dates for CAC can be found on our homepage at http://www.cac-chem.de/cac/Presse/Events.

KHIMIA 2016
Expocentre site,
Moscow, Russia

19 to 22 September 2016
Hall 2.1

C·A·C®

ALWAYS AN IDEA AHEAD

Germany Headquarters
Augustusburger Straße 34
09111 Chemnitz, Germany

Phone: +49 371 6899-0
Fax: +49 371 6899-253
E-mail: info@cac-chem.de

Representation in Russia
Novocheremushkinskaya ul. 61
117418 Moscow, Russia

Phone: +7 495 937-5048
Fax: +7 495 937-5049
E-mail: mos@cac-chem.ru

Representation in Kazakhstan
Mikrorayon 5 House 30 «b»
050062 Almaty, Kazakhstan

Phone: +7 7272 9646-15
Fax: +7 7272 9646-19
E-mail: info@cac-chem.kz

Representation in Ukraine
ul. Kudryavskaya 8b, off. 3
04053 Kiev, Ukraine

Phone: +380 44 2723018
Fax: +380 44 2724428
E-mail: cac-kiev@voliacable.com

Affiliated companies

HUGO PETERSEN GmbH
Industriepark Kalle-Albert, Bldg. K330
Rheingaustraße 190-196
65203 Wiesbaden, Germany

Phone: +49 611 962-7820
Fax: +49 611 962-9099
E-mail: contact@hugo-petersen.de

BIPROTECH Sp. z o. o.
ul. Kamieńskiego 47
30-644 Kraków, Poland

Phone: +48 12 260 37 40
Fax: +48 12 267 83 37
E-mail: office@biprotech.com