

# wave

*Insights from Veolia Water Technologies*

## New horizons for sludge

### **BILLUND BIOREFINERY**

Resource recovery for the future

### **MINING**

Effective sludge management in North America

### **ANAEROBIC DIGESTION**

Innovation serving green energy

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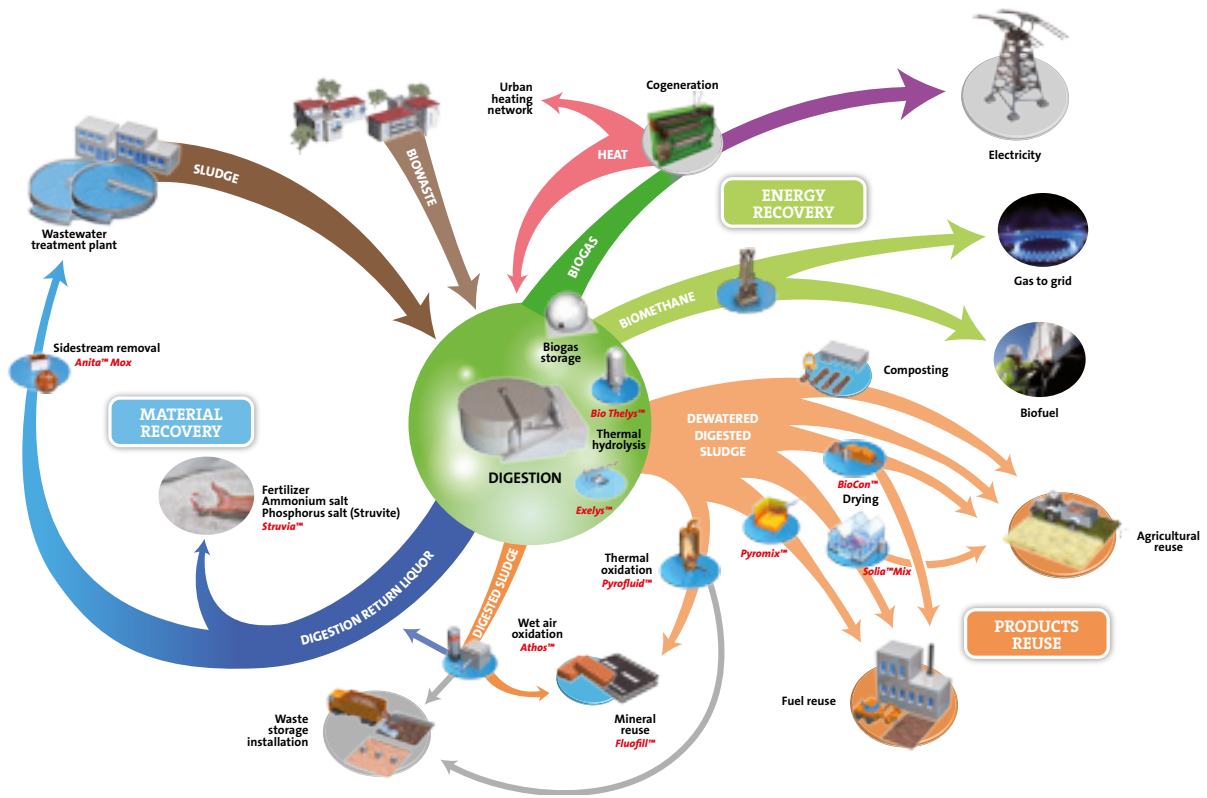
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# New horizons for sludge

**Increasing production worldwide, higher cost for disposal, tighter restriction... sludge management solutions are in high demand. New technologies are rapidly multiplying, fueled as well by sludge's potential as a source of energy and potential for phosphorus recycling.**

Several drivers are contributing to the need for sludge solutions. A global population of 7.5 billion people, growing at a rate of 200,000 per day, is increasing production of sludge – and all other wastes – all around the world. Sludge problems are exacerbated by the increasing number of megacities, with their populations greater than 10 million.

In Europe, environmental restrictions and shrinking available space are making it more difficult to continue traditional approaches of disposal.

For example, Germany is taking steps to prohibit agricultural application of sludge and to require phosphorus recovery. Wastewater treatment plants in urbanized areas also face limits on truck traffic and all factors are contributing to rising disposal costs that can range from €20 to €150/ton.

In North America, attitudes are changing. Sludge is converted to biofertilizer that can be reused, including as a dry pelletized product applied in agricultural and landscaping.

Recovering nutrients such as phosphorus

from treated sludge, called biosolids, is being driven by economics and regulatory pressures. Increasingly important is the recovery of water, which makes up to 99% of untreated sludge, especially in drought-stricken western regions.

## Attractive values

Appreciation also is rising of sludge's energy-producing qualities as a means of fulfilling renewable energy goals. The European Union, for example, has set an objective of increasing to 20% the portion of energy generated from renewable sources by 2020 and to 27% by 2030. In the U.S., utility companies unable to build solar and wind farms fast enough to meet new renewable energy mandates are purchasing energy from sources powered by biosolids.

Proven technologies such as anaerobic digestion, thermal hydrolysis, co-digestion or thermal drying are enabling sludge to be converted into a valuable energy source, with uses varying according to country energy prices. In Germany, for example, sludge-producing wastewater treatment plants often consume the energy they produce. In France,



plants such as the one being built in Cagnes, are able to export the green energy produced back to the grid while in the UK, sludge is collected from multiple sites and processed in big digesters, with the energy sold on the market.

Sludge is also increasingly being viewed and treated as a source of valuable by-products and agriculturally beneficial ingredients, such as phosphorus extracted from struvite. France-based Veolia Water Technologies has long regarded sludge not as a costly waste but rather a resource from which to extract value for the benefit of customers. The company is applying an array of technologies to produce energy and fertilizer products from sludge.

### Heated response

Coupling thermal hydrolysis with anaerobic digestion minimizes sludge volumes while maximizing biogas and green energy production. Thermal hydrolysis uses heat to break down sludge prior to treatment by anaerobic digestion, considerably increasing the biogas yield and reducing the quantity of sludge for final disposal.

One leading **thermal hydrolysis technology, Bio Thelys™**, is being applied to increasingly large projects. In **Bonneuil, France**, energy-efficiency is at the heart of a new wastewater treatment plant which will feature Bio Thelys™. Energy produced from wastewater will be used to heat the plant and surrounding buildings, while biogas produced from the sludge will be treated and injected into the grid. Dehydrated, digested sludge will be transformed into compost and spread in fields to facilitate agriculture.

In **Denmark, the Billund BioRefinery**, which features the **Exelys® thermal hydrolysis** process, treats wastewater and organic waste from households as well as from industrial sources to generate biogas for

energy production, reducing the plant's power requirement and creating additional income through the sale of surplus energy, both heat and electricity, to the local grid.

Both Bio Thelys™ and Exelys® technologies can be applied for thermal hydrolysis, depending on the clients need and existing conditions at site.

### Thermal dried pellets

Applying the **Biocon™ thermal drying process** allowed the municipality of **Buffalo, Minnesota**, to do much more than simply reducing the biosolids mass from its wastewater treatment plant, by 95%; it also resulted in 70-80% savings of the plant's thermal energy requirements, helping reduce operating costs by 50% (compared to disposal of wet sludge). In addition to generating inexpensive renewable energy, the remaining biosolids are ready for land application.

The Biocon dryer is now also available at low temperature (70 to 90 °C), enabling the client to use different energy sources.

### Oxidation power

The **Pyrofluid™ thermal treatment solution** oxidizes organic matter contained within sewage sludge in a number of countries. At **Marne-Aval in France**, for example, steam from two Pyrofluid furnaces feed an electricity-generating turbine, contributing to meeting the plant's energy needs.

In **Hong Kong**, Veolia designed and operates **the world's largest sludge incineration facilities**. With state-of-the-art incineration and flue gas treatment technology, the facility generates 14 MW of electricity that is used to power the plant while up to 2 MW of surplus electricity are exported to the power grid.

### Multiplying solutions

Another innovative solution is **SOLIA™ Mix**, a new generation of solar sludge drying. This

process can achieve dry solids content up to 90%, reducing sludge volume and removal costs and opening multiple disposal routes, including agricultural reuse, composting, landfill, incineration and co-incineration. Among Veolia's references is **Belchatow, Poland**.

Veolia's sludge expertise doesn't stop with energy recovery solutions. The company is constantly looking for new ways to derive value and produce materials that are recyclable or reusable. Its **Ecrusor™ Depackaging** solution turns food and other waste high in caloric value into useful energy by depacking the waste from its packaging in order to extract the organic material. The process creates a homogenous mixture of liquid and solid organics that can then be conveyed to an anaerobic digester to produce biogas, which can then be converted into energy for use at the facility or for sale back to the grid.

As the multiple drivers combine to increase the demand for new sludge management solutions, Veolia is continuing to work on new

technologies and upstream improvements. These include **advanced instrumentation and control technologies** to optimize the environmental and energy performance of facilities. Work is ongoing as well to improve existing approaches such as the introduction of **low-temperature dryers** capable of being used with a heat pump.

Finally, Veolia's patented TurboMix™ mixing system provides improved **phosphorus recovery** capabilities through its compact, resource-efficient Struvia™ process. In the U.S., new regulations driven by eutrophication concerns and recognition of the potential value of the phosphorus is making recovery strategies increasingly popular. As a result, Veolia is working to increase the Struvia™ system's application range in other parts of wastewater treatment and industrial phosphorus recovery.

Clearly, the future of sludge has never burned so bright! ■





## CAGNES-SUR-MER

### FRANCE'S FIRST ENERGY-POSITIVE WWTP

In the southern France resort town of Cagnes-sur-Mer, Veolia is building the country's first wastewater treatment plant with a positive energy balance. Christened "Aeris," the plant will treat the wastewater of 160,000 inhabitants of Nice Côte d'Azur and other neighboring municipalities.

It will be equipped with Spidflow® primary treatment, new generation Biostyr® Duo filters and low temperature sludge drying to achieve up to 90% of dryness.

The sludge is digested in two reactors and the biomethane produced is exported to the Natural Gas distribution grid after upgrading for CO<sub>2</sub> removal. To ensure it produces more energy than it consumes, in all seasons, the design relies on good insulation and controls on energy consumption. With advanced controls to avoid noise and olfactory nuisances, the plant's contemporary architecture integrates it in perfect harmony with its surrounding environment. ■



## HONG KONG

### THE WORLD'S LARGEST SLUDGE INCINERATION PLANT

The sludge treatment plant built by Veolia in Hong Kong is much more than just an industrial site: it is a truly environmentally-friendly complex.

Built for the energy efficient treatment of sludge from 11 wastewater treatment plants in this region with 7.2 million inhabitants, the plant is completely autonomous in water and energy. Using Veolia's Pyrofluid™, sludge weight will be reduced by 90% through incineration and residues will be buried in landfills, whereas today all sludge goes to landfills.

The plant's installed capacity makes it the largest wastewater sludge incineration unit in the world. Sludge treatment produces over 14 MW of electricity which is more than the site needs to operate. The excess electricity produced is therefore distributed on the public network.

600 m<sup>3</sup> of drinking water is produced every day by a sea water desalination plant on the site. This water is used by the ecological complex for its operational requirements. A wastewater recycling circuit avoids discharging effluents into the sea. ■

# Anaerobic digestion

## *Innovation serving green energy*



**With anaerobic digestion, innovation is at the heart of the production of green energy.**

### **What is anaerobic digestion?**

Anaerobic digestion uses bacteria to transform organic waste into energy in the complete absence of oxygen. This transformation occurs in nature, in marshes, for example. In order to be useable on a larger scale, the process has been tamed and optimized in closed tanks called digesters. The micro-organisms digest the organic fraction of the waste and convert it into biogas, a source of renewable energy. The residual organic matter (fraction not degraded during the process) forms the digestate that is dewatered, composted and used as a fertilizer by farmers.

### **Anaerobic digestion: why and for whom?**

Anaerobic digestion delivers two types of recovery from organic waste in a virtuous carbon circle: agronomic with the production of compost, and energy in the form of biogas, electricity or heat. This technology is widely used across Europe and is gaining momentum all around the world.

It provides an answer to one of the current challenges facing the farming sector: design new models of production taking into account environmental constraints and improve competitiveness. Anaerobic digestion is not just used by the agricultural sector. It targets all types of organic waste, whether it is derived from farming, food and beverage industries or municipalities, such as green waste from parks and gardens and the by-products from wastewater treatment plants.

### **What does anaerobic digestion mean for Veolia?**

With anaerobic digestion, Veolia is stepping away from the linear production and consumption approach and moving towards the circular economy, an economy in which the waste discarded by some systematically becomes valuable resources for others.

**Artois Anaerobic Digestion Plant** is a perfect illustration of the convergence between environmental services and energy efficiency from anaerobic digestion at Veolia. ■

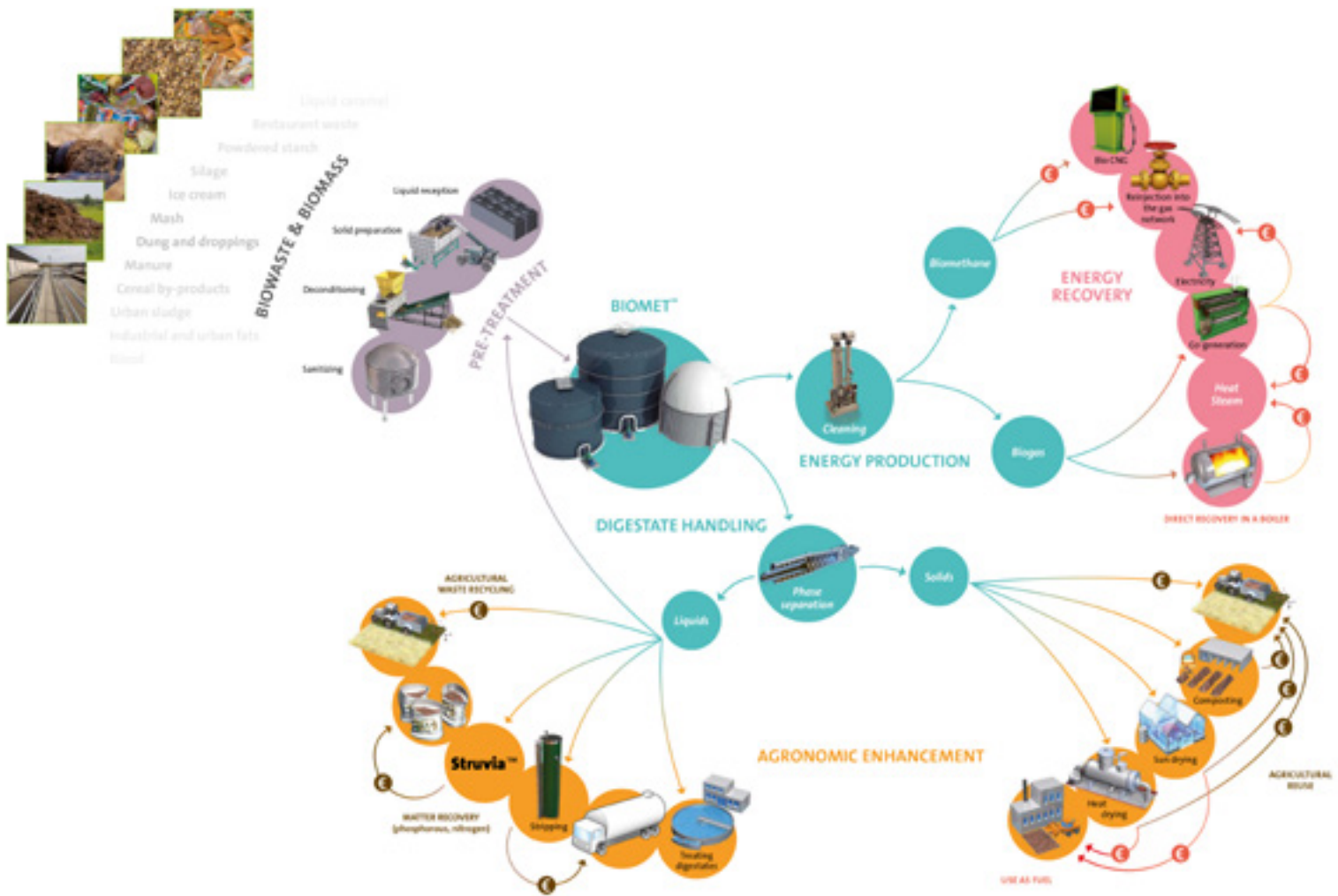




## VEOLIA'S PROCESS AT THE ARTOIS ANAEROBIC DIGESTION PLANT

Since April 2012, on a 9,000 m<sup>2</sup> site in Graincourt-lès-Havrincourt (northern France), the Artois anaerobic digestion plant recovers all types of organic waste from farming (agricultural biomass, endive roots, etc.), industry (biological sludge, flotation grease, production waste, meat waste and restaurant grease), municipalities (grass clippings, municipal canteen waste and treatment plant waste) and the mass retail sector.

Each year, this anaerobic digestion plant recovers 25,000 metric tons of waste and generates 8,000 MWh, the equivalent electricity consumption of 6,500 people. The 7,000 metric tons of digestate, or organic material, not degraded by the process, is composted and used to fertilize the surrounding farmland.



**Waste delivery.** The waste is delivered in bulk and liquids are stored in storage tanks. Pasty and solid waste is directly transferred to the preparation pits. Packaged waste is first unpackaged to extract the organic matter.

**Anaerobic digestion with Biomet™ process.** All this waste forms the energy mix which is fed into the hydrolysis tank. For 3 days, hydrolytic bacteria degrade the waste. After hydrolysis, the energy mix is fed into a digester. For 30 days, methanogen bacteria produce methane from the energy mix. The digestate, or residue from this fermentation, is delivered to a post-digester to complete the degassing process. The biogas storage tank above this post-digester is used to control supply to the cogeneration motor.

**Energy recovery.** The biogas, 60% methane and 40% CO<sub>2</sub>, is treated prior to its use in a cogeneration motor. Each year, this process produces several million cubic meters of biogas. The biogas is used as a fuel to produce electricity that is then fed into the French national grid.

**Agricultural recycling.** The digestate undergoes stabilization heat treatment at 70°C for one hour prior to being dewatered in a centrifuge. At the exit from the centrifuge, the solid fraction of the digestate is composted and ready for recovery as a fertilizer that can replace the chemical fertilizers used by farmers.



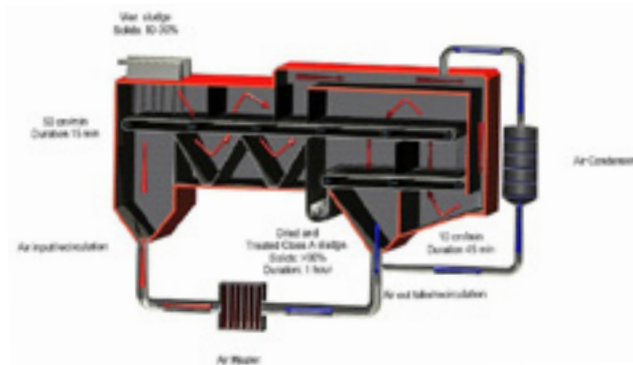
# Alderwood, USA

## A Class A solution

**The Picnic Point Wastewater Treatment Facility is located in Edmonds, WA and is operated by the Alderwood Water and Wastewater District out of Lynnwood, WA. The BioCon™ dryer has been operational since 2013. The plant has a design flow of 4 MGD, expandable to 6 MGD.**

### The client's needs

The Picnic Point Wastewater Treatment Facility was faced with reaching plant processing capacity and was sending its biosolids to be incinerated. The challenge was to find a way to manage the biosolids produced by this facility as hauling and disposing of this sludge was difficult and becoming expensive. It was desirable to have a Class A biosolid to alleviate this concern and be more environmentally conscious.



### The solution

The Picnic Point WWTF is a new activated sludge plant using MBR and a Veolia BioCon™ Dryer. Upgrading the facility with Veolia's BioCon dryer has reduced the amount of biosolid to be disposed of as well as producing a Class A biosolids, allowing to be utilized by a third party to fertilize nearby agriculture. With the help of the BioCon dryer, the plant doubled its sewage treatment capacity, ensuring the site will be able to handle increased biosolids loads for the foreseeable future.

### Process description

The BioCon dryer is a dual-belt convective air dryer designed to be one of the safest on the market. Low drying temperatures and gentle material handling provide a safer drying environment.

The wet biosolids are dried at a temperature of less than 350°F in the first stage; then the drying temperature is lowered as the total solids concentration increases. In order to ensure an odor free operation, wet drying air is passed through a condenser and reintroduced into the dryer.

### Results

The effectiveness of Veolia's BioCon dryer allows the Alderwood Water and Wastewater District to reduce the amount of biosolids, and to safely and easily dispose of it. This solution was executed in a small footprint and allows the municipality to produce a valuable end product, meeting Class A requirements. The newly constructed BioCon building includes an odor control system which eliminates odor. This system coupled with the production of Class A biosolids has earned the plant the support of the surrounding community. ■

### BENEFITS

- Reduces biosolids disposal rate
- Produces Class A biosolids
- Doubles sewage treatment capacity
- Allows for alternative sludge disposal options



# Ovilléo,

## An exemplary wastewater treatment plant in Marquette-lez-Lille, France

**A rising urban population increases wastewater production. Cleaning wastewater requires appropriate technologies which are tailor-made, reliable and energy efficient. The challenge is to offer the best technologies for improving wastewater treatment while using resources more efficiently.**

This challenge was fully met by OTV, a Veolia Water Technologies subsidiary, when it designed and built, in only four years, a new wastewater treatment plant in Marquette-lez-Lille called Ovilléo. Cutting-edge techniques were used for water and sludge treatment, and particular care was given to the sustainability of the design.

### **An efficient and promising sludge treatment line**

New and promising technologies have been implemented at Marquette-lez-Lille for the purpose of:

- reducing the amount of digested sludge produced,
- producing more biogas,
- offering two reuse possibilities: in agriculture or cement plants.

Each treatment step was designed with the aim of enhancing the job and reducing operations costs.

### **Optimizing the use of resources**

- Two separate treatment lines for wastewater and stormwater,
- Some of the treated water is reused in the plant,
- 30% more biogas produced thanks to the EXELYS® process,
- Reduced amounts of sludge,
- 94% of the plant's heating requirements are met through thermal recovery,
- O<sub>2</sub> consumption is regulated,
- Automated control: Smart Building.

### **Improving environmental quality for residents**

- All industrial activities take place in closed buildings and the air is deodorized before being released,
- Visitors are greeted by attractive architecture and plant walls,
- An educational garden symbolizes biodiversity with the species planted there,
- Green roof space limits stormwater runoff,
- Visitor circuits are planned for schools and the general public (both indoors and out). ■

# Technologies serving the

## FOR WASTEWATER

1. **MULTIFLO™**, a simple decantation process for removing part of the pollution
2. **HYBAS™**, a hybrid process that combines biofilm technology and activated sludge
3. **AMONIT®**, continuous aeration control strategy based on pollution load
4. **CLARIFICATION**
5. **HYDROTECH™**, supplementary filtration using filter panels mounted on rotating discs



## WATER REUSE ON-SITE

1. **OPAMEM™ ULTRA**, a compact nanofiltration unit
2. **FILTRAFLO™ PACK**, a filtration unit using media under pressure

## FOR SLUDGE

1. **DIGESTION**
2. **EXELYS®**, a sludge reduction system using thermal hydrolysis which increases biogas production
3. **BIOCON™**, a drying process which produces granules which can be used in agriculture or cement works

# environment

## FOR STORMWATER

1. **MECTAN™**, a pretreatment application adapted to large flow rates
2. **ACTIFLO®**, a compact clarifier which is easy to maintain and well-suited to rapidly fluctuating flow rates
3. **ACTIDYN®**, a sludge thickening process used before sludge treatment



## FOR AIR

1. **AQUILAIR™**, physical and chemical deodorization process adapted to pretreatment and sludge treatment areas
2. **ALIZAIR™**, biological deodorization process installed in the rest of the plant
3. **DESODORISATION** based on active carbon process for sludge drying
4. **ODOWATCH®**, electronic nose to analyze and control onsite odors

## Ovilléo at a glance

**37 municipalities**

*served by the plant*

**620,000**

**PE\***

*\*quantity of organic matter discharged daily per capita and released in wastewater*

**€ 173 million**

*investment by the European Metropolis of Lille (MEL) to build/operate the plant*

**8.1 m³/sec**

*maximum flow of treated water with two treatment lines – wastewater (2.8 m³/sec) and stormwater (5.3 m³/sec)*

**365,000 m³**

*of water saved each year by the two wastewater filtration and recycling units*

**4,785,000**

**KWh**

*produced each year by treating sludge*

# AQUAVISTA™

## DIGITAL SERVICES



# Billund Biorefinery

## Resource Recovery for the Future

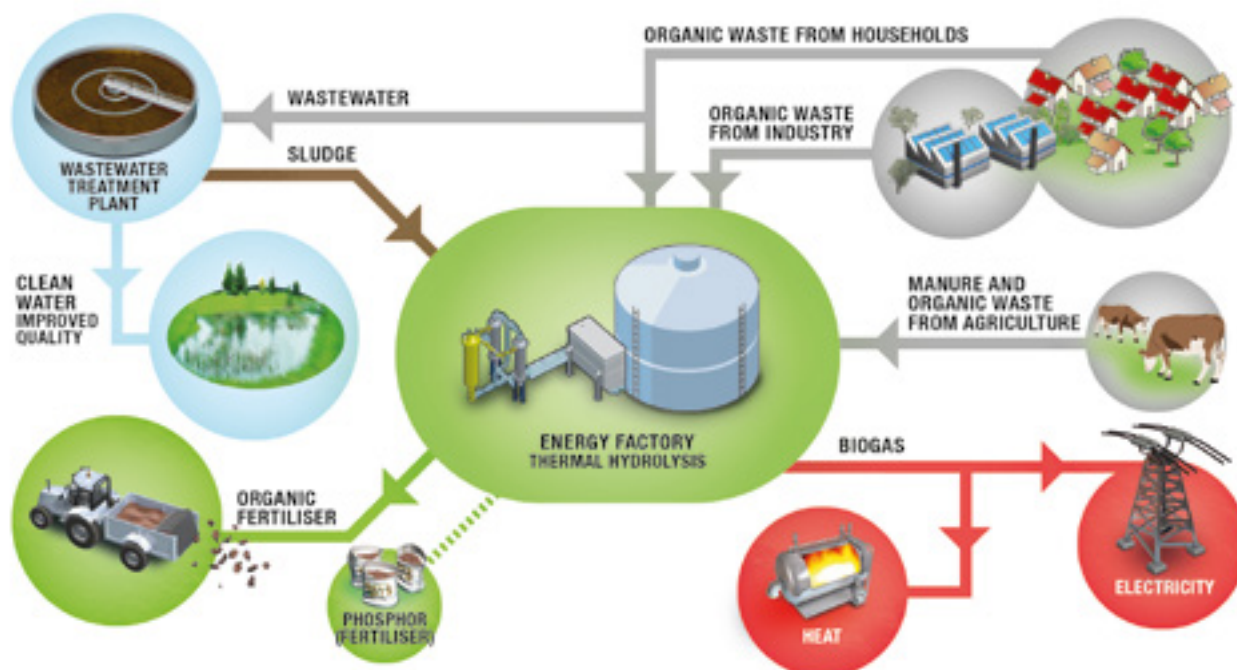


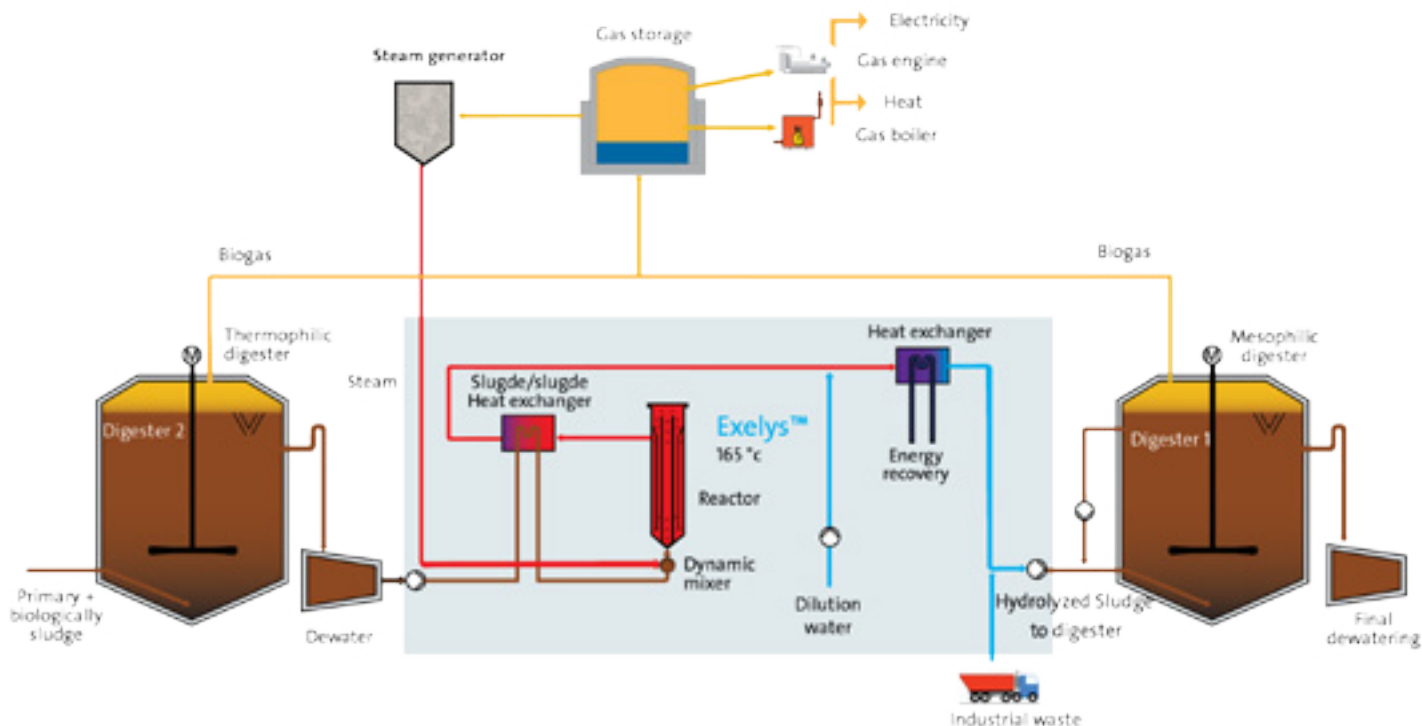
The Danish wastewater treatment plant of tomorrow, Billund BioRefinery builds upon the latest developments in the field and a combination of unique global technologies. The concept combines new technologies to process raw materials consisting of wastewater, organic household waste and organic waste from industries and agriculture. Outputs are purified water and green energy (in the form of heat and electricity) while the amount of sludge is reduced and refined to an odorless, easily manageable and very efficient organic fertilizer for agricultural purposes.

### Great success achieved through public-private partnership

The project is developed through a strong partnership between the Danish Utility company Billund Vand A/S and Krüger A/S, a Veolia Water Technologies subsidiary. The vision behind the project is that waste and wastewater are not waste – they are resources, and these resources contain immense potential to implement a circular economy at wastewater treatment plants.

The ambition has been achieved owing to a well-functioning public-private partnership where joint targets and clearly defined rules have contributed to a successful project.





*“From the beginning, we wished to create a joint identity in the project. We put a lot of emphasis on letting the key employees from Krüger A/S and Billund Vand get to know each other. The purpose was not only to create a technological lighthouse project but to develop the project with as much benefit as possible for all parties involved”,* says Billund Vand Managing Director Ole P. Johnsen.

The Billund BioRefinery was officially inaugurated in June this year, but has shown its worth as a Lighthouse Project over its 4-year development period. The environmental results have exceeded expectations and the international interest has been very high.

*“Billund BioRefinery has in a very short time proven its value on the export markets. It is a wastewater treatment plant that is able to achieve better treatment results, lower the energy consumption and make better use of the resources in the wastewater than other plants”,* says Danish Minister for Environment and Food Esben Lunde Larsen who visited the plant last spring to get a personal first-hand impression of the plant.

### Continuous thermal hydrolysis of sludge is the cornerstone of the energy plant

Veolia’s patented Exelys® technology with double lysis digestion (DLD), is a central element of Billund BioRefinery and is the key to transforming the treatment plant into a true energy powerhouse. As part of the expansion of the treatment plant, it is now possible to process much larger amounts of both household and industrial waste at the plant.

98% of all of Billund’s wastewater and household waste sorted at source is now recycled, which is totally unique at international level and creates a whole new outlook on wastewater and waste as valuable resources.

Thermal hydrolysis is the most effective technology for increasing biogas production from different types of waste. Exelys ensures maximum energy recovery with the lowest possible energy consumption. The process allows more complex substrates to be reduced downstream in the digester. The Exelys plant only treats a partial stream of the total biomass, namely that part that includes wastewater sludge and solid waste, including



98% of all of Billund's wastewater and household waste sorted at source is now recycled

household waste sorted at source.

After the Exelys technology was put into operation, all expectations in terms of energy production, treatment efficiency and reduction of residues for disposal have been more than fulfilled. The energy surplus is distributed to the power and district heating network and benefits the local community. Sludge for disposal is also significantly reduced and the total amount of nutrients discharged in the water to recipients is approximately 60% of that established in the legislation.

### Expansion of digester capacity

The establishment of the Exelys plant for thermal hydrolysis of digested sludge creates the opportunity to exploit the larger digester volume because, in principle, the sludge can be digested twice. Household waste and sludge from the treatment plant is thus led to anaerobic digestion under thermophilic conditions (52-55°C) in the new digester.

### New thermophilic digester ensures maximum gas production

A new digester of 1,400 m<sup>3</sup> has been set up, thereby creating the opportunity for better management of the digestion process and hence gas production. With the new digester in operation, sludge is sent together with household waste from the treatment plant to the new digester, while sludge from the Exelys plant is sent together with industrial waste to the existing digester.

The new digester has been designed with an innovative gas system (similar to the new Veolia patented GasTop) that is especially well-suited to the processing of biogas from thermophilic digesters. The gas washer alleviates condensation problems and foam in the gas pipelines. The gas washer has a built-in safety valve that is designed as a double siphon trap. ■



## The Billund BioRefinery

The project was supported by a €2 million grant from the Danish Eco-innovation Program (MUDP) and the Vandsektorens Teknologiuudviklingsfond (VTUF).

**Location: Billund, Denmark**

**Plant size: 70,000 PE**

**Total budget for the upgrading: approximately €9 million**

The project began in 2015 and was inaugurated on 8<sup>th</sup> June 2017:

- The energy production has increased by more than 160% from approximately 8.5 million kWh to approximately 22 million kWh per year. Billund BioRefinery is considered to be self-sufficient in terms of energy consumption. Excess energy is sold onto the electricity grid and district heating network.
- The sludge amount treated in the Exelys® is reduced by 30-40%.
- The plant is receiving approximately 40,000 tons/year of waste from the food industry.
- The discharge of nutrients from the plant has already been reduced by approximately 60%, due to the installation of Veolia technologies such as STAR Utility Solution™, Hydrotech™ filters and ANITA™ Mox.



# Effective sludge management at Brucejack Gold Mine



Pretium Resources Inc.’s Brucejack underground, high-grade gold mine, located in northwestern British Columbia, Canada, started commercial production in 2017. Pretium challenged Veolia Water Technologies Canada to provide a wastewater treatment plant to remove Total Suspended Solids (TSS) and some heavy metals from their new gold mine effluent by using as little land space as possible while producing a solid waste.

## Environmental challenges

Veolia was approached by Pretium in 2014 to assist for the permit request with all government instances, to supply a temporary plant used for the exploration and construction phases and ultimately, a permanent wastewater treatment plant to be used once the mine is in operation.

The project brought its own set of challenges, mainly due to the location of the mine.

Indeed, with the mine situated near a glacier, the treated water criteria are very stringent.

With no road or air access, the site is only accessible by using a Husky tracked vehicle to cross the glacier.

The available space at the site being very limited, Pretium was unable to find space to build a pond for primary decantation, which meant that the TSS in wastewater was correspondingly potentially very high. Space constraints also meant that the treatment chain needed to be as compact as possible.

## Optimized technological solution

The permanent effluent treatment system, started-up in 2017, consists of several Veolia proprietary technologies which were selected for their robustness and compactness, starting with the Actiflo® high-rate ballasted clarification process for primary metals removal.

The water is further polished by a highly-efficient Hydrotech™ Discfilter, which gives added insurance in meeting very stringent discharge criteria. A centrifuge was installed to dewater the water treatment sludge. The inlet flow is between 3,200 and 6,000 m³/d.

Veolia has been operating the plant for more than two years. As can be seen on the figure on page 19, TSS concentration at the treatment inlet (blue bullets) was much higher than expected during design.

As the construction activities increased, the TSS increased gradually to eventually exceed 10,000 mg/L. Even given this, the Actiflo® effluent quality (red bullets) was better than required with an average TSS at the Actiflo outlet around 8 mg/L.

The Hydrotech™ Discfilter, acting as polishing after the Actiflo, was able to decrease the TSS even further, with an average of less than 2 mg/L (green bullets).

This mining application **demonstrated that the Actiflo can operate with much higher TSS than normally believed**, and is still operating with no degradation of performance with TSS at more than 10,000 mg/L.

Example of Brucejack Influent and effluent water criteria (in mg/L)

PERFORMANCE CRITERIA	RAW WATER	EFFLUENT CRITERIA (Monthly average)
Total Suspended Solids	2 000	15
Total Aluminum	18.9	0.15
Total Arsenic	0.80	0.005
Total Cadmium	0.011	0.00015
Total Chromium	0.15	0.01
Total Copper	0.37	0.01
Total Iron	88.0	0.25
Total Silver	0.0094	0.00025

# Management Mine

## New heights for sand ballasted decantation

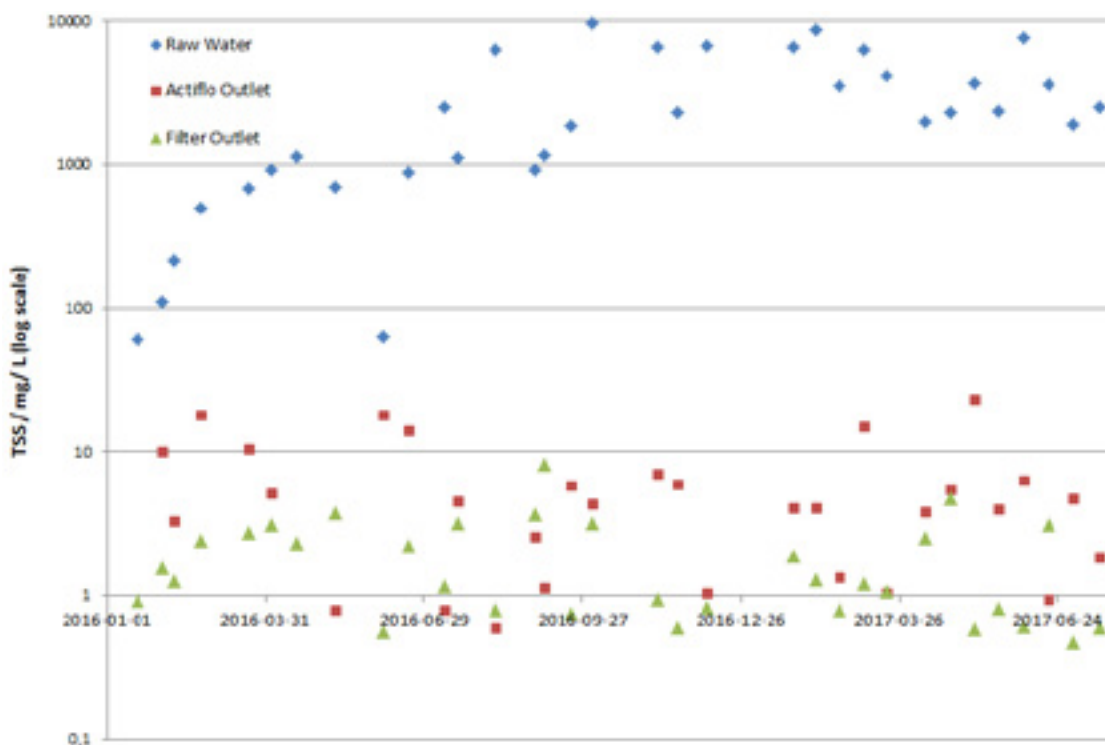
One of the perceived weaknesses of sand ballasted decantation is the relatively low solid content of the produced sludge. Pretium requested that Veolia produce a sludge that could be dry stacked with over 30 % solid. Given the space requirement constraints, the use of a conventional thickener was not possible. The sludge was first thickened by recycling part of the slurry produced by the Actiflo upstream of the process.



To achieve the sludge requirements, Veolia provided an Andritz centrifuge to dewater the sludge. With a judicious choice of polymers, the sludge solid content was increased from 1.9% to 47% on average. The cake produced by the centrifuge was much better than required, while maintaining 24/7 operation and no significant downtime except for normal preventive maintenance.

Veolia was able to meet Pretium’s expectation by building a compact and efficient plant. The two years of operation data collected on this project have proved the robustness of the equipment used. The treatment chain used on the project was able to handle more than 10,000 mg/L TSS and to deliver clarified water at less than 10 mg/L while producing sludge at well over 40% solid. ■

## Brucejack WWTP TSS removal results



# Canal de Isabel II

## Spain's first phosphorus recovery plant

**In 2016, Canal de Isabel II commissioned Spain's first industrial scale plant for the recovery of phosphorus in the form of struvite at the Sur de Madrid Wastewater Treatment Plant (WWTP). It is sized to extract up to 260 kg of phosphorus per day from the WWTP's two return streams. Canal de Isabel II has invested €2.3 million in this initiative, which is in line with the company's commitment to the circular economy, environmental care, sustainable management and investment in R&D&I.**

### Background

The Sur de Madrid WWTP is located on the left bank of the River Manzanares and receives wastewater from the Sur sewer. The existing sewer network enables the wastewater from other plants situated upstream from the Sur WWTP to be diverted there in the event that further treatment is necessary to guarantee the quality of the water returned to the receiving waterway. This also endows the system with flexibility.

### What is struvite?

Uncontrolled struvite precipitation is a problem at wastewater treatment plants because it causes clogging of pipes, generally in the sludge line, downstream from anaerobic digestion.

Struvite is a crystal made up of magnesium, ammonium and phosphate ( $\text{NH}_4\text{MgPO}_4 \cdot 6(\text{H}_2\text{O})$ ) which forms when these three ions are present in the solution above their saturation points. Magnesium is the limiting reactant in wastewater treatment and it must be provided in the form of magnesium chloride or magnesium oxide in order to balance the concentration of phosphorus, generating a product that can be used at industrial level for certain applications. Eliminating this compound significantly reduces struvite precipitations in sludge line pipes.

### Project objective and scope

This project saw the implementation of a struvite production system. Struvite is generated at different points of the sludge line, hindering operation of the facility. The Sur WWTP has suffered from periodic episodes of uncontrolled struvite precipitation in the digested sludge outlet pipe, in the elbows of the centrifuge feed pipes and inside the anaerobic digesters.

The rate of struvite formation is controlled in the process in such a way as to obtain a high-quality product with the desired physical properties. Phosphorus removal efficiencies of around 90% in the treated stream can be achieved and the product obtained is sold as fertilizer.





The technology adopted removes a large portion of the dissolved orthophosphate from a liquid stream, along with a small percentage of the ammonium, in order to obtain a product of higher quality for subsequent sale. For this purpose, a crystallization reactor with continuous recirculation is implemented, where magnesium chloride and caustic soda are dosed.

The reactor can be fed by either the dewatering overflows or the flotation overflows, which are sent separately to the feed chambers. The overflows from dewatering have a much higher concentration of phosphate and ammonium than the overflows from flotation. Therefore, the former stream is predominantly used to feed the reactor.

Struvite crystallized into granules in a controlled manner using magnesium chloride has been **certified as an extremely pure, pathogen-free inorganic fertilizer**. It has a number of features that differentiate it from conventional fertilizers and enable it to be positioned as a high added-value product. Chief amongst these features are: low release of nutrients, a beneficial magnesium content and a fully sustainable production source. This product has been certified as a fertilizer in the United States, Canada and Europe. ■

## Veolia Water Technologies opens door to phosphorus circular economy in Spain

The Sur de Madrid WWTP project, undertaken by the Spanish subsidiary of Veolia Water Technologies, included the design of the plant based on the OSTARA process, turnkey construction and commissioning of the facility, and commercialization of the struvite produced.

Sized for a phosphorus treatment capacity of up to 260 kilograms per day, the facility enables controlled struvite formation. One of the main features and benefits of the Ostara process is the ability to control the spherical grain size of the struvite. Moreover, these grains undergo a drying process to ensure a pathogen-free end product, thus guaranteeing safe application from a health perspective.

Phosphorus is as scarcely available in nature as it is essential to human life. Apart from the environmental benefit of its recovery, the process also has significant economic benefits: spontaneous struvite formation is controlled, thus preventing the problems and costs associated with clogged pipes; there are considerable savings in chemical reagent consumption for phosphorus removal; and less sludge is produced, so sludge disposal costs are lower.

This project is a perfect example of the circular economy. It enables the recovery of phosphorus, a valuable resource, from wastewater for reuse. This promotes and fosters the sustainable use of this element and helps to offset Europe's phosphorus production deficit.

Its strong involvement in the circular economy has motivated Veolia to develop its own technology, called Struvia™, for the recovery of phosphorus in sewage water treatment plants. Veolia obtained its first reference with Struvia on an industrial site in Denmark in 2016. ■

# Still getting the sludge out



## Enduring DenseSludge™ process reduces volumes by 90%

### More than 30 years after its introduction, DenseSludge™ is still going strong.

The technology enables mines to successfully reduce the cost of water treatment and sludge management from their Acid Mine/Rock Drainage (AMD/ARD) systems. AMD/ARD from operating mines and abandoned mine sites require treatment to prevent adverse impacts to rivers and streams, which can produce significant volumes of sludge. Many AMD/ARD systems operating in the U.S. face increasing constraints on their sludge storage capacities whether they are impounding the sludge above or below ground.

The DenseSludge™ recycle process forms particles that settle quickly, dewater readily, and hold little water. The result is a reduction in sludge generation by nearly 90% and production of a drier sludge, which reduces the volume of water that returns to the mine pool for re-treatment. The technology has enabled mining companies to extend the life of existing sludge storage facilities and reduce requirements for building of new storage.

### First mining application

Initially developed to treat metal bearing wastewaters in the steel industry, the first application at a mine came in the mid-1990's. The mine's owner, a producer of high-BTU bituminous coal in the United States, sought a solution for better sludge management at the mine site, located in the Eastern panhandle of West Virginia. A 2,000-gpm demonstration plant retrofitted by Veolia to an existing AMD treatment

facility demonstrated the benefits of the DenseSludge™ process and provided design criteria for a new, larger facility.

The new full-scale facility was constructed downstream of the demonstration plant on a former coal refuse disposal site. Still operating today, the facility treats effluent from two deep well pumps, surface runoff and coal refuse leachate. Although designed for a flow rate of 9,000 gpm, operational experience has shown that the plant can handle more than 12,000 gpm.

The plant has enabled the mine to achieve consistent compliance with the discharge limitations. Cost savings are generated from reduced sludge volumes, by as much as 90%, as well as reduced water treatment, gypsum deposits on treatment equipment and tanks and lime usage.

### Non-conventional solution

While the DenseSludge™ process itself is not new, sophisticated automation, including advanced online monitoring, measuring and control technologies, provide highly efficient AMD wastewater treatment, requiring minimal input to operate the plant.

The process differs from conventional metals treatment in a number of ways. The most significant difference is the method by which the alkali source is added. In conventional treatment systems, the alkali is added directly into the influent to achieve a desired pH setpoint. Generally, that setpoint is the pH at which the minimum solubility occurs for the target metal(s), or at the pH where discharge

limitations can reliably be met.

In the DenseSludge™ process, the alkali source is combined with recycled sludge before being combined with the influent. The sludge particles react with the alkali to provide attraction sites for the removal of metals. This causes the sludge particles to become layered like an onion and enhances crystallization. The net effect is that the sludge consists of particles that are more crystalline and less amorphous than those created in a traditional AMD/ARD treatment system. Crystalline sludge carries less water and more solids per unit volume and is therefore denser and dewatered better, resulting in a decrease in sludge volume.

Through a series of steps, the continued recirculation of sludge ultimately converts the metal hydroxides to oxides. Sludge for recirculation is withdrawn from the solids settling unit and pumped to the sludge-conditioning tank where it combines with the alkali source.

The resultant mixture of sludge and alkali is then directed to a neutralization tank where it combines with the influent. For typical AMD/ARD applications, the neutralization tank is aerated to oxidize iron from the ferrous to ferric state. The demand for alkali is controlled by the system pH setpoints. The recirculation of the sludge enables the system to utilize unreacted alkali in the sludge, enabling more rapid and efficient dewatering and pumping and minimizing lime usage and its associated cost.

Sludge generated in the solids settling unit is recirculated constantly at a rate sufficient to meet the constraints of the DenseSludge™ process. To maintain the system's equilibrium, the sludge is removed from the system periodically when it reaches a certain high density set-point. A number of methods are used to dispose of the sludge, most typically into directional boreholes.

### Conserving natural resources

The well-proven technology continues to deliver impressive results. In Pennsylvania, a Veolia- designed treatment facility enabled the state's Department of Environmental

Protection to recently achieve its goal of restoring the water quality of the Bennett Branch tributary of the Susquehanna River to sustain sport fishing. The facility treats highly polluted AMD from four underground coal mine complexes that had been draining into Bennett Branch and its tributaries.

To treat the AMD, Veolia conducted treatability studies and designed a centralized treatment process and system based on DenseSludge™ technology. Veolia partnered with Civil & Environmental Consultants, Inc. (CEC) for the design of the civil work, including design of the collection system, sludge disposal system, a polishing basin for the effluent and building architecture. Veolia's work scope included the treatability studies, process design, equipment specifications, general plant layout, the basic mechanical design for the treatment plant, and electrical and instrumentation/controls for the entire project. Veolia also assisted with startup of the treatment process.

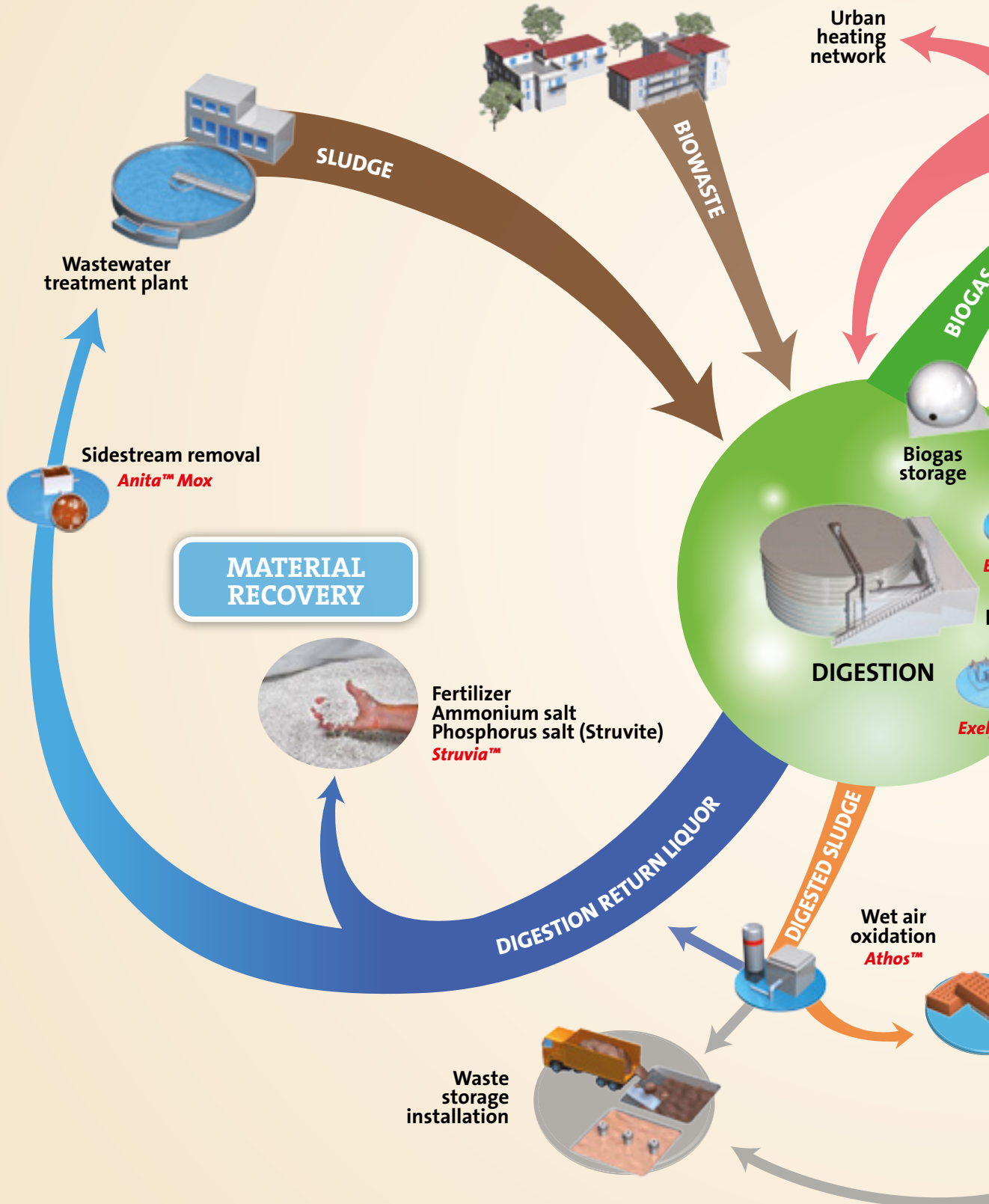
Treating an average of 2,000 gallons a minute and operating 24/7, the DenseSludge™ system has enabled the facility to meet its highly stringent discharge parameters and allowed the water quality of the Bennett Branch to be restored to a level that supports a viable sport fishery.

Veolia-installed DenseSludge™ AMD/ARD treatment systems worldwide, including more than 10 in the United States, are enabling mines to comply with discharge restrictions and reduce costs while preserving precious water resources. ■

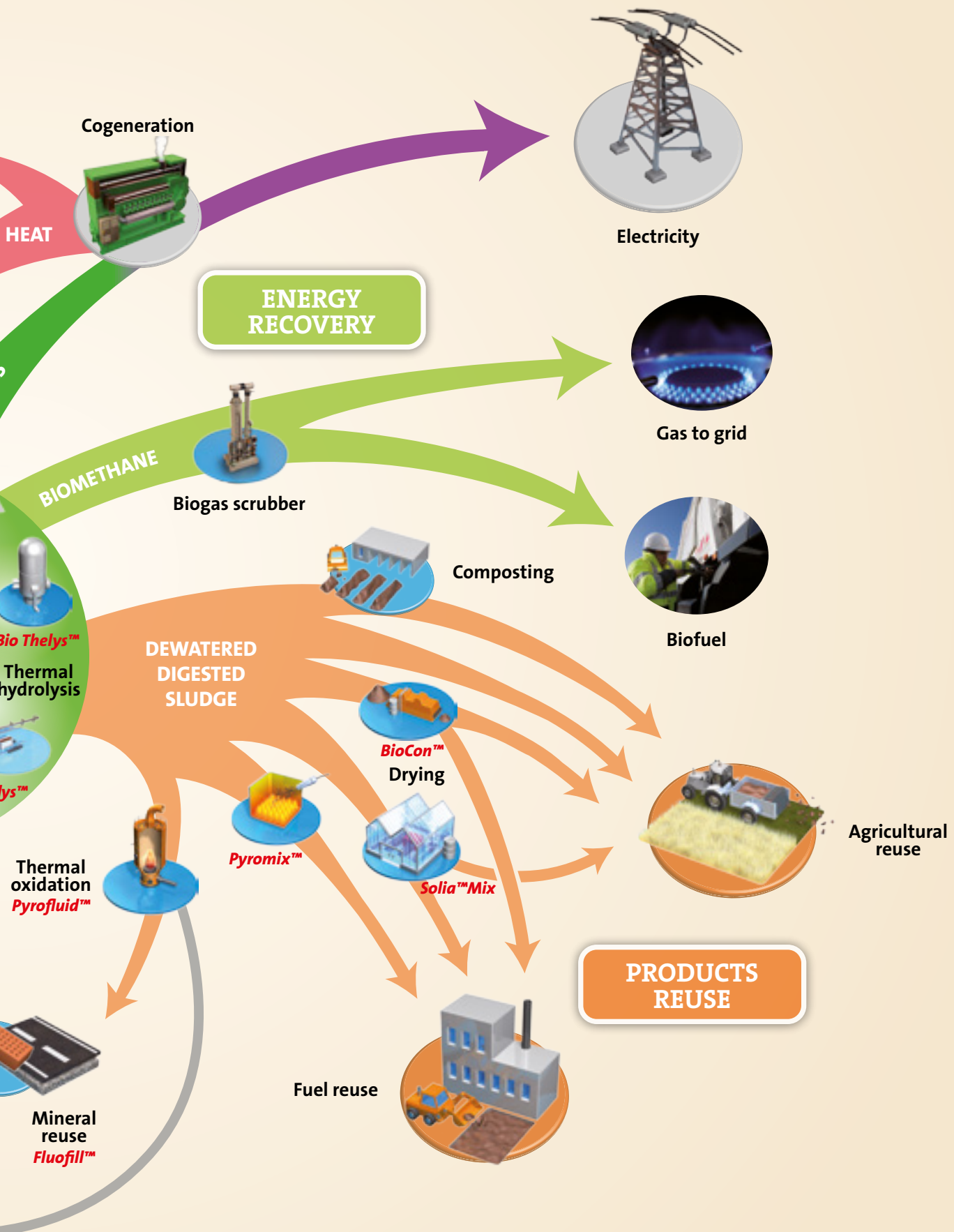


# Creating value from sludge

*Digestion at the heart of the process*









# BIO THELYS™ & EXELYS®

## Thermal Hydrolysis Processes

**BIO THELYS™** is a complete sludge reduction solution that works in batch mode, combining thermal hydrolysis and anaerobic digestion.

**EXELYS®** is an innovative and complete sludge reduction solution that works in continuous mode and can be packaged as a standard solution for small to medium thermal hydrolysis plants.

### APPLICATIONS

Both **Bio Thelys™** and **Exelys®** are able to process a wide range of organic, industrial or municipal sludge, including those containing fats, oils and grease (FOG).

### PERFORMANCES


By coupling thermal hydrolysis with anaerobic digestion, Bio Thelys™ and Exelys® offer enhanced performance over conventional digestion and optimize sludge treatment by producing:

- 25 to 35% less dry solids
- 30 to 50% more biogas
- No odors
- A safe, high quality product for land application


### BENEFITS

- Reduced digester related investment for new installations
- Reduced operating costs with less sludge to manage
- Income is generated from:
  - Additional energy generated with more biogas
  - Additional capacity to process organic imports

### BIO THELYS™ REFERENCES

**Bonneuil-sur-Marne (France)** 

- 500,000 population equivalent
- 13,000 tDS / year


**Oxford (UK)** 

- 1,400,000 population equivalent
- 26,000 tDS / year

**Esholt (UK)**

- 2,100,000 population equivalent
- 32,800 tDS / year


### EXELYS® REFERENCES

**Versailles (France)** 

- 330,000 population equivalent
- 9,300 tDS / year

**Marquette-Lez-Lille (France)**

- 620,000 population equivalent
- 25,000 tDS / year

**Billund (Denmark)** 

- 130,000 population equivalent
- 5,200 tDS / year



# BIOCON™

## Sludge drying and energy optimization

The **BIOCON™** dryer treats municipal dewatered sludge at a low temperature and within a safe environment for the operator.

### APPLICATIONS

Municipal dewatered sludge treatment at low temperature

### PERFORMANCES

- Safe operation due to low drying temperature
- Delivers disinfected and granulated dried biosolids
- Low operation and maintenance costs
- Meets Class A requirement
- Energy recovery
- Low carbon footprint

### BENEFITS

- Safe, simple & efficient operation
- Customized end product
- Self-cleaning nozzles
- No dust
- Air tight
- No odors

### REFERENCES

#### Marquette-lez-Lille (France)

- 620,000 population equivalent
- 3.6 tons / hour

#### Rosny-sur-Seine (France)

- 142,000 population equivalent
- 1.7 tons / hour

#### Roskilde (Denmark)

- 103,000 population equivalent
- 1.2 tons / hour

#### Alderwood, WA (USA)

- 100,000 population equivalent
- 1.5 tons / hour

#### Juneau, AK (USA)

- 150,000 population equivalent
- 3.7 tons / hour

#### Pomorzany (Poland)

- 420,000 population equivalent
- 2 tons / hour



# SOLIA™ Mix

## The new generation of solar sludge drying

As a pioneer and expert in solar sludge drying, Veolia Water Technologies has developed innovative solutions such as **SOLIA™ Mix**. This new and more compact process can achieve a dry solids content up to 90%, reducing sludge volume and removal costs.

Mainly dedicated to small and mid-sized municipalities and industries, SOLIA™ Mix opens the way to all outlet disposal routes: agricultural reuse, composting, landfill, incineration and co-incineration.

### APPLICATIONS

- Mainly dedicated to small and mid-sized municipalities and industries
- All outlet disposal routes: agricultural reuse, composting, landfill, incineration and co-incineration

### PERFORMANCES

- A dry solids content up to 85%
- Sludge volume reduced by 3 to 4 times
- A low carbon footprint process
- Sludge storage before reuse

### BENEFITS

- Reliable and robust
- Fully automated process operation
- Uses renewable energy sources
- Odor control
- Aesthetic and easily integrated architecture

### REFERENCES

#### Bras-Panon, Réunion Island (France)

- 204 TDM/year
- 680 m<sup>2</sup>

#### Saint-Michel-en-L'Herm (France)

- 120 TDM/year
- 300 m<sup>2</sup>

#### Pia (France)

- 242 TDM/year
- 947 m<sup>2</sup>

#### Belchatow (Poland)

- 1850 TDM/year
- 6,144 m<sup>2</sup>





# PYROFLUID™

## Sludge incineration, energy recovery and ash recycling

**PYROFLUID™** is a thermal treatment solution that oxidizes organic matter contained within sewage sludge.

### APPLICATIONS

Depending on the characteristics of the ash produced PYROFLUID™, it can be:

- Recycled for use within road construction
- Used for concrete production
- Discharged to landfill

### SPECIAL FEATURES

- Treat urban sewage sludge within plants of variable capacities (200 kg to 5 t DS/hr\*),
- Produce stable and recyclable by-products (ash, dust)
- Comply with the strictest emission standards

### BENEFITS

- SafeTotal mineralization of sludge
- Total destruction of pathogens
- Energy recovery
- No odor
- Low maintenance costs
- Long-term reliability
- Easy operation (automated 24/7)

### REFERENCES

#### Hong Kong

- Incineration capacity of 2,000 tons of sludge per day
- 14 MW of electricity produced



#### Zaragoza (Spain)

- 2 furnaces
- 4.6 TDM / hour



#### Colombes (France)

- 4 furnaces
- 8 TDM / hour



#### Saint-Petersburg North (Russia)

- 3 furnaces
- 5.8 TDM / hour



#### Warsaw (Poland)

- 2 furnaces
- 5 TDM / hour





# ATHOS™

## Wet air oxidation

**ATHOS™** is a sludge Hydro-Thermal Oxidation (HTO) process, which turns organic sludge with low dry matter into an essentially solid mineral. The operation is carried out under pressure by injecting pure oxygen into the sludge heated by the treated effluent.

### APPLICATIONS

**Athos™** is an innovative process, which combined with anaerobic digestion, enables sludge removal while producing a renewable energy source: biogas. The process is suitable for all types of thickened sludge:

- Primary
- Biological
- Fresh
- Digested
- Urban
- Industrial

### BENEFITS

- Environmentally friendly: all the sludge components are recycled, recovered or discharged to the natural environment with no adverse effects.
- Cost-effective: operating costs are reduced by moderate operating conditions (temperature and pressure, limited O<sub>2</sub> consumption) and by reducing the dewatering stage.
- Flexible: treats all types of thickened sludge (7 to 8% of DS) and is equipped with advanced automation.
- Compact: can be fully integrated into the wastewater treatment plant and provides continuous sludge processing, as well as by-product treatment.

### REFERENCES

#### Epernay (France)

- 80,000 EH
- One 4 m<sup>3</sup> ATHOS reactor
- Technosand dryness (%DM): 50



#### Brussels North (Belgium)

- 1,200,000 EH
- Two 12 m<sup>3</sup> ATHOS reactors
- Technosand dryness (%DM): 90





## ANITA™ Mox

### The cost-effective ammonia removal solution

With an ammonia removal efficiency of over 80% with no use of external carbon source and at a very low energy cost, **ANITA™ Mox** is well-suited to efficiently reduce the operating cost and improve the environmental record of a wastewater treatment plant.

#### APPLICATIONS

ANITA™ Mox is specially developed for treatment of streams highly loaded in ammonia such as:

- Reject water following anaerobic digestion from municipal WWTP to reduce the nitrogen load on the main wastewater treatment line
- Industrial wastewaters, especially after anaerobic treatment and landfill leachates

#### BENEFITS

- No carbon source needed
- Compact process
- Almost 60% oxygen savings
- Reduced sludge production
- Robust process
- Stable process
- Lower CO<sub>2</sub> emissions

#### REFERENCES

##### Sundets, Växjö (Sweden)



- Treating digestion returns by MBBR
- 430 kgN per day
- Adding co-digestion and thermal hydrolysis systems in 2014

##### Holbaek (Denmark)



- Treating digestion returns and landfill leachate by MBBR
- 120 kgN per day

##### South Durham (USA)



- Treating digestion returns by MBBR
- 330 kgN per day

##### Locarno (Switzerland)



- Treating digestion returns by MBBR
- 300 kgN per day



# STRUVIA™

## *Sustainable recycling of phosphorus from wastewater*

Phosphorus is a key ingredient in the fertilizers used in agriculture and for animal feed. **STRUVIA™** allows for phosphorus to be recovered as struvite crystals from the effluents produced by industrial, agricultural and municipal activities. This opens the way to a local reuse of phosphorus, especially in agriculture.

### APPLICATIONS

Recovery, valorisation and reuse of phosphorus contained in wastewater and in concentrated industrial water as struvite.

### PERFORMANCES

- Reduction of internal phosphorus load
- Reduction of chemical sludge production
- Prevents operation downtime and maintenance cost caused by uncontrolled struvite precipitation
- Reduced needs for chemicals for P-precipitation

### BENEFITS

- Low investment and operating costs
- Limited footprint and building height requirements
- Recycle struvite by incorporating it into a fertilizer
- The recovered phosphorus is made freely available for plants and crop
- Cadmium free and improvement of carbon footprint

### REFERENCES

#### Brussels North (Belgium)

- Prototype reactor (0.2 to 0.5 m<sup>3</sup>/h)



#### Helsingør (Denmark)

- First industrial unit (4.8 tons of phosphorus extracted per year)







# DENSESLUDGE™

## Cost-effective treatment technology for acid mine / rock drainage

Operating mines and abandoned mine sites generate acid mine/rock drainage that must be treated to prevent adverse impacts to rivers and streams. The **DENSESLUDGE™** process can use conventional equipment or Veolia's Multiflo™ technology to employ sludge recirculation techniques, forming particles that settle quickly, dewater readily, and hold little water.

### APPLICATIONS

- Soft rock mines
- Applications with acid rock drainage

### PERFORMANCES

- Uses either conventional equipment or Multiflo™ technology to employ sludge recirculation techniques
- Reduces sludge volume in clarifier underflow by 90%
- Decreases sludge flow back to the mine pool, reducing re-treatment costs

### BENEFITS

- Minimizes lime usage and associated cost
- Removes manganese, iron and most other metals at a lower pH than predicted by theoretical solubility curves
- Minimizes calcium sulfate (gypsum) and calcium carbonate (calcite) scaling
- Provides consistent pH control
- Lowers depth of sludge blanket in the clarifier, reducing torque

### REFERENCES

**Bureau of Abandoned Mine Reclamation, Hollywood, PA (USA)**



**Atlantic Richfield/Montana Resources, Butte, MT (USA)**

**Potomac Coal Company (CONSOL Energy), Bayard, WV (USA)**

**MEPCO, LL, Garards Fort, PA (USA)**

**Bureau of Abandoned Mine Reclamation, Lancashire Mine Site, PA (USA)**

**Kingsmill Tunnel, Morococha Mining Region (Peru)**





## BIOMET™

### *A biowaste methanization process leveraging on an external agitation system with continual crushing*

**BIOMET™** guarantees energy and environmental performance by combining two separate steps: hydrolysis and methanogenic processes. Hydrolysis is a mixture breakdown by hydrolytic bacteria in order to obtain increased availability of organic matter and better yields. Methanogenic step produces biogas through the action of methanogenic bacteria. Separating these two steps and reactors, even with hard biomass, brings more stability to the process compared to traditional plants.

#### ADVANTAGES

- Works in both in mesophilia and thermophilia and can be fed with all kind of substrates, making the process very flexible
- Tolerates a mixture with a higher rate of dry matter (24% and more)

than conventional processes which are limited to 17%

- Secures, depending on the substrates, a biogas production of 10 to 20% more than conventional digestion/post-digestion processes
- Allows the digester to be powered seven days a week while limiting the input reception to five days
- Reduced retention time = reduced footprint (from 25 to 50%)
- Mixing and heating systems external to digesters, making maintenance very easy without need of interrupting the process

#### BENEFITS

- Digestion process stability
- Increased biogas production
- External maintenance
- Foaming control

#### REFERENCES

##### Artois Methanisation (France)

- 25,000 tons treated each year
- Generates electricity to cover the needs of 6,500 people every year

##### Conserve Italia (Italy)

- 1000 kW electrical potential
- Treatment of fruit and vegetables by-products, sludge from WWTP and silo maize

##### Brusadino Farm (Italy)

- 1000 kW electrical potential
- Treatment of manure and silo maize and eventual F&B by-products

##### Azienda Agricola Agriferrarese Farm (Italy)

- 1000 kW electrical potential
- Treatment of manure and silo maize



# ECRUSOR™

## Solution for depackaging and preparing biodegradable wastes for energy generation

**Ecrusor™** is a patented process to separate biodegradable wastes from commercial packaging. The single unit then grinds the organic material into a homogeneous slurry. Once processed by **Ecrusor™**, the highly organic, biodegradable material can be combined with indigenous and imported sludge and sent to the digester/biogas system.

### APPLICATIONS

- Liquids
  - Sewage liquid with 1% to 30% dry matter content
  - Packaged dairy waste
- Packed products
  - Packaged dairy, meat and confectionery products
  - Manufacturing residues
  - Packed cakes and left-over uncooked dough
  - Expired food products and packaged soft drinks

### CHARACTERISTICS

- Compact and robust
- Fully-automated

### ADVANTAGES

- Ecrusor removes plastic, metal and mixed material packaging simultaneously
- Very low operating energy while producing a slurry that generates electricity
- Over 10 years of full-scale operation at multiple installations
- Installed below grade, outdoors or within truck off-loading stations to receive material directly from vehicles
- Ecrusor is capable of processing up to 40 cubic meters of waste every hour

### REFERENCES

#### Braunschweig (Germany)

- 275,000 PE
- 100% electricity autonomy

#### Gera (Germany)

- 200,000 PE
- 100% electricity autonomy

#### North Pest (Budapest, Hungary)

- 200,000 PE
- 100% electricity autonomy

#### Nagykörös Biogas Plant

- Industrial biomass to energy project, 3<sup>rd</sup> largest in Hungary
- 100% electricity autonomy

#### Prague (Czech Republic)

- 1,400,000 PE
- 75% electricity autonomy



# IDRAFLOT™

## *Dissolved Air Flotation technology for suspended solids and oil/grease separation*

*IDRAFLOT is an innovative and effective water mixing device with a modular design. It is an excellent solution where water clarification and suspended solids, organic fibers, insoluble COD and oil removal are required.*

*From a technological perspective, it is the most advanced liquid/solid separation plant and provides opportunities for water recycling when combined with MBBR Pack.*

### APPLICATIONS

Pretreatment, tertiary treatment, sludge thickening and more for:

- Light industries: Food & Beverage, Pharma & Cosmetics, Textile, etc.
- Heavy Industries: Pulp & Paper, Mining & Primary Metals, Chemical, Oil & Gas, etc.
- Waste
- Biogas & Biofuels
- Municipal

### PERFORMANCES

- A unique mobile and modular stainless steel design for faster delivery, easier implementation and reduced costs

- An innovative and patented effective water mixing device
- Treatment capacities from 5 to 480 m<sup>3</sup>/h

### BENEFITS

- Packaged solution, transport on single truck
- SS separation > 95%
- Reduction of oil/grease > 95%
- Innovative air distribution system
- Reduction in chemicals consumption
- Minimal sludge production
- Adjustable system for an optimized separation efficiency

### REFERENCES

**IDRAFLOT® Multi DAF Technology boasts hundreds of installations worldwide.**



# BIOPASTEUR™

## *A simple and energy-efficient Class A biosolids for anaerobic digestion*

The **BioPasteur™** process utilizes heat exchangers and batch pasteurization tanks to meet US EPA Class A pathogen reduction conditions. The SWS heat exchanger design enables simple, flexible and low maintenance means of heat transfer. The variable heat recovery significantly reduces the energy input requirements for biosolids pasteurization.

### APPLICATIONS

- Municipal and industrial wastewater sludge
- Industrial sludge and wastes
- Livestock manure and by-products

### ADVANTAGES

- Provides Class A biosolids
- Continuous sludge flows in the BioPasteur™ system and to the digesters
- Compact design leads to a small footprint
- Energy efficient
- Variable heat recovery to react to process conditions
- Simple operation and maintenance
- Clean in place design for sludge piping

### SPECIAL FEATURES

- Variable heat recovery
- Stainless steel construction
- PLC control to ensure compliance to regulations

### REFERENCES

#### Alexandria, VA (USA)



- 1000 wet tons per day
- Integrated into existing wastewater treatment plant

#### Charlottetown, PEI (Canada)



- 130 wet tons per day
- Integrated into existing wastewater treatment plant

#### Csepel WWTP, Budapest (Hungary)



- 1500 wet tons per day
- New treatment facility with thermophilic digestion and heat recovery

#### Grindste (Denmark)



- 140 wet tons per day
- Biogas production facility with sludge consisting of municipal wastewater sludge and source sorted household wastes.

*BIOTHANE leading anaerobic technologies... a name you can trust*



## **WATER TECHNOLOGIES**

### **Anaerobic Digestion is the solution**

If you need a treatment plant with low operational costs and a small footprint that generates energy from waste and low sludge production.

- Minimal sludge production
- Limited energy consumption
- Organic contaminants transformed into «Green energy»(Biogas)
- Efficient removal of organic matter (up to 90%)
- Low nutrient needs

[www.veoliawatertechnologies.com](http://www.veoliawatertechnologies.com)

Resourcing the world



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**Design:** Veolia Water Technologies Graphic Design Team

**Photo credits:** Veolia Photo Library / Christophe Majani d'Inguibert / Stephane Lavoue / iStock / Image Club

**Cover Photo:** Veolia Photo Library / Olivier Guerrin

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