

Shell and Paques create new JV to push bio-desulphurisation technology for Oil and Gas

Shell and Paques Holding B.V. have agreed upon the formation of a 50-50 joint venture, Paqell B.V., to focus their efforts on the marketing of biological desulphurisation in the oil and gas sector for high pressure gas applications using THIOPAQ® O&G (Oil and Gas) technology.

"The joint venture itself demonstrates Shell's continuous drive to develop innovative solutions for the future, particularly with growth in the gas sector and the challenges in meeting increasing energy demand and environmental expectations," said Theo Bodewes, Shell Vice President for Gas & Liquids Treating Technologies. "Our unique sulphur recovery technology is well-positioned to address the industry needs, and we are pleased to start a new chapter in our cooperation with Paques."

"The foundation of Paqell will give a stronger dedicated focus for their successful activities. This joint venture is the achievement of our strategy of continuous innovation and forming partnerships for product and market development. We therefore look forward to an even closer cooperation with Shell", said Rob Heim, Managing Director of Paques Holding B.V.

THIOPAQ® has been deployed by Paques in the water business for atmospheric



biogas desulphurisation since the early 1990's. Paques then formed a technology alliance with Shell in 1997, and saw the successful deployment of THIOPAQ® to the broader oil and gas industry, particularly in large scale H₂S removal and sulphur recovery. THIOPAQ® is currently being applied in four (4) sites in the oil and gas industry, with seven (7) projects under construction.

A new research and development program will be concluded by the end of next year,

which aims to provide the next generation THIOPAQ® O&G technology with a step change in efficiency and capacity. Once this research program is successfully completed, Paqell will operate from the Watercampus in Leeuwarden, the Netherlands where there is a high level of expertise available in sustainable water technology. For now, Paqell operates from Leeuwarden, Amsterdam and Balk in the Netherlands. Machiel van der Schoot will be Managing Director of Paqell B.V.

Paques Invitation for Industrial Leaders Forum

Did you know that between 1987 and 2003 roughly twice as much water was used by industries than was used for what is classed as domestic purposes: on average 665 billion cubic meters per year. Just under a third of this water usage was recorded in the United States. Just under a thirtieth was used by all 19 territories of Southeastern Africa. Central Africa, Southeastern Africa, Southern Asia, Northern Africa and Asia Pacific all have low per person industrial water use, because total volume of water used for industrial purposes is relatively low, whereas industries in these regions use relatively little water.

Territory sizes below shows the proportion of all water used for industrial purposes that was used there, 1987 to 2003.

This is what Paques is all about: biological wastewater and gas treatment in order to contribute to reducing water and carbon footprints of industrial companies and municipalities and in reclaiming valuable resources.

Are you interested in learning more about Paques' Pure Solutions that we offer? It would be nice if we could meet each other at the Industrial Leaders Forum as part of the International Water Week Amsterdam. The Industrial Leaders Forum on Thursday 3 November in Amsterdam will bring together an exclusive audience of executives from different industrial sectors and the water sector itself with the aim to create a positive and comprehensive dialogue, challenging each other to innovate and develop a road map to identify crucial



necessary advantages! Attached invitation includes all relevant information.

If you are you more in favor of enjoying a sustainable Ben & Jerry's ice cream, then we would like to recommend you to visit our stand 428 in Hall 7 during the Aquatech Exhibition, from 1 November till 4 November at Amsterdam RAI. Paques' innovative BIOPAQ®AFR for fat- and oil containing wastewater at the Ben & Jerry's ice cream factory in the Netherlands will be presented there.

We look forward to meeting you in Amsterdam!

Paques Partner Event 2011

Paques welcomes its partners for their biennial Partner Event, to be held in the northern part of the Netherlands from October 31st until November 2nd. This year's event will have an interactive character in order to learn from each other's visions, strategies, ideas and experiences. Themes that will be discussed are strategy, market developments, innovation and cooperation.

Tuesday afternoon is reserved for a site visit of the Ben & Jerry's ice cream factory, to visit one of Paques' latest innovations: the BIOPAQ®AFR reactor. Aquatech and the International Water Week will be visited from Wednesday onwards.

Paques looks forward to welcoming their partners in the Netherlands on the 30th of October! Paques is ready to shape the future and would like to do that in close cooperation with its partners.



Visit the Paques stand Hall 7, number 428

Crew	
Tuesday	Ilse Schuurman, Emil Sandstra, Peter Yspeert, Willie Driessen, Leo Habets
Wednesday	Ilse Schuurman, Emil Sandstra, Peter Yspeert, Willie Driessen, Leo Habets
Thursday	Ilse Schuurman, Emil Sandstra, Peter Yspeert, Willie Driessen, Véronique Renard
Friday	Emil Sandstra, Peter Yspeert, Willie Driessen, Véronique Renard

Timetable:
Tuesday till Thursday: 10am – 6pm, Friday: 10am – 5pm

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Revitalizing resources

The world is changing rapidly. Besides global warming and depletion of valuable resources, water scarcity is one of the most important challenges of today and for the future. Water is a bare necessity of life and essential in the production of food, goods and energy. Integration of water purification, sustainable energy generation and reuse of resources is therefore becoming more and more important.



'Used water creates green energy.'

Ideas and Solutions

Paques helps companies to contribute to the major challenges of today: to reduce water and carbon footprints and reclaim valuable resources. Paques' anaerobic water purification systems produce energy from wastewater, whilst purifying the water and facilitating water reuse. The biogas produced in the purifying process is a source of green energy. Since the introduction of our first BIOPAQ® reactor in 1981, close cooperation with our partners has resulted in a broad portfolio for integrated water and gas treatment. Paques' technologies have proven to be cost-effective and reliable solutions.

the sustainability of companies and contribute to the balanced improvement of People, Profit and Planet through revitalization of resources.

Vision

Paques biotechnology helps companies to reduce fresh water intake, decrease their carbon footprints and reclaim valuable resources from waste. Major global changes make integration of water purification, sustainable energy generation and reuse of resources of growing importance.

Water

Water scarcity is one of the most important challenges of today and for the future. Water is a bare necessity of life. It is essential in the production of food, goods and energy, for socio- economic development

and for maintaining healthy ecosystems. Although 70% of the earth's surface consists of water, only 1% is fresh water and available for human consumption. A growing world population, a changing climate and higher standards of living only intensify the pressure on already scarce resources.

Energy

Continuing global warming and depleting reserves of fossil fuels force us to explore alternative, sustainable energy sources. There is a close connection between energy and water, as one is needed to use the other.

Resources

The world's natural resources are running low. Take phosphate, an essential element in the production of food. It is expected that half of the world's current high-grade resources will be gone before the end of the century. Besides this, reserves of some base metals are expected to be depleted within two decades.

Paques: looking forward to a pure future

A lot of activities and opportunities in the world of water and wastewater treatment! With the Aquatech 2011 and the first edition of the International Water Week ahead of us, we are eager and proud to be part of this hustle and bustle.

At the Paques stand (no. 428 in Hall 7) you will be welcomed by our experienced staff to inform you on how we can contribute to the major challenges of today: to reduce water and carbon footprints and reclaim valuable resources. If you like, you can enjoy a Ben & Jerry's ice cream during your discussion. Why ice cream? Because recently, we built one of our latest innovations in the field of anaerobic wastewater treatment at Unilever's Ben & Jerry's ice cream factory in the Netherlands. The BIOPAQ®AFR bio-digester is especially

designed to produce biogas from fat containing wastewater. With this solution, we are nominated for the Aquatech Innovation Award. In addition to anaerobic treatment, we can also inform you about highly efficient biogas desulphurisation, biological ammonia removal that saves energy and chemicals, a new way of membrane filtration that increases the lifetime of the membranes, and many more subjects.

To the Conference Program of the International Water Week, we contribute with four presentations. You will find the subjects and the agenda in this newspaper.

Paques is also present at the Industrial Leaders Forum on Thursday November 3rd. This Forum will bring together an

exclusive audience of executives from different industrial sectors and the water sector with the aim to create a positive and comprehensive dialogue, challenging each other to innovate and develop a road map to identify crucial necessary advantages! Paques has a close connection with world's industrial leaders DSM, Shell and Unilever and today we are already working with them for a better world tomorrow.

Just ahead of the Aquatech and International Water Week, we welcome around 50 people of our partner network. Through this network, Paques technologies are available all over the world. In a separate 'Paques Partner Event', we learn from each other's visions, strategies, ideas and experiences. Themes discussed are



strategy, market developments, innovation and cooperation. After this event we will visit the Aquatech and International Water Week with them. They too are ready to shape the future!

I wish you an inspiring visit to Aquatech and International Water Week and hope that I or my colleagues will meet you at the Paques stand or at any of the other events.

Rob Heim
CEO Paques bv

BIOPAQ® AFR for wastewater with fats

UASB and super high-rate IC reactors are the industry standard for treatment of wastewater with higher concentration COD, however the incoming water also should be relatively ‘clear’ in terms of very little suspended solids and nearly no FOG (Fat, Oil and Grease). In typical situations where content of solids and FOG in the waste water are too high, pre-treatment steps such as settling tanks and/or DAF units are required to remove FOG. These pre-treatment steps make the whole installation more vulnerable to malfunctioning (more units of operation); they require chemical dosing and produce a sludge layer from the DAF unit that often cannot be treated on site.

For thick fat containing slurries the current option is to digest it in a CSTR. However these can only treat low loads, are large due to long retention times and can not be used for water. The digested material should be removed from the CSTR as a mixture of digested matter and water and needs a post dewatering to separate the water from the digested material.

Paques now developed the BIOPAQ®AFR reactor: a new and innovative technology that fills in the longtime existing gap between the CSTR-digesters (for fat and solids containing slurries) and the super high-rate reactor (which always need a DAF when waste water contains FOG).

Working principle

The AFR combines the pre-, main- and post treatment in a one-stage system with flocculent sludge. The physical or chemical pre-treatment as well as the post-treatment to remove sludge can be skipped due to an integrated flotation unit. The flotation unit supports the biomass retention and therefore a high biomass density in the reactor so that the HRT can be shortened, whereas the SRT remains high.

This will contribute to a compact, space saving design of the reactor. The integrated flotation unit also prevents odor problems due to the release of biogas. The increased SRT will enable the system to deal with the fat and the solid content of the wastewater that normally causes difficulties in granular anaerobic biological treatment. The retention of the compounds due to flotation facilitates the anaerobic digestion and will contribute to their conversion into biogas.

Key success factor is to ensure a short retention time for water and a high retention time for sludge, fats and solids. The application of an integrated flotation unit results in high sludge concentrations and a long sludge retention time. The hydraulic retention time, on the other hand, is very short. The reactor design is therefore very compact.

The use of a flotation unit in the reactor was selected by us prior to using membranes due to the robustness of a flotation unit and due to the high (operational) costs of membranes. Moreover, membranes are not suitable for fats in the wastewaterstreams.



Typical influent characteristics

Characteristic	Influent specification
Type of industry	Food industry (dairy, vegetable oils, slaughter houses)
COD level	5 - 70 g/l
% of fats	maximum 50% of total COD
BOD/COD	0.3 - 0.6
TSS load	up to 70 g/l (solids must be largely biodegradable)

Advantages of BIOPAQ®AFR

- Produces valuable biogas
- Combines the best characteristics of the compact high rate anaerobic reactors and the CSTR
- Is a compact reactor: short hydraulic retention time and long biomass retention
- Requires no acidification or solids separation up front
- Has no odour emission because of its closed design.

In a nutshell

Wastewater with fats, oil and grease and/or solids such as proteins and starch, can effectively be treated in the BIOPAQ®AFR. This anaerobic flotation reactor (AFR) is an all-in-one system that converts all organic compounds into valuable biogas. Waste

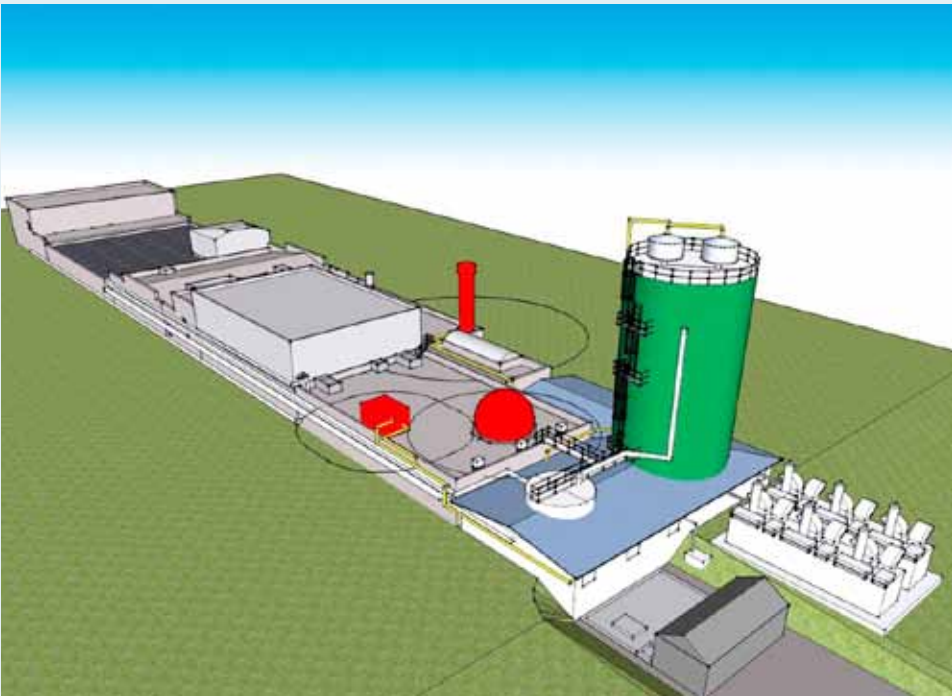
water from the food industry is especially suitable. The compactly designed bioreactor treats wastewater with vegetable or animal fats at hydraulically short retention times from 1-8 days.

The intensive contact between the open bacteria flocks and the organic compounds in combination with the biomass retention in the integrated flotation unit is the success factor for this technology. Considerably reduces discharge costs, with 90-95% COD removal in most cases

KNW Conference Water & Innovation: Water Technology. Thursday, 3 November 2011, Session 3: BIOPAQ®AFR Technology by Tim Hülsen, 2:20 pm RAI conference centre

Moscow Brewing Company cleans brewery effluent water with BIOPAQ® IC

In order to comply to strict effluent requirements, Moscow Brewing Company signed a contract for the reconstruction and upgrade of a existing wastewater treatment plant with Hydrotech a.s. Slovakia., our business partner in Eastern Europe. The plant is now under reconstruction and will be fully operational summer 2012. The WWTP is designed for a future capacity of 400 m3/hr (720 000 hl of beer/month). The heart of the wwtp is a BIOPAQ®IC reactor, which will reduce the soluble COD level by 80%. Post-treatment comprises a reconstruction of MBC's existing aerobic treatment by nitrification/denitrification, volumes extension and installation of the new sedimentation tank equipment. The generated biogas will be used for electrical energy production which will be consumed in brewery. Paques supplies the internals for the reactor and a biogas flare. Hydrotech a.s. manages the total project.



THIOPAQ® cooperation USA

Since the early years of the 21st century Paques teamed up with Cameron (headquarters in Houston, Texas), a leading provider of equipment and services in the oil, gas and process industries. In combination with Paques' activities in the typical oil and gas related industries, more than a dozen THIOPAQ® installations in the biogas industry and landfills were engineered, manufactured and maintained.

Within this installation base some of the larger city landfills near New York and Las Vegas are two of the eye catchers, also with regards to their large removal capacity and sizing.

‘Reuse of water is vital for the future.’

New options for wastewater with BIOPAQ® MBR Downstream

Paques has developed an innovative improvement for MBR systems (membrane bioreactor) which significantly reduce energy consumption and maintenance costs. This brings the use of MBR systems suddenly much closer to (food) manufacturers. Using a compact MBR for wastewater treatment with high effluent quality was still not widespread in recent years in the Netherlands. This was partly due to the fact that available systems require a lot of energy, need to be cleaned with chemicals and require quite some effort to maintain. The development of the BIOPAQ®MBR is an answer to those problems.

Paques provides it customer's solutions to convert wastewater into valuable biogas. In addition, we often propose aerobic (post)treatment. Until recently, such an aerated tank was always followed by a large settling tank where the sludge was separated from the purified water, but today the sludge-water separation can also be done through membranes. The advantages of membranes are: a lot less space required than a settling tank, the effluent has a much higher quality because all particles are retained by the membranes and finally, the aeration tank can also be kept smaller as a higher sludge concentration can be reached. Such a combination of aeration and a membrane system, called a MBR, is therefore considerably more compact.

As mentioned in the introduction, MBR plants have still not had their ‘breakthrough’ because there were also disadvantages: membranes ask relatively a lot of energy, many chemicals must be used (to counter fouling) and are also rather labor intensive. The innovative development of the so-called downstream MBR greatly improved many of these disadvantages.

The problem of conventional systems was that the membrane will clog with dirt and then backflush or chemicals become necessary. An already existing improvement is the use of turbulent air bubbles rising to scour the membrane surface. This is applied both to submerged membranes and side-stream membrane modules. However, in practice, it appears that these systems still require to be frequently (back) flushed with chemicals because the bubbles are not homogeneously distributed and do not scour the entire membrane surface. In those systems the air supply also requires energy.

The innovative approach from Paques is the BIOPAQ®MBR, a downstream system where the water and sludge flows from the top to the bottom and the air is sucked downwards through a venturi effect. Unlike conventional systems, the bubbles in a downstream system have a nice uniform distribution over the entire membrane surface. The effect is a much more homogeneous scouring that also requires less energy because the air is naturally drawn.

Recently, this was verified with very foul mud water at a potato processing factory: an existing MBR, equipped with submerged membranes, showed very fast fouling tendency and usually required cleaning every two weeks, while the BIOPAQ®MBR pilot, equipped with downstream membrane modules was able to run for more than two months at twice the flux before cleaning became necessary! A comparative test was also performed with



hospital wastewater. The Paques downstream membranes were compared to an upstream system with air injection from below. It appeared that the downstream membranes, with air intake from above, showed permeability twice as high for only a third of the energy consumption. Finally, the side-stream membrane installations as the BIOPAQ®MBR are inherently more hygienic than submerged membranes and the maintenance is easier and costs, especially with the new downstream membranes, much less time.

The innovative BIOPAQ®MBR means the following for the end user:

- fouling sludge can be filtered with a lower use of chemicals
- lower energy consumption
- less and easier maintenance

KNW Conference Water & Innovation: Water Technology. Thursday, 3 November 2011, Session 1: BIOPAQ®MBR Technology by Maxime Remy, 9:30 am RAI conference centre

Bio-energy by BIOPAQ® installations

Paques has a very interesting position in the bio-energy sector, being both; supplier to the bio-energy industry as producer.

Supplier to the bio-energy industry

Paques offers solutions to the sector (e.g. bioethanol and biodiesel producers) for treatment of their water and gas effluents in order to comply with discharge regulations and to produce biogas from their wastewater.

Producer of bio-energy

Over 850 Paques' BIOPAQ® installations

produce biogas that meet the natural gas requirements of approximately 2 million Dutch households.

Paques is dedicated to getting the most from the raw materials to produce bio-energy. Whenever wastewater or digester feed contains sulphur compounds, the generated biogas will contain hydrogen sulphide. The THIOPAQ® desulphurization

process removes this compound cost effectively at very high uptime (> 98%). Activated sludge systems remove the remaining COD after anaerobic treatment. Other Paques tech-nologies recover phosphate and remove ammonium.

Paques' anaerobic systems apply to a variety of wastewater streams, such as;

- Spent wash
- Evaporator condensate
- Dried distillers grain soluble (DDGS) dryer condensate
- Thin stillage



Paques Shanghai continues to grow with ANAMMOX® and BIOPAQ® AFR!

Shanghai - Paques Environmental Technology (Shanghai) Co. Ltd., which was established in 1997 and since then has grown into the anaerobic market leader in China for anaerobic waste water treatment employing some 200 people nowadays, continues to grow steadily in 2011, according to Managing Director Dr. Wei Zhang.

“Our anaerobic reference base is still expanding,” according to Dr. Zhang, “but what makes it so exciting is the growth of our newly introduced technologies. Take ANAMMOX® for example; since the introduction of in the Chinese market in 2009 we have already sold 6 installations, 3 of which this year at glutamate plants and the biggest one at the Meihua Group (MSG production) converting a daily Ammonia load of 11 tons per day!”.

A similar story holds for the BIOPAQ®AFR technology of which already 2 installations where sold in the bioethanol- and yeast industry, since the introduction in China last year and several discussions with customers are in a very far stadium.

Dr. Zhang thinks the success of Paques in China has 3 reasons; firstly the Chinese market continues to grow vastly and water and gas treatment will remain an important topic for government and industry. Secondly the Paques technologies have been proven in the market and customers value the innovative character of it and thirdly Paques Shanghai is fortunate to have a great team of people who are all motivated to contribute to a cleaner environment within the corporate Paques family.

On November 14th, 2011, Mr Joop Atsma, State Secretary of Infrastructure and the Environment of the Netherlands is expected to visit Paques in Shanghai. “We look forward to this important visit and to continue to revitalize resources in China in the future”, dr. Zhang concludes.



Ammonia removal with ANAMMOX®

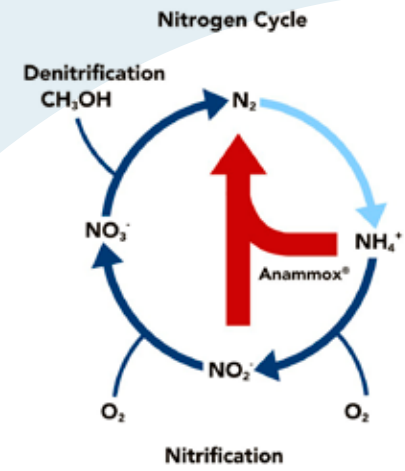
The ANAMMOX® (anaerobic ammonium oxidation) process is an innovative biological process that represents a major breakthrough in nitrogen removal. It is a cost effective, robust and sustainable way of removing ammonium from wastewater and from waste gas. Compared to conventional nitrification/denitrification, operational costs are reduced by up to 90% as are CO₂ emission levels. This brings the plant's carbon footprint down to a minimum.

The ANAMMOX® conversion is an elegant shortcut in the natural nitrogen cycle. In combination with nitrification ANAMMOX® bacteria convert ammonium (NH₄⁺) directly into dinitrogen gas. Working closely with Delft University of Technology, Paques developed the patented ANAMMOX® process for commercial purposes.

Global presence
The first full-scale ANAMMOX® plant started up in the Netherlands in 2002. Ten years later there are 14 full-scale ANAMMOX® references operational. Paques' experience of over twenty years in the design, construction and operation of biological wastewater treatment plants has resulted in an ANAMMOX® reactor that combines excellent biomass retention and granule formation with very good mixing. Effective conversion and stable operation are therefore guaranteed.

Advantages of ANAMMOX® compared to conventional nitrification/denitrification:

- High nitrogen removal
- No methanol dosing is needed for denitrification
- Up to 60% reduction of power consumption
- Minimal production of excess sludge
- Up to 90% reduction of CO₂ emission
- Up to 50% less space required



Applications
The ANAMMOX® process can be used for the removal of ammonium from all types of effluents with a relatively high ammonium concentration (NH₄⁺-N > 100 mg/l).

Some examples of processes and industries where these effluents can be found:

- Municipal wastewater treatment (reject water from a sludge digester)
- Organic solid waste treatment (landfills, composting, digestion)
- Food industry
- Manure processing industry
- Fertilizer industry
- (Petro)chemical industry
- Metal and mining industry

Working principle
In the ANAMMOX® reactor ammonium is converted to nitrogen gas. The reaction is executed by two different bacteria, which coexist in the reactor. Nitrification bacteria oxidize about half of the ammonium to nitrite. Anammox bacteria convert the ammonium and nitrite into nitrogen gas.

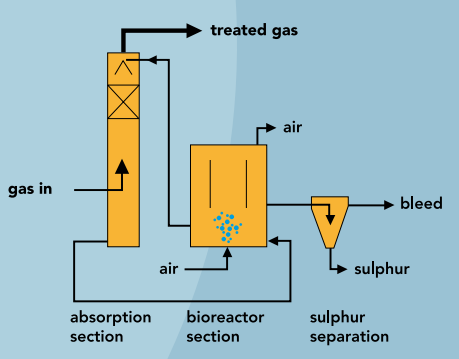
The ANAMMOX® reactor is aerated and equipped with a biomass retention system. The reactor contains granular biomass. The wastewater is continuously fed to the reactor. The aeration provides for rapid mixing of the influent with the reactor

Biogas desulphurisation with THIOPAQ®

Biogas is increasingly important as source of sustainable energy. When biogas is produced through any form of anaerobic digestion, it will be mostly polluted with hydrogen sulphide. The concentrations can vary from 200 ppm up to several volume %. Removal of H₂S is often required for reasons of health, safety, environment and corrosion of equipment such as gas engines, boilers and piping. Desulphurisation is also necessary when biogas is upgraded to natural gas quality and injected in the grid. Of the many methods available, THIOPAQ® is the most elegant. This technology is very reliable (> 98% uptime) and shows deep removal of hydrogen sulphide. Importantly, the caloric value of the biogas is retained as it does not dilute biogas with air or oxygen.

THIOPAQ® technology is used to desulphurise:

- Biogas
- Vent air
- Landfill gas
- H₂S containing gases from the oil and gas industry



Hoogewerff Gold Medal for Jos Pâques

In awarding the Hoogewerff Gold Medal 2011 to Jos Pâques, the Board of 'Stichting Hoogewerff-Fonds' would like to express its deep appreciation for the impressive way Pâques has set up a highly successful global company over a period of many years where he developed, tested, scaled and then commercially applied a wide range of innovative (bio)process technologies in among others high quality and other unique biological processes in many different application areas.

The Hoogewerff Gold Medal is presented every three to five years to a renowned candidate who has exceptionally distinguished him- or herself in the field of chemical engineering. The award is regarded as an important recognition of the candidate's entire lifework. In the recent period of more than 80 years, the Medal is awarded to many famous people in the field of chemical process industry.

Jos Pâques has developed the company, set up by his father in 1960 for trade in agricultural equipment, into a successful company which is world leader in anaerobic wastewater treatment. Early 80's, the company was active in manure fermentation. At that time Pâques came into contact with Wageningen University where a technique was developed in a compact reactor for cleaning industrial wastewater and converting pollution into biogas. This UASB technology, under the brand name BIOPAQ®UASB, was the first innovation from a Dutch university that Pâques has brought to the international market. The BIOPAQ®UASB technology (up-flow reactors) was succeeded over the years by BIOPAQ®IC (internal circulation) technology for the same application. There are now more than 850 of these industrial

biogas plants built that jointly produce a biogas amount equal to the natural gas needs of approximately two million Dutch households. Pâques' entrepreneurship and his passion for innovation and technological advances have ensured that his company Paques Holding B.V. has developed a wide range of industrial processes and renewable



technologies, always from university research to full-scale applications. These include more than fifteen different process technologies for the conversion of organic matter, nitrogen, sulphur, metals, and also separation technology. Pâques has always

been aware that the development and introduction of new technology takes many years, in which a family business has more chance of success than a Plc. The company has an annual turnover of 50 to 60 million Euros and employs approximately 350 employees, many of the activities currently take place in China.

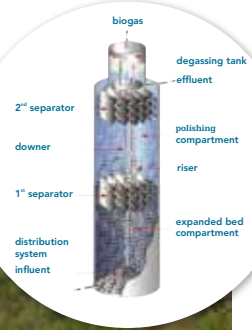
About Jos Pâques
Jos Pâques is the founder and shareholder of Paques Holding B.V. He was CEO of the company from 1973 to October 1, 2002. As of that date, he joined the Supervisory Board of Paques Holding B.V. He worked as Director External Relations for Paques until 2007. Jos Pâques is Chairman of the Advisory Board of Paques in China since 2006.

Jos Pâques is a strong advocate of corporate responsibility. Paques develops and produces high-quality purification systems for cleaning water, gas and air for industrial processes as clean and profitable as possible. Innovation and internationalization are key concepts within the company. Paques has its own office in China. In addition, the company has a worldwide network of licensees.

Paques cases in the spotlight

An archetype for wastewater treatment from pulp mills

Client: Tembec Termiscaming Quebec, Canada
Wastewater: Effluent from pulp mills
Wastewater containing: High concentrations of COD and SO₄
Capacity: 16,000 m³/d and 180,000 kg COD/d
Status: Operational since 2006



BIOPAQ®IC
Anaerobic effluent treatment

THIOPAQ®
Deep H₂S removal from biogas at high uptime

The Challenge

- Minimise electricity cost and sludge dewatering
- Replace natural gas through biogas
- Discharge to surface water according to permit

The Solution

- Application of two BIOPAQ® IC reactors and a THIOPAQ® unit
- Treated water of WWTP can be discharged to river nearby
- Highly reliable and stable process

The Benefits

- Replacement of 75% of natural gas by produced biogas
- Reduction of CO₂ emission by 35,000 ton per annum
- Full support of the Tembec Zero Impact program

Clean biogas for power generation from landfill

Client: Eco Energy, Korea
Biogas from: Landfill
Capacity: 42,000 Nm³/h and 11,000 kg S/d
Status: Under construction, operational in 2012



THIOPAQ®
Deep H₂S removal from biogas at high uptime

The Challenge

- Limit SO₂ emission
- Desulphurise 42,000 Nm³/h landfill gas
- High H₂S concentration of 9,000 ppm

The Solution

- Implementation of THIOPAQ® technology
- Realisation on small footprint
- Usage of biogas for power generation (50 MWe)

The Benefits

- Highly reliable biogas desulphurisation process
- Low chemical cost
- Reusable sulphur cake
- H₂S removal efficiency > 97%

Bio-digester devours ice cream

Client: Unilever - Ben & Jerry's Hellendoorn, the Netherlands
Wastewater: Effluent from ice cream factory
Wastewater containing: Milk, cream, syrup, fruit, fats and proteins
Capacity: 200 m³/d and 4,400 kg COD/d (incl. 800 kg fat/d)
Status: Operational since 2011



BIOPAQ®AFR
Anaerobic COD removal from fat and oil containing wastewater

The Challenge

- Treatment of highly concentrated, fat containing wastewater
- Maximised biogas production
- Reliable and stable process

The Solution

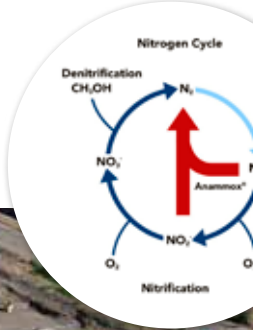
- Compact all-in-one solution combining pre-, main-, and post-treatment
- Application of innovative BIOPAQ®AFR technology with integrated flotation unit

The Benefits

- Total COD removal efficiency of > 90%
- Compact, space saving design
- Minimum sludge production and maximum energy yield

Great virtues through advanced reject water treatment

Client: Severn Trent - WWTW Minworth, United Kingdom
Wastewater: Reject water from digester
Wastewater containing: Inert COD, high amount of ammonia
Capacity: 6,000 m³/d and 4,000 kg N/d
Status: Under construction, operational in 2012



ANAMMOX®
Cost-effective and sustainable nitrogen removal

The Challenge

- Highly concentrated reject water
- Reduction of nitrogen load of the 2nd largest WWTW in the UK
- Minimum total cost of ownership at maximum sustainability

The Solution

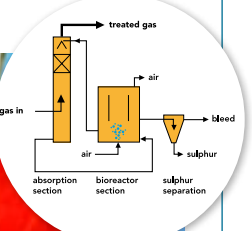
- Conversion of Ammonia to Nitrogen gas with ANAMMOX®
- Maximum flexibility by using existing tanks
- Compact design with high conversion rates (> 2 kg N/ m³/d)

The Benefits

- High savings on chemicals and power consumption
- Reduction of sludge production and CO₂ emission
- Total ammonia removal efficiency > 90%
- Resistant to inert solids and high nitrite concentrations due to granular biomass

Revitalizing distillery effluent

Client: Confidential
Wastewater: Effluent from distillery
Wastewater containing: High loads of COD, Ammonia, Phosphate and Sulphate
Capacity: 800 m³/d, 40,000 kg COD/d, 1,450 kg N/d and 350 kg P/d
Status: Operational since 2011



BIOPAQ®IC
Anaerobic effluent treatment

PHOSPAQ®
Phosphate recovery

ANAMMOX®
Cost-effective and sustainable nitrogen removal

THIOPAQ®
Deep H₂S removal from biogas at high uptime

The Challenge

- Treatment of high strength wastewater with high COD, N, P and S
- Discharge to surface water
- Integrated solution to meet strict effluent restrictions

The Solution

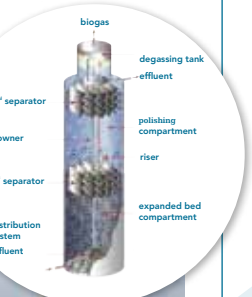
- Advanced integrated anaerobic treatment
- Implementation of BIOPAQ®IC, PHOSPAQ®, ANAMMOX® and THIOPAQ®
- Biogas, struvite and (bio)sulphur production

The Benefits

- Removal efficiencies of > 90% for COD, N and P
- Recovery and production of nutrients and green gas
- Reduction of discharge costs through deep purification

Sugar factory creates sweet energy

Client: Royal Cosun - Suiker Unie Dinteloord, the Netherlands
Wastewater: Effluent from sugar factory
Wastewater containing: High COD from sugar beets
Capacity: 16,800 m³/d and 58,000 kg COD/d
Status: Operational since 2009



BIOPAQ®IC
Anaerobic effluent treatment

The Challenge

- Treatment of highly concentrated wash water from sugar beets
- Flexible solution for season / off-season
- WWTP with positive energy balance

The Solution

- Use of two BIOPAQ®IC reactors
- Adaptive system to handle seasonal changes
- Reclaim biogas from process water

The Benefits

- Production of 8,3 MW primary energy
- Reuse of effluent water
- Strong reduction of odour emissions