Sludge Treatment

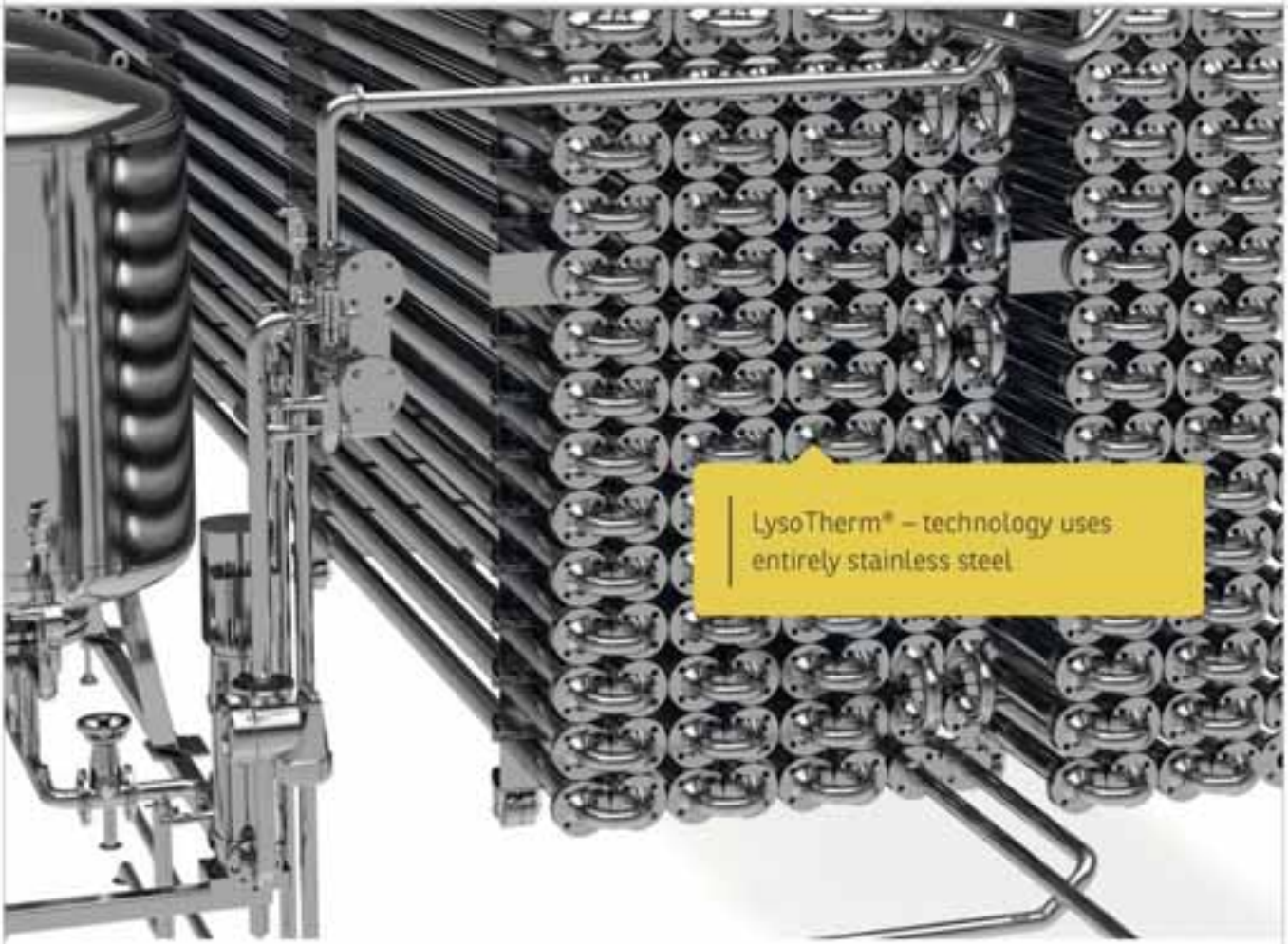
ELIQUO | HYDROK

Biosolids Technology

LysoTherm®

IS A NOVEL, PATENTED SYSTEM FOR THE THERMAL DISINTEGRATION OF ORGANIC SLUDGE, ESPECIALLY SEWAGE SLUDGE.

IT IS SPECIALLY DESIGNED TO ENABLE THE EFFICIENT, COST-EFFECTIVE AND SAFE DISINTEGRATION OF SLUDGE, AND IS PARTICULARLY SUITED FOR SMALLER SEWAGE TREATMENT PLANTS.



Goal

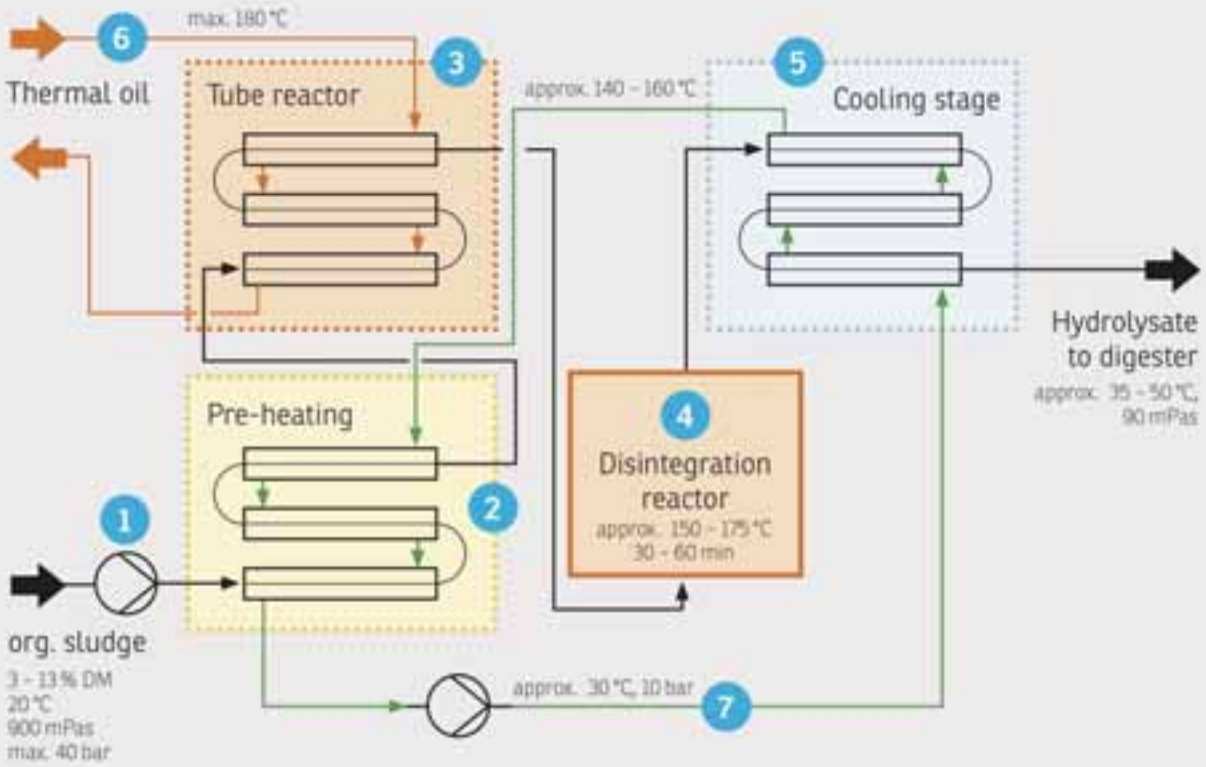
The goal of thermal disintegration is to enhance the anaerobic stabilisation (digestion) of organic sludge, especially sewage sludge and, hence:

- increase the gas yield
- decrease the amount of organic residues in digested sludge
- increase the dry matter content (DM) in the digested, dewatered sludge
- reduce polymer consumption used in the dewatering process
- reduce the amount of sludge to be disposed of
- reduce digestion time
- increase digestion capacity

Further advantages of thermal disintegration are:

- reduction of sludge viscosity in the digester
- reduction of foaming in the digester
- increase potential to recover phosphorus as magnesium-ammonium-phosphate from the sludge
- elimination of pathogenic bacteria

Operating principle



Sludge is fed via the sludge pump (feeding pump, 1) into a multistage heat exchanger system. The feed is a continuous process.

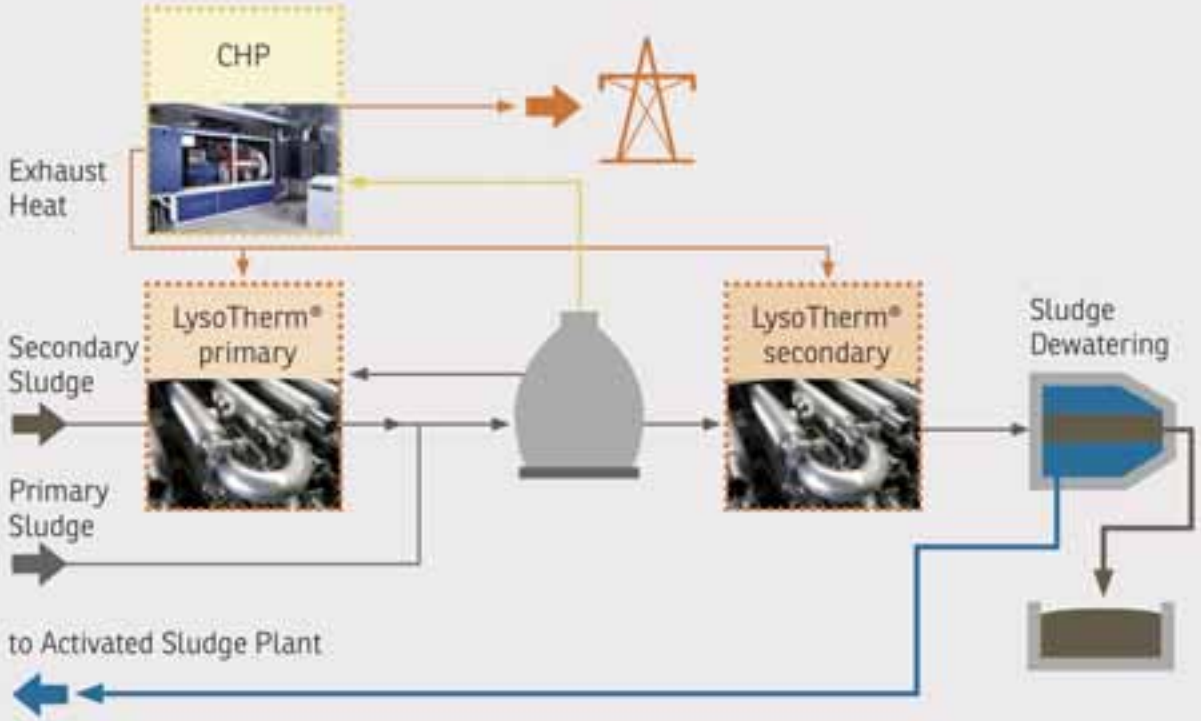
Pre-heating takes place in the first stage of the heat exchanger system, 2 then the sludge is heated up to reaction temperature within the tube reactor 3

The proper disintegration process takes place at the pre-determined reaction temperature in the disintegration reactor 4 where the sludge usually remains for 30 – 60 minutes. After the disintegration is completed, the sludge is cooled down in the cooling stage 5 to the temperature required for entering the digestion tower; alternatively, it can be mixed with cold primary sludge in order to be cooled down to digestion temperature.

The system is heated via two heating circuits:

- the thermal oil circuit 6 to create the necessary process heat in the pipe reactor. The process heat is typically recovered from the exhaust gases of the CHPs
- the regenerative circuit 7 using water as heat transfer medium. This circuit makes the heat recovered from the disintegrated sludge in the cooling stage available for pre-heating.

Design-concept



PERFORMANCE DATA

The LysoTherm® system is flexible and versatile. In addition to the thermal disintegration of excess sludge (primary disintegration), it can also be used for the conditioning of digested sludge (secondary disintegration).

PRIMARY SLUDGE DISINTEGRATION

Sewage sludge disintegration

Main advantages

- Applicable for sewage sludge with a dry matter content of 3 - 13 %
- Increase of gas production by up to > 50 %
- Reduction of oDM by up to > 50 %
- Improvement of dewatering by approx. 3 - 5 % DM (e.g. from 27 % DM to 32 % DM in the dewatered sludge)
- Increase of digestion capacity by up to > 100 %
- Elimination of pathogenic germs
- Net win of produced electricity by the CHP due to higher gas yield

SECONDARY SLUDGE DISINTEGRATION

Conditioning of digested sludge

Main advantages

- Improvement of dewatering by approx. 10 % DM (e.g. from 25 % DM to 35 % DM in the dewatered sludge)
- Reduction of sludge volume by up to 50 %
- Elimination of pathogenic bacteria
- Only negligible reduction of sludge heating value as the oDM-content of the sludge cake is only marginally decreased by the thermal conditioning

USER- AND MAINTENANCE-FRIENDLY

Another major advantage of the LysoTherm® system is its high user-friendliness:

- Fully automated operation
- Easy accessibility to all critical items including isolated parts
- Easy inspection and cleaning of the sludge-pipes: The pipe bends within the pipe bundle system can be removed with only a few steps if maintenance becomes necessary; the complete interior of the sludge pipes can be visually inspected and easily cleaned. By default the system is equipped with a fully automated CIP-system (clean-in-place).

> For pilot testing we have a mobile test rig with a capacity of 1000 kg/d DM ready for use.

OPERATIONAL SAFETY

An additional benefit of the system is its high operational safety. During the step-by-step heating of sludge up to reaction temperature, the temperature difference between heat transfer medium and sludge is kept low and is carefully controlled, thereby reducing the risk of deposits and adherence of burnt materials to a minimum.
Possible scaling of the heat transfer surfaces are removed efficiently and automatically by the CIP-cleaning procedure. For the operation of the plant, there are no special assessments or inspections required as they are mandatory for the operation of steam boiler systems.

PROFITABILITY

The LysoTherm® system is characterised by a favourable price-performance ratio and low operating costs:

- Less requirement for measuring and control technology due to the continuous operation of the system and the system structure.
- Few potential wearing parts: The only pump which is indispensable for the operation of the system – the sludge feed pump – operates at normal temperature.
- Space-saving system structure and high-quality materials: By selecting the corresponding pipe lengths and number of bends, the heat exchanger system can easily be adjusted to fit in the existing space and there is also the option to supply it within containers. LysoTherm®-plants are manufactured completely in-house.
- Modular plant design: The modular plant design allows for simple and cost-efficient expansions and modifications.
- High energy efficiency: The high energy efficiency of a LysoTherm®-plant is due to the high degree of heat recovery through the heat regenerative circuit. Thermal oil used in the heat circuit can be heated using the exhaust heat of the CHP. The plant can be designed in such a way to fully provide the digestion heating demand.
- The reduced viscosity of the sludge by approx. 70 % as a result of the disintegration reduces the energy demand for mixing of the digester significantly.

INSTALLATION

The system's plug & play design makes it easy to install and put into operation.

FEATURES

Efficient, versatile, indirect thermal process for the disintegration of organic sludge with the following results:

- increased gas yield
- decreased amount of organic residues in digested sludge
- increased dry matter content (DM) in the digested, dewatered sludge
- reduced polymer consumption used in the subsequent dewatering process
- reduced amount of sludge for disposal
- reduced digestion time
- increased digestion capacity
- reduced sludge viscosity in the digester
- reduced risk of foaming in the digester
- increased potential to recover phosphorus as magnesium-ammonium-phosphate from the sludge
- elimination of pathogenic bacteria

Multi-stage heat exchanger system for continuous operation and utmost operating safety

No steam necessary

No additional water into the substrate during heating

Robust, low wear, space-saving system structure

Standard modular assembly sizes

Highly user and maintenance friendly

Low operating costs, especially low energy costs due to the high heat recovery rate in the regenerative circuit and using thermal oil heating from the waste heat of the CHP.

For the operation of the plant, there are no special assessments or inspections required as they are mandatory for the operation of steam boiler systems.

APPLICATION

Thermal disintegration from low- to medium-viscosity organic sludge, especially of sewage sludge from municipal and industrial waste water treatment plants:

- Thermal disintegration of excess sludge (primary hydrolysis)
- Thermal conditioning of digested sludge (secondary hydrolysis)

Thermal disintegration of other organic sludge

TECHNICAL DATA

Influent temperature	approx. 20 °C
oDM influent	approx. 3 - 13 %
Viscosity influent	up to approx. 900 mPas
Reaction time	approx. 30 - 60 min
Reaction temperature	> 100 - approx. 175 °C
Pressure	approx. 5 - 15 bar
Effluent temperature	approx. 35 - 50 °C

We are happy to carry out laboratory testing to determine the additional gas yield as a consequence of thermal disintegration.

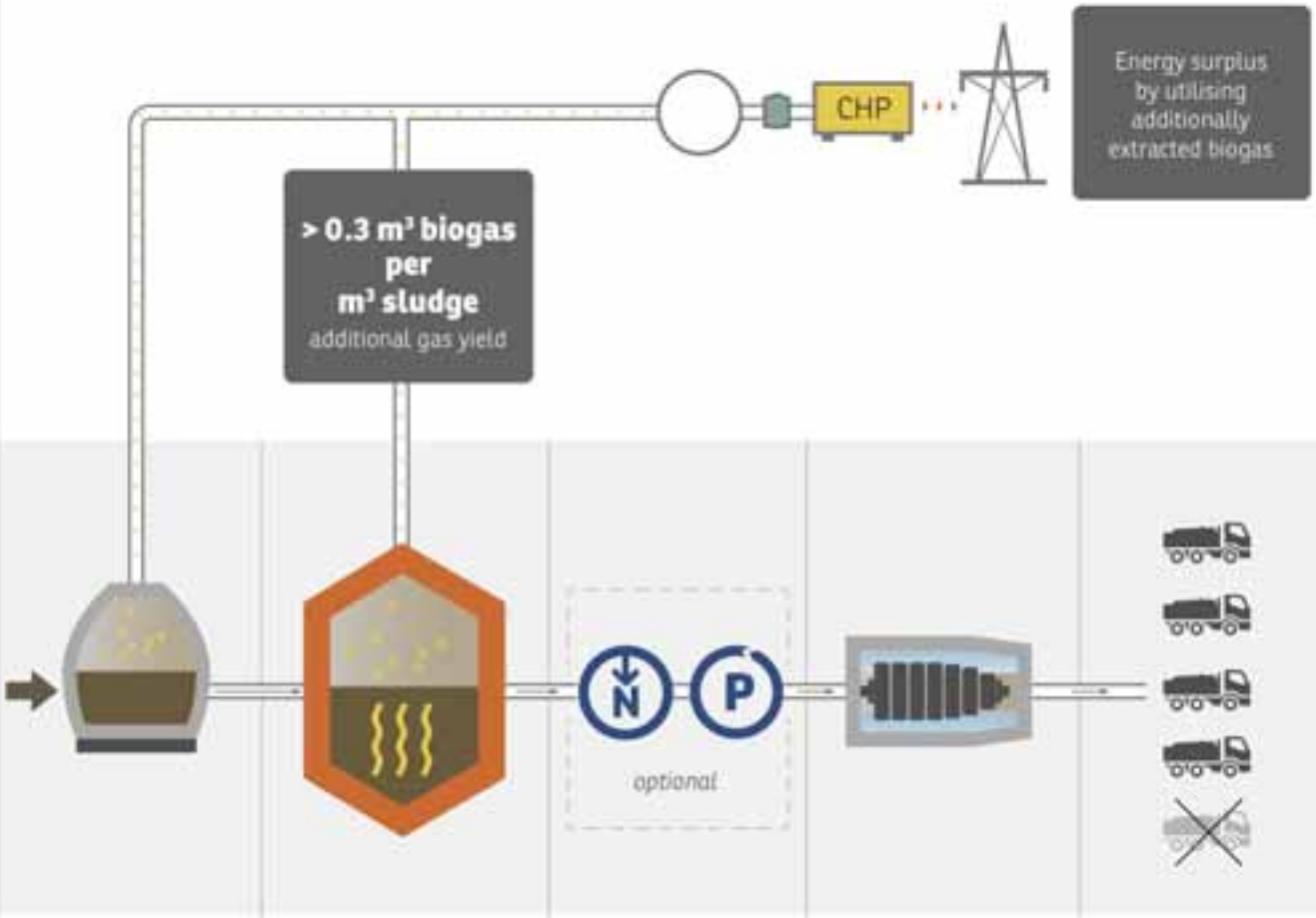
EloVac®

IS A COMPACT SYSTEM FOR THE DEGASSING OF LIQUIDS SUCH AS DIGESTED SLUDGE.

EloVac® SIGNIFICANTLY IMPROVES THE ECOLOGICAL FOOTPRINT OF YOUR TREATMENT PLANT BY AVOIDING UNCONTROLLED METHANE EMISSIONS. IN ADDITION, IT ENHANCES SLUDGE DEWATERING AND THUS REDUCES SLUDGE DISPOSAL COSTS.

Objective

EloVac® withdraws methane from the digested sludge and hence reduces climate-damaging methane emissions.
EloVac® is thus a major component of a climate-friendly treatment plant. Additionally, EloVac® improves the sludge dewatering.



EloVac®

Increase of pH

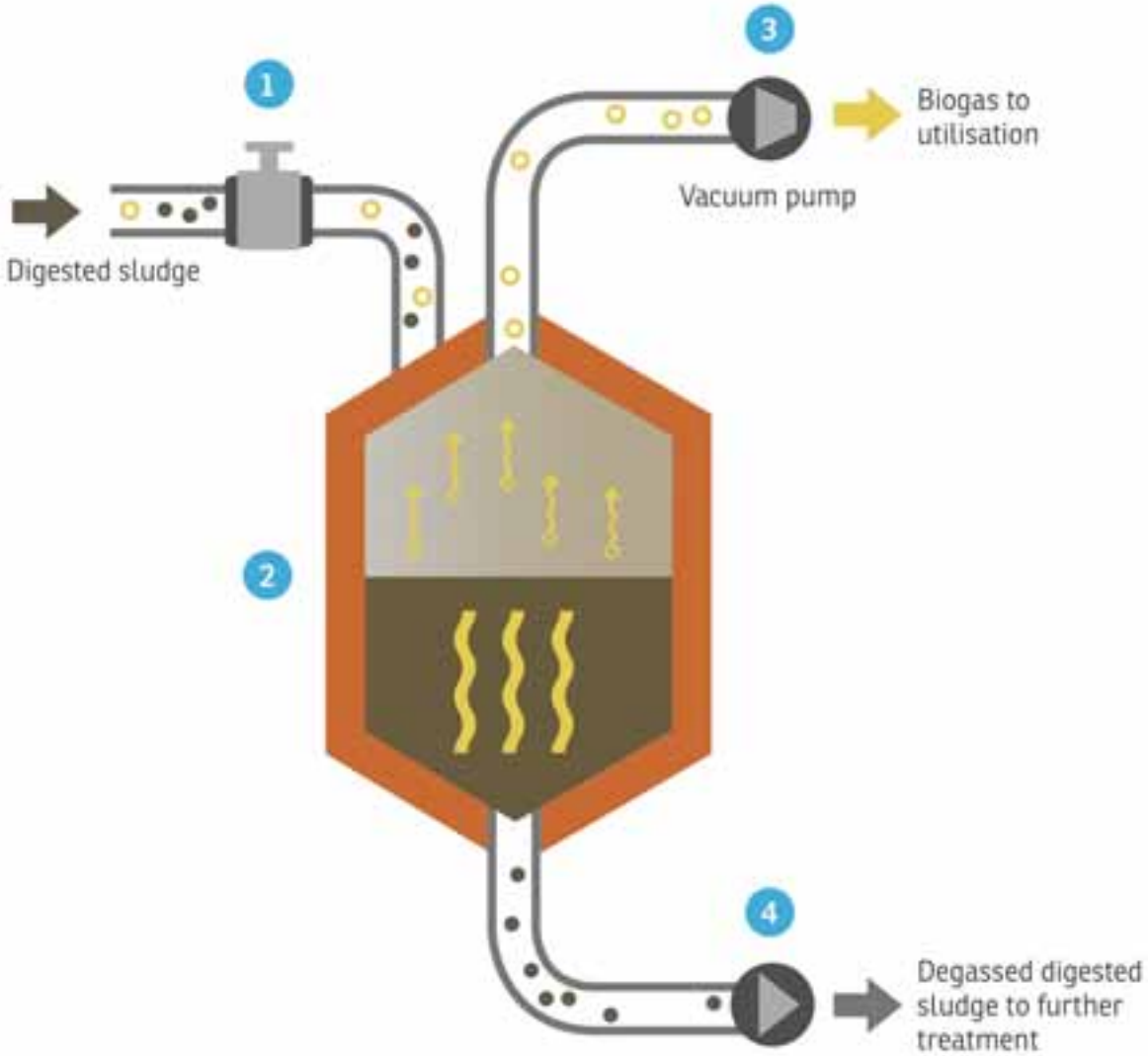
Increased potential for recovery of nutrients

Up to 3 %
improvement in dewatering

Avoidance of climate-damaging methane emissions

Up to 15 %
reduction in sludge to be disposed of

Operating principle



The digested sludge is continuously provided to the degassing tank 2 via a control valve 1 or a pump.

In the degassing tank 2 vacuum is created by a vacuum pump 3. Pressure and filling level in the degassing tank are controlled to predefined values. Due to the vacuum, gas – present in dissolved form and as bubbles – is withdrawn from the digested sludge.

By a sludge pump 4 the degassed digested sludge is continuously discharged from the degassing tank to the downstream sludge treatment step.

The withdrawn gas is provided to a gas system and can be used as a source of energy (e.g. in CHPs). Hence, the operation of the EloVac® system is energy-positive.

Profitability and climate protection

EloVac® is a very cost-efficient process. As a stand-alone system, that does not require extensive process conversion, EloVac® can provide for significant savings with low investment costs. Additionally, EloVac® can make a major contribution to climate protection.

SEWAGE TREATMENT PLANT 200,000 PE

⊖ 140,000 €
Sludge disposal

⊖ 740 kg CO_2 per day
≙ 5,700 car km per day
Avoided CO_2 equivalent emissions

⊖ 25 %
Reduction of CO_2 footprint of the whole treatment plant

Energy-positive operation of EloVac®

Annual savings are calculated on the base of the following assumptions: sludge disposal costs: € 85/t dewatered sludge, specific CO_2 equivalent emissions: 13.8 g CO_2/PE (source: LANUV NRW), CO_2 car emissions: 130 g CO_2/km (source: Regulation (EC) No. 443/2009).

We are happy to conduct laboratory trials and pilot trials with EloVac® for you.

TECHNICAL DATA

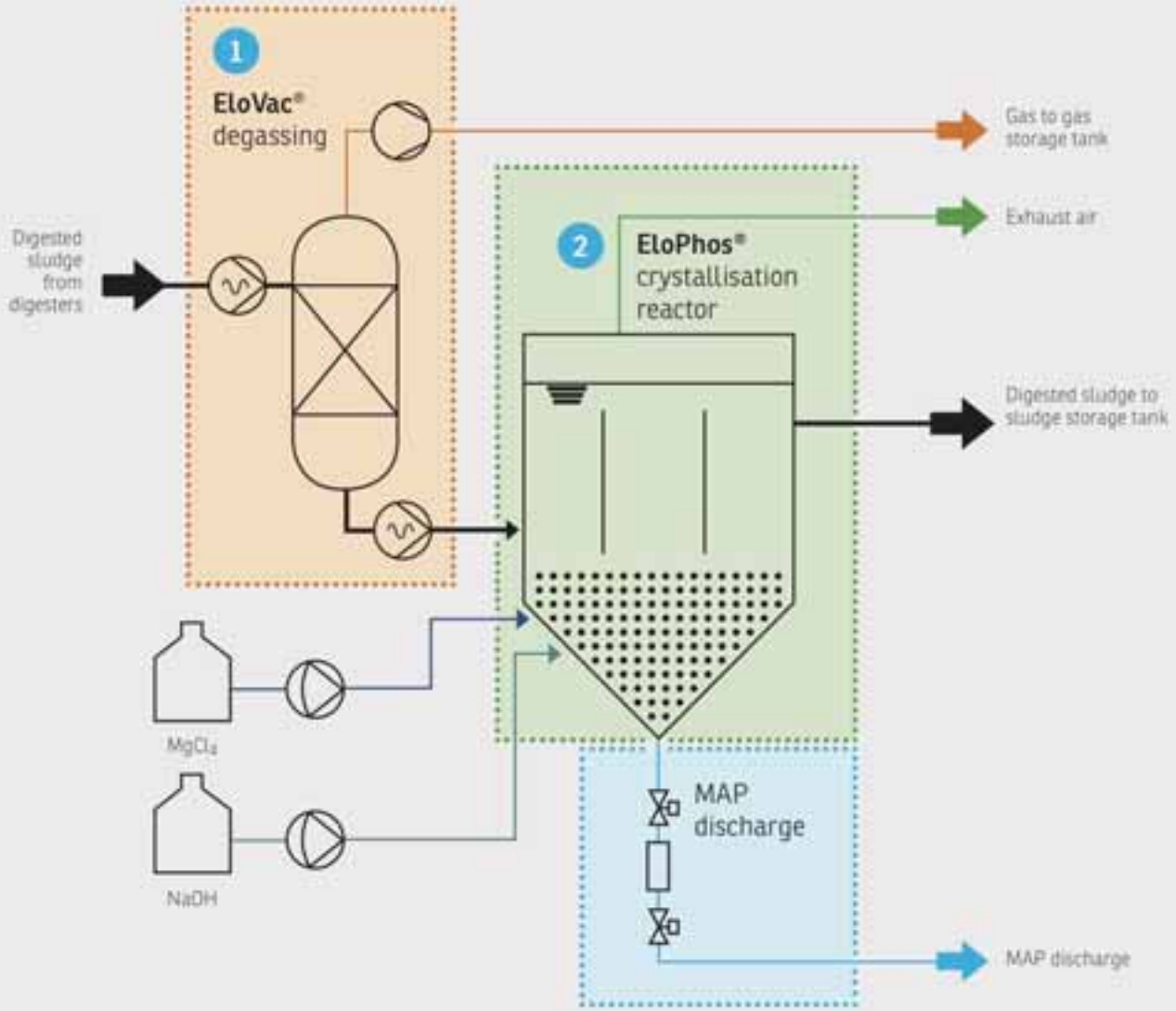
Influent DM content	< 6 %
Hydraulic retention time	< 15 min
System pressure	< 300 hPa
Material	Stainless steel (degassing chamber and pipelines)

EloPhos®

IS A SYSTEM FOR THE RECOVERY OF PHOSPHATE FROM DIGESTED SEWAGE SLUDGE EMANATING FROM WASTE WATER TREATMENT PLANTS WITH BIOLOGICAL PHOSPHATE (bio-P) REMOVAL IN THE FORM OF MAGNESIUM-AMMONIUM-PHOSPHATE ("MAP" OR "STRUVITE") FERTILISER. **EloPhos®** IS A PROPRIETARY TECHNOLOGY OF ELIQUO STULZ (PATENT PENDING).

THE **EloPhos®** PROCESS IS BASED ON THE PRECIPITATION OF DISSOLVED PHOSPHATE FROM DIGESTED SEWAGE SLUDGE USING MAGNESIUM SALTS, USUALLY MAGNESIUM CHLORIDE ($MgCl_2$). CRYSTALS WHICH ARE GROWN IN THE **EloPhos®** CRYSTALLISATION REACTOR UP TO APPROX. 1 - 2 MM DIAMETER OR ABOVE CAN SUBSEQUENTLY BE SEPARATED FROM THE SLUDGE.

Schematic diagram



Core components

1 THE **EloVac®** DEGASSING MODULE

For efficient MAP precipitation in the EloPhos® crystallisation reactor, the pH value of the sewage sludge must be increased. This is normally carried out by addition of an alkaline solution, usually sodium hydroxide solution (NaOH), or by aeration of the sludge. The latter leads to a pH increase due to the stripping of dissolved carbon dioxide in the sludge. However, in addition to carbon dioxide, digested sludge also contains dissolved hydrogen sulphide gas, ammonia gas and methane. Aeration can therefore cause a high degree of undesirable odours and lead to unacceptable methane emissions.

The EloVac® degassing module ensures no unwanted gas emission takes place.
In the EloVac® module, the digested sewage sludge is degassed under vacuum. This leads to a pH increase of 0.3 – 0.4 pH units and at the same time prevents emissions. The gas mixture extracted from the sewage sludge can be fed into the gas stream of the anaerobic digestion system.

2 THE **EloPhos®** CRYSTALLISATION REACTOR

The core of the EloPhos® system is the EloPhos® crystallisation reactor. In the reactor, the dissolved phosphate is chemically precipitated from the digested sewage sludge as Magnesium-Ammonium-Phosphate (MAP) by dosing magnesium salts, usually magnesium chloride ($MgCl_2$).

The EloPhos® reactor is designed as a reactor with specific and optimized flow conditions. Selective magnesium salt dosing and digested sludge addition lead to a zone of rapid chemical reaction of the dissolved phosphate and the magnesium salt. Thus high degrees of nucleation and growth of the MAP crystals are achieved without significant overdosing of the precipitant.

If the pH increase of the digested sludge by the degassing stage is not sufficient to ensure efficient precipitation, supplementary dosing of alkaline solution into the crystallisation reactor is possible.

The MAP crystals formed in the EloPhos® are initially very small. If separation and MAP recovery are not required, these can be discharged together with the sludge. However, the hydraulic retention time of the crystals in the reactor can be controlled independently of the hydraulic retention time of the sludge and crystal growth can be encouraged in a targeted manner.
This process is used if a MAP fertiliser is desired with MAP crystals being recovered separately. With this option, MAP crystals of > 1 - 2 mm in diameter are separated from the sludge and collected via the automatic discharge system.

The entire EloPhos® system is automatically controlled and monitored by a process control system. The cost of plant operation is therefore kept to a minimum.

Benefits

The following benefits can be expected by treating digested sludge from bio-P waste water treatment plants using EloPhos®:

An increase of up to approx. 5 % in solids content in the digested and dewatered sewage sludge

➡ **Reduced sludge disposal costs**

A reduction of up to approx. 20 % in the consumption of polymer for the dewatering of the digested sludge

➡ **Reduced sludge dewatering costs**

A reduction in crystallisation problems by virtue of unwanted, spontaneous MAP deposits in the zone downstream from the EloPhos® system, e.g. in the digested sludge dewatering zone

➡ **Reduced maintenance costs**

A reduction of up to approx. 95 % in phosphate recycle load / sludge liquor

➡ **Reduced operational costs**

The recovery of MAP fertiliser

➡ **Revenues**

So far, EloPhos® systems for the treatment of digested sewage sludge in bio-P plants amortise favourably predominantly because of improved dewatering of digested sewage sludge, i.e. amortisation is dependent on the respective sludge disposal costs and must be individually calculated on a case by case basis.

Increasingly, both thermal hydrolysis processes (THP) and bio-P are found together. For such plants, the EloPhos® system is an ideal addition as it removes the phosphorus which is released by the THP process. EloPhos® is therefore also an ideal partner to ELIQUO's LysoTherm® system (thermal sludge hydrolysis process) in such circumstances.

EloDry®

IS A LOW-TEMPERATURE BELT DRYER OF THE LATEST GENERATION, IN PARTICULAR FOR DRYING SEWAGE SLUDGE.

DUE TO THE SPECIAL DESIGN THAT IS OPTIMALLY ADAPTED TO THE RESPECTIVE CONDITIONS, **EloDry®** DRYING SYSTEMS PROVIDE RELIABLE AND HIGHLY ENERGY-EFFICIENT, ECONOMICAL DRYING AT LOW DRYING TEMPERATURES.

Objective

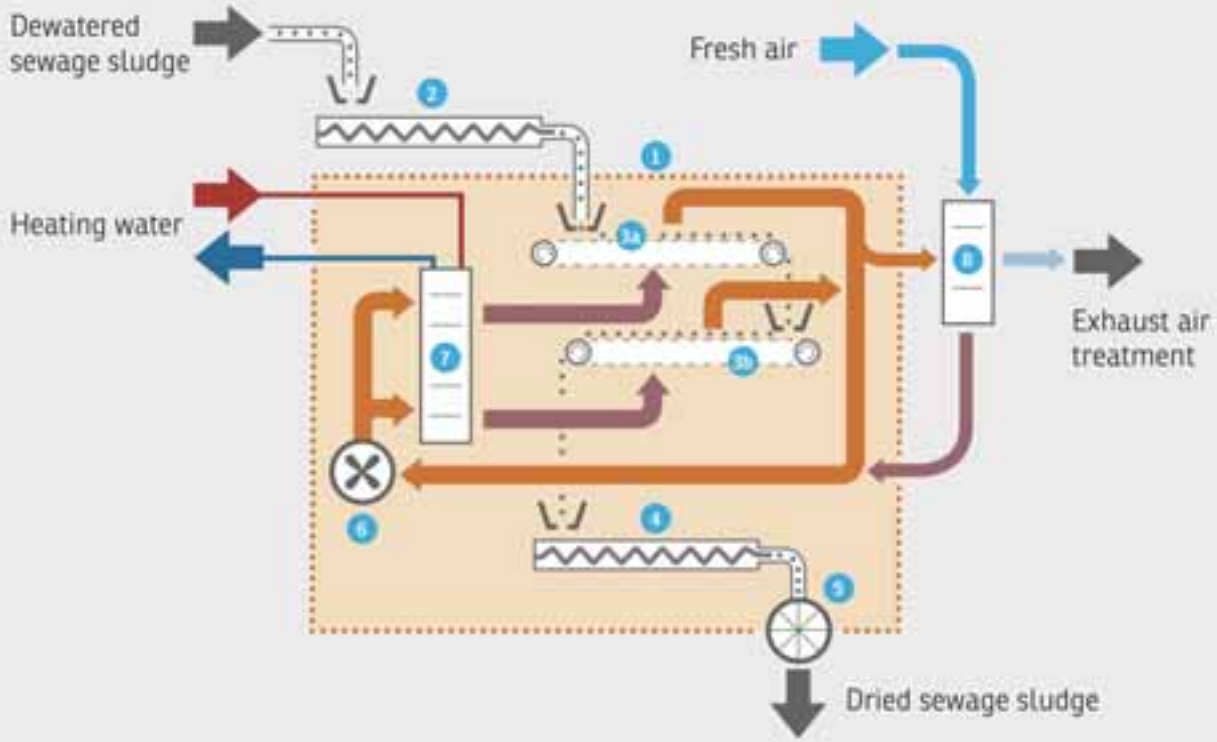
The objective of using EloDry® is reliable and highly energy-efficient, economical drying, in particular drying of dewatered sewage sludge, and thus:

- the reduction of disposal costs
- the production of safe dry material
- the production of an economic substitute fuel
- the production of a storable resource for phosphorus

through:

- integrated, optimal pre-treatment and preparation of the material to be dried
- individual customization of the degree of drying in the range of approximately 60 – 92 % dry matter (DM)
- efficient use of heat sources starting at a temperature level of approximately 50 °C combined with an intelligent, holistic heat utilization and heat recycling concept

Operating principle



The dewatered sludge is optimally supplied to the EloDry® low-temperature belt dryer according to demand.

For example, the feed can be carried out via a storage tank with pump and extruder. The extruder may be necessary in order to convert the sludge into a crumbly structure.
Alternatively, the sludge feed can be done via a storage tank with push floor and discharge screw and mixing screws. In parallel, dried sewage sludge is added and mixed with the fresh feed. Older external sludge and poorly dewatered sludge is converted into a manageable form this way.

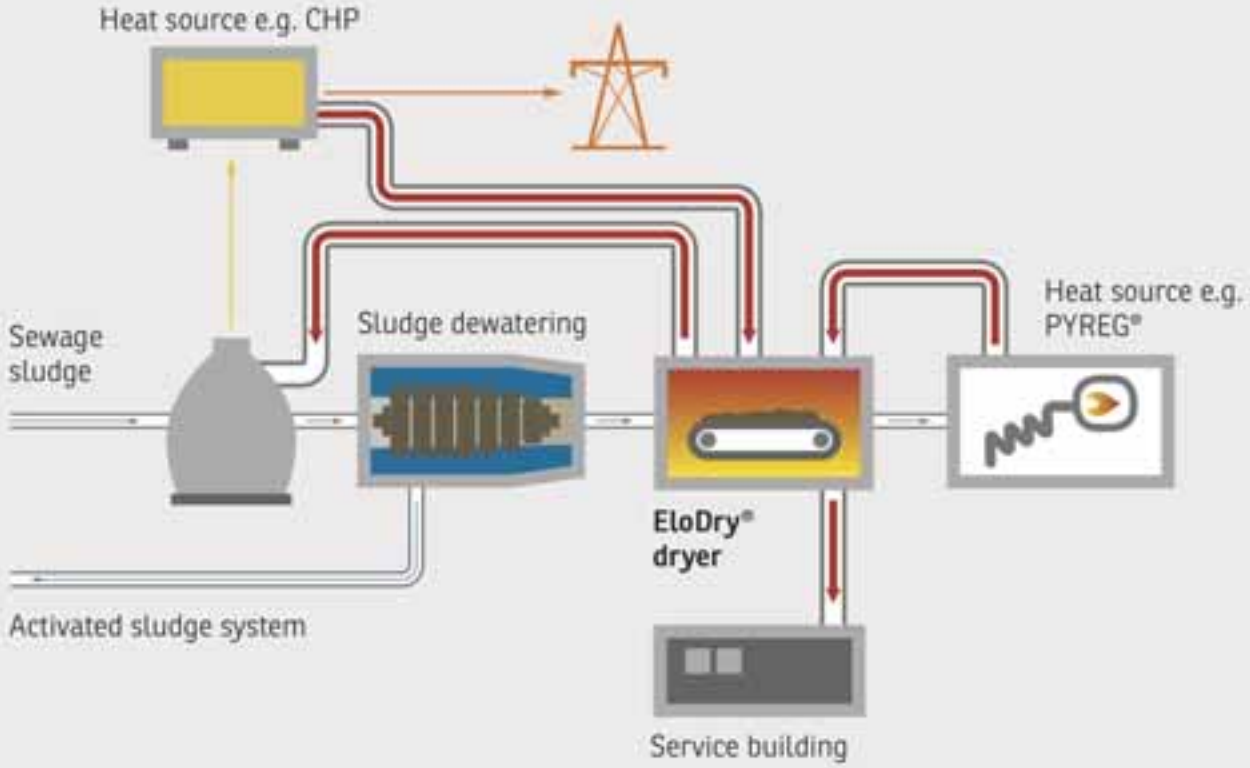
In the EloDry® belt dryer (1) the granular sludge is distributed evenly onto the dryer's upper belt (3a) by a distribution screw (2). The upper belt moves the sludge forward from the head of the dryer to the dryer end, where it is thrown onto the lower belt (3b). From the lower belt, the sludge is returned to the discharge screw conveyor (4) and discharged via the rotary valve (5).

The drying of the sludge is performed using hot air, which is supplied by a circulating-air fan (6) and heated to the desired temperature by a heat exchanger (7). The fresh air supplied to the dryer is pre-heated by means of heat recovery (8) from the exhaust air and then added to the circulation flow.

Dry material measurement allows for automatic adjustment of the drying process to changing DM contents in the sludge supply and ensures a very uniform drying result.

The dryer in operation is permanently kept in vacuum to prevent fugitive emissions. The exhaust air is fed into the exhaust air treatment.

Design concept



TECHNICAL DATA

EloDry® sewage sludge drying systems intelligently integrate the highly energy-efficient EloDry® belt dryer into a holistic heat utilization and heat recycling concept. This ensures optimal use of the energy resource heat.

SEWAGE SLUDGE DRYING WITH EloDry® DRYING SYSTEMS

Key benefits

- Optimally tailored pre-treatment and preparation of the material to be dried
- Individual customization of the degree of drying in the range of approximately 60 - 92 % dry matter (DM)
- Use of highly efficient EloDry® dryers with low specific heat demand from approximately 750 - 850 kWh/t $H_2O_{evap.}$
- Economic use of waste heat from approximately 50 - 80 °C to more than 100 °C
  Possible waste heat sources: CHP plants, gas-fired microturbine systems
- Supply of waste heat from the EloDry® dryers at a temperature level of 55 - 60 °C to other consumers with individual customization of the quantity of decoupled heat according to respective circumstances
- Potential use of the exhaust heat of the dryer: Digester, service building of sewage treatment plant

USER- AND MAINTENANCE-FRIENDLY

The EloDry® dryer is very easy to operate and is very low in maintenance:

- Continuous, fully automatic operation
- 24/7-operation possible, supervision expenditures < 1 h/d, no supervision expenditures during night shift and on weekends
- Guarantee of the desired degree of drying through continuous automatic monitoring at the discharge
- Excellent inspection options
- Very good accessibility of all system components

EloDry® NT16

PROFITABILITY

EloDry® drying systems are characterised by a favourable price/performance ratio and low operating costs:

High energy efficiency

The EloDry® low-temperature dryer is characterized by very good use of the available process heat with approximately 60 - 80 °C. The specific thermal energy consumption can, depending on the process, be as little as approx. 750 kWh/t H_2O_{vapour}.

However, the dryer can also be operated with heat carrier systems with a temperature of ≥ approx. 50 °C.

Operation of the EloDry® dryer is possible with electrical energy requirement of as little as approx. 50 kWh/t H_2O_{vapour}.

Modular, standardised construction

EloDry® belt dryers have standardized, identical head and end pieces. In between these, depending on the required drying capacity, several identical intermediate segments are arranged.

Robust, fault-immune design

Conclusion of a maintenance contract ensures the consistent high performance and reliability of the EloDry® dryer for many years.

EMISSIONS

EloDry® systems for sludge drying meet the requirements of the German Clean Air Act (TA-Luft).

Prevention of emissions into the environment due to design of the dryer and operation in a slight vacuum. Prevention of air filtration by airlock at the sludge feed and rotary valve at the outlet.

Individually customized cleaning of exhaust air in accordance with the respective sludge quality.

RELIABILITY

EloDry® drying systems offer a high degree of operational reliability. The minimum system availability is 8000 h/a.

There is very little dust formation in the EloDry® drying systems. Like smoke and temperature, this is constantly monitored. The installed sprinkler system provides additional safety.

The EloDry® dryer is Ex-zone free. This is certified by an authorized company if required.

FEATURES

EloDry® drying systems - Reliable and highly energy-efficient, economical sewage sludge drying at low drying temperatures with the following benefits:

- Reduction of disposal cost by reduction in volume of the sludge during drying by up to 50 %
- Production of safe dry material
- Production of an economical substitute fuel
- Production of a storable resource for phosphorus

Optimal and demand-driven pre-treatment and preparation of the material to be dried that can be flexibly adapted to the respective application, individual customization of the degree of drying in the range of approximately 60 – 92 % DM

Efficient use of heat sources starting at a temperature level of approximately 50°C, intelligent, holistic heat utilization and heat recycling concept

Very uniform drying result due to automatic adjustment of the drying process to changing DM contents in the sludge supply

High degree of operational safety with the highest safety standards in respect of fire and explosion protection

Compliance with the German Clean Air Act requirements

Robust, fault-immune system design

Modular, standardised dryer design

Very easy operation and very low maintenance requirements

APPLICATIONS

Reliable and highly energy-efficient, economical drying of, in particular, dewatered sewage sludge:

- Digested sludge
- Waste activated sludge
- Primary sludge
- Temporarily stored sewage sludge from reception bunkers and silos
- Pre-dried sludge from, for example, solar dryers

Drying of other materials such as fermentation residues, wood, green waste, bio waste, temperature-sensitive products

TECHNICAL DATA

	Water evaporation capacity, kg H_2O/h	Belt length, m	L x W x H, m
NT08	220	8,0	4,4 x 3,0 x 2,8
NT16	440	13,2	7,1 x 3,0 x 2,8
NT24	660	18,6	9,7 x 3,0 x 2,8
NT32	880	23,6	12,4 x 3,0 x 2,8
NT40	1.100	29,1	15,0 x 3,0 x 2,8

Material

Frame, cover and heat exchanger: Stainless steel

Belts: Polyester with woven bronze wires

Belt surface area

Distributed on the upper and lower belt

Specific heat requirement

From approx. 750 up to approx. 850 kWh/t H_2O_{evap}

Required heat level

Low-temperature, heat ≥ 50 °C

Specific power requirement

From approx. 50 kWh/t H_2O_{evap}

Operating hours

≥ 8.000 h/a

The PYREG® process

IS A PROCESS WHICH DRASTICALLY REDUCES DRIED SEWAGE SLUDGE VOLUMES THROUGH A STAGED COMBUSTION PROCESS RESULTING IN A HIGH-GRADE RAW PHOSPHORIC FERTILISER END PRODUCT.
THE IDEAL, DECENTRALISED UTILISATION OF THE THERMAL AND MATERIAL RESOURCES IN SEWAGE SLUDGE IS COST-EFFECTIVELY ASSURED USING LOW TEMPERATURE DRYING OPTIMALLY ADAPTED TO THE PYREG® PLANT.
THE MODULAR CONSTRUCTION AND STANDARDISED PLANT DESIGN ALLOW THE RECYCLING SYSTEM TO BE DEPLOYED IN SEWAGE WORKS RANGING FROM A MINIMUM 30 000 TO 50 000 PE UPWARDS.

PYREG

PYREG is an innovative solution provider in the field of environmental technology. The company works on thermal and material recycling of various biomasses such as sewage sludge, screenings and other biomass materials.

ELIQUO | HYDROK is a PYREG partner

for the installation of PYREG® plants for recycling municipal sewage sludge in the United Kingdom.

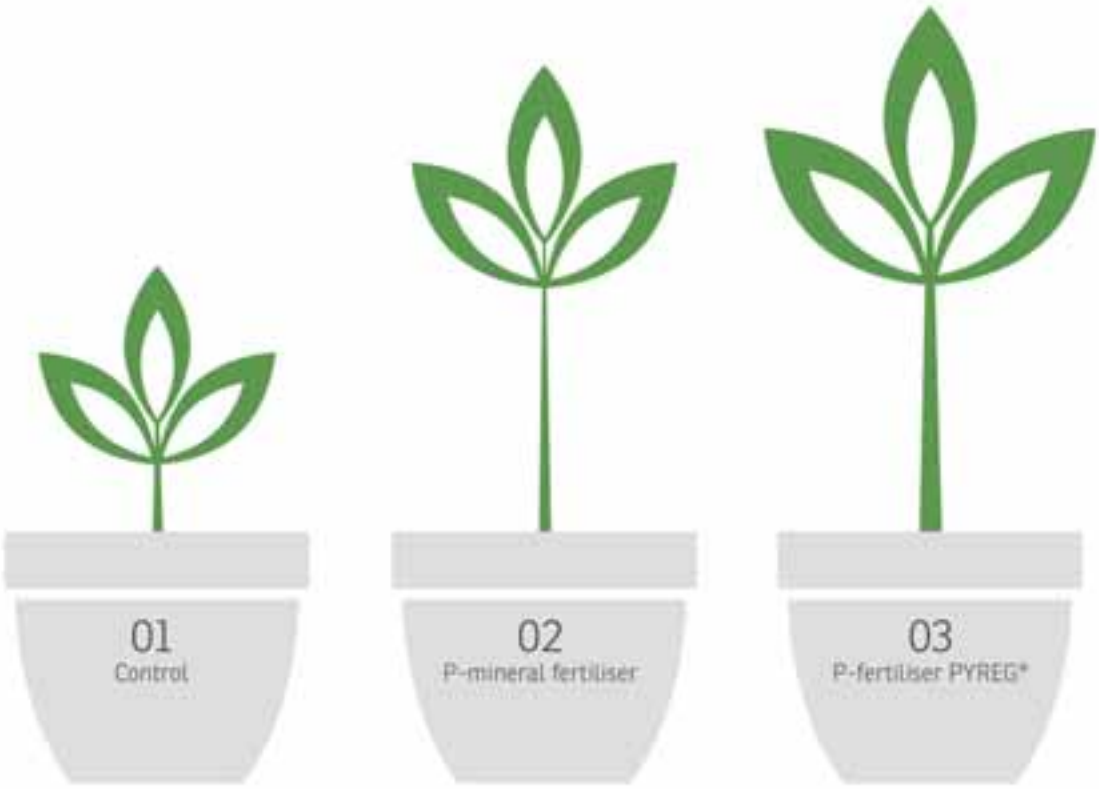
Objective

The objective of the PYREG® process when used with upstream drying of sewage sludge is the optimal thermal and material recycling of sewage sludge and, as such:

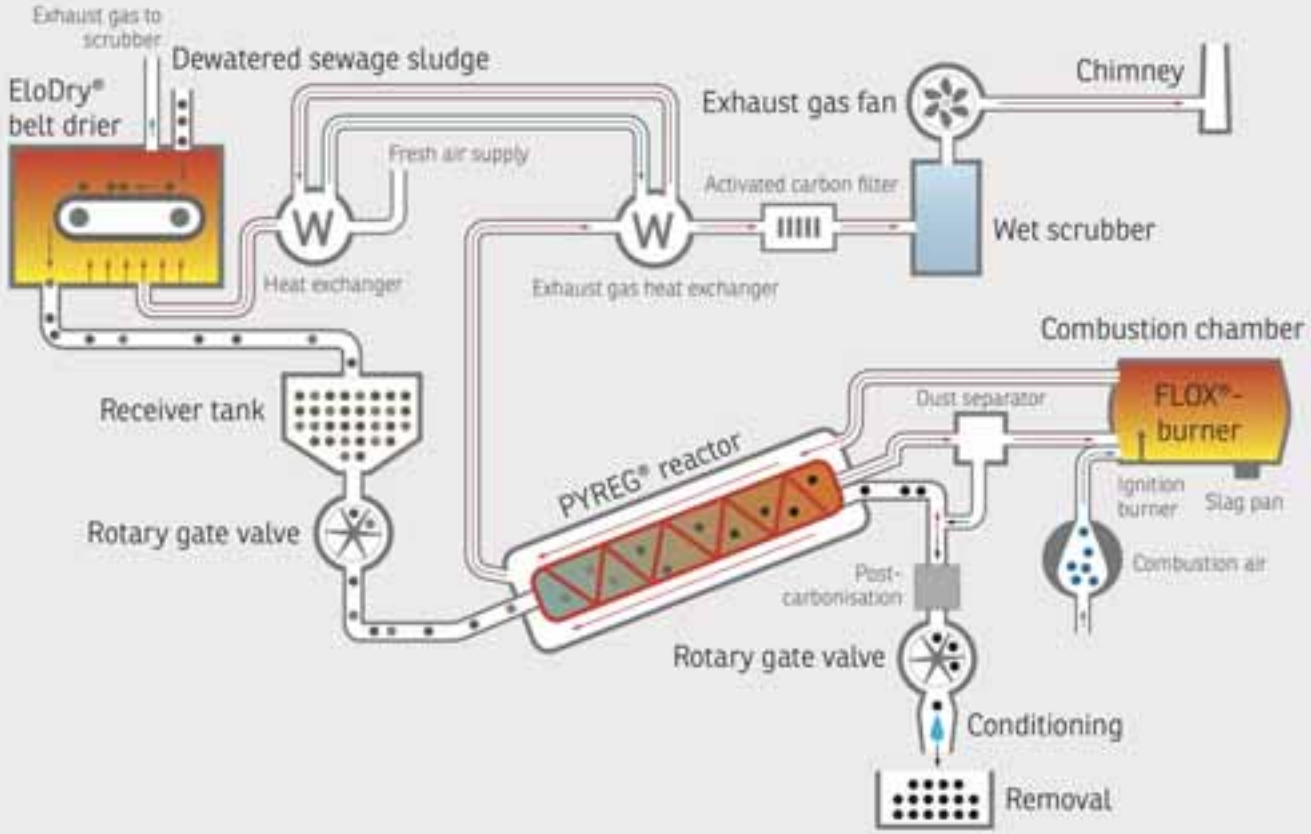
- keeps disposal costs to a minimum
- utilisation of a phosphorus resource
- long-term assured recycling

through:

- energy-efficient drying and thermal recycling of sewage sludge
- conversion to sewage sludge ash containing a high percentage of plant available phosphorus
- cost-effective and future-orientated decentralised recycling



Operating principle



Dewatered sewage sludge is dried on an energy-optimised low temperature belt drier, perfectly matching the PYREG® plant requirements from approx.25 % DS, to normally 75 - 90 % DS. The drying process uses the waste heat of the PYREG® plant; the drier's waste air is cleaned to comply with appropriate standards such as TA-Luft [Technical Instructions on Air Quality Control] limits.

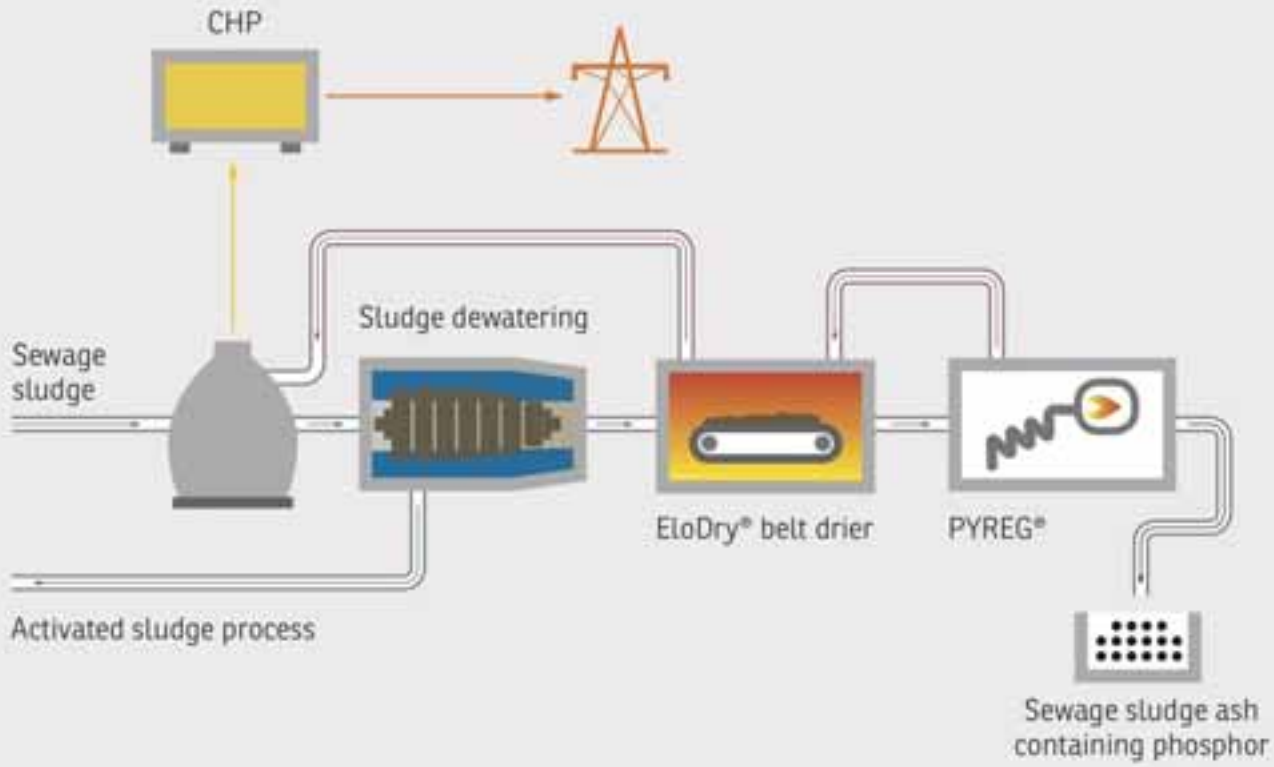
The dried sewage sludge is continuously fed to the PYREG® reactor via a rotary gate valve.

The PYREG® technology works using a staged combustion design:
Dried sewage sludge is heated to ca. 650 °C in the PYREG® reactor without fully burning, but by first degassing and then reducing to ashes under a controlled supply of air results in a fully hygienised ash containing phosphorus which can be used directly as a raw material for fertiliser production.

In a second stage the syngas developing in the reactor is completely incinerated at about 1,250 °C in the combustion chamber. The generated heat is used for heating the PYREG® reactor and for drying the sewage sludge feed.

Waste gas is cleaned through an activated carbon filter together with a wet scrubber. Harmful substances such as mercury and sulphur are separated in this process.

Design concept



PERFORMANCE DATA

The PYREG® technology solution is the optimal approach to decentralised thermal and material recycling of sewage sludge. Together with upstream low temperature drying, it constitutes an autonomous process route for the conversion of dewatered sewage sludge to sewage sludge ash whilst providing a high percentage of plant available phosphorus.

SEWAGE SLUDGE RECYCLING USING THE PYREG® PROCESS

Main advantages

- Sewage sludge volumes reduced by up to 90 %
- Reduction of lorry transportation by up to 90 %
- Hygienisation and separation of harmful substances (e.g. mercury, microplastics, hormones)
- Sewage sludge recycling in accordance with the scheduled amendment of the German Sewage Sludge Ordinance, the German Fertiliser Ordinance and BImSchV (Federal Immission Control Ordinance)
- Direct use of the recycled sewage sludge in the fertiliser industry
- Long-term assured recycling and cost control

USER- AND MAINTENANCE-FRIENDLY

The PYREG® module with upstream drying is particularly easy to operate and service:

- Continuous, fully automatic operation requiring few staff
- Very good access to all system components
- Robust and reliable components

PYREG® 500 module

EMISSIONS

The PYREG® system with sewage sludge drying meets the requirements pursuant to 17. BImSchV.

Drying

Avoidance of emissions into the atmosphere through using a fully enclosed design with operation at a slightly negative air pressure

Cleaning the drier waste air for compliance with TA-Luft limits

PYREG® plant

Reduction of fuel-based NOx emissions by means of redox reactions in a reducing atmosphere

Prevention of thermal NOx formation by using the FLOX® process in the combustion chamber (FLOX® = flameless oxidation) with internal flue gas recirculation.

PROFITABILITY

The PYREG® module with upstream drying offers low specific investment and operating costs:

- Recuperative process: Thermal processes in the PYREG® reactor use the energy recovered from the introduced sewage sludge. The surplus energy is used for drying the sewage sludge.
- Energy-efficient drying of sewage sludge: The low temperature drier used for drying the sewage sludge is closely adapted to the requirements of the PYREG® plant and distinguishes itself by optimal utilisation of available process heat. Waste heat from the drier is used for heating anaerobic digestion plants and/or buildings.
- Modular, standardised plant construction: The modular, standardised plant design offers cost-effective, flexible solutions for sewage works ranging upwards from a minimum of approx. 30 000 to 50 000 PE in multiple units.
- Robust, user- and maintenance-friendly plant design

OPERATING RELIABILITY

Both the low temperature drier and the PYREG® plant offer high operational reliability, thus justifying the assumption of 7,500 h/year for plant availability.

The plant is robust and not susceptible to malfunctioning due to its simplified process design.

Careful conveyance of sludge through the drier ensures minimal dust creation.

UNIQUE FEATURES

PYREG® – a modular, decentralised system for economic recycling of dried sewage sludge using staged combustion, with the following features:

- Recuperative process: Recovery of energy contained in sewage sludge for thermal processes and more
- End-of-pipe technology: production of phosphorus rich sewage sludge ash for direct sale as a raw material for the fertiliser industry
- Sewage sludge volumes reduced by up to 90 %
- Separation of harmful substances from the sewage sludge
- Flexible, modular plant, robust and simple to operate and maintain

APPLICATIONS

The PYREG® process represents cutting-edge technology for recycling of sewage – against the background of planned phosphorus recycling from sewage sludge, putting an end to agricultural recycling of sewage sludge and the incineration of phosphorus rich sewage sludge. Optimal functionality and economy demands optimal planning, implementation and integration of the complete system, especially also need-based, adapted drying of sewage sludge and heat recovery. This is assured with the ELIQUO planned and implemented overall systems.

The PYREG® module can in addition also be used for converting various biomass types into high-quality biochar.

TECHNICAL DATA

Key data for a PYREG® 500 module

Annual throughput

Approx. 4,000 t p.a. of dewatered sewage sludge with 25 % DS, equivalent to approx. 1,250 t p.a. dried sewage sludge with 80 % DS

Minimum heating value of the dried sewage sludge

10 MJ/kg

Annual production

Approx. 500 t sewage sludge ash containing up to 20 % phosphor

Operating hours

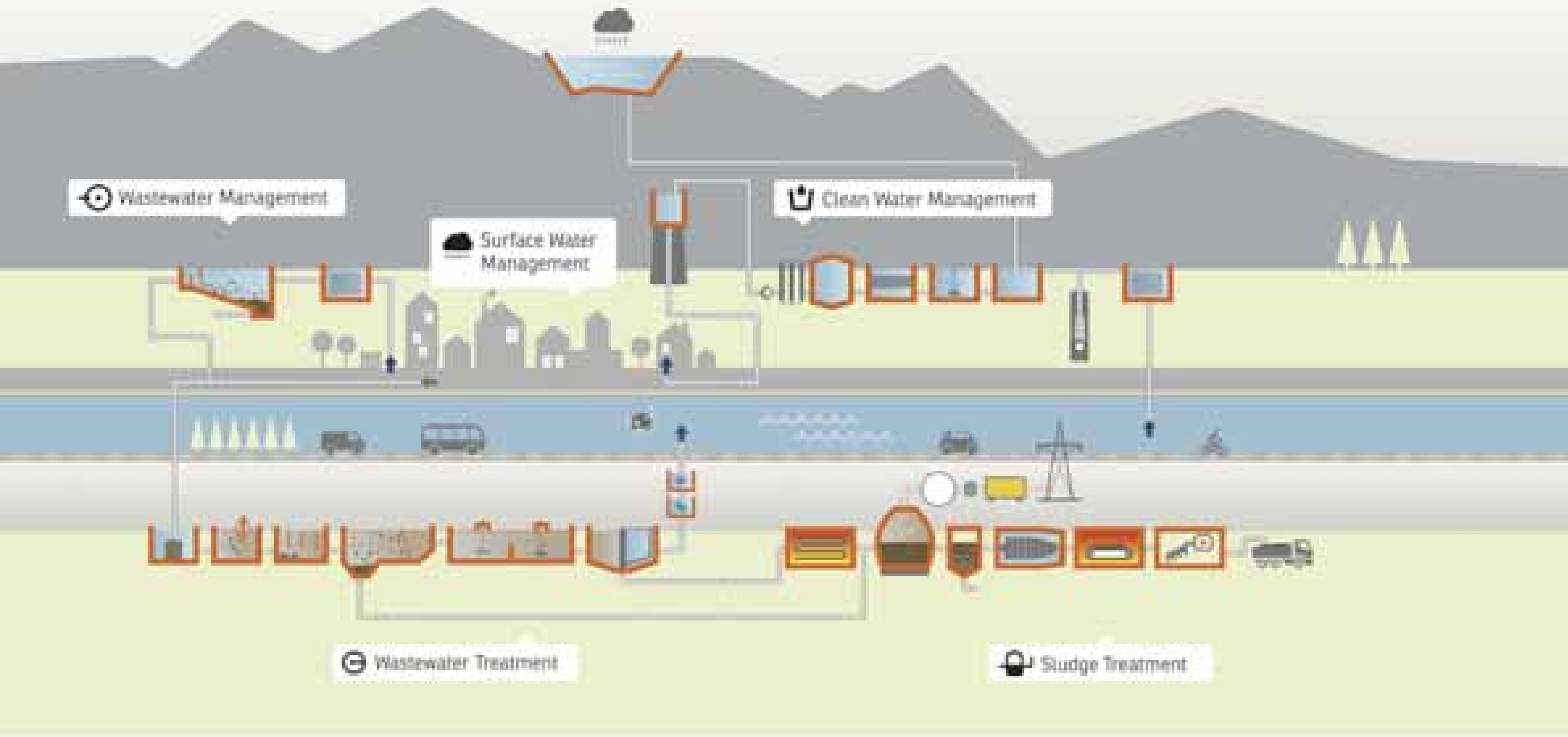
7,500 operating hours/year

Waste heat available for drying

Up to 200 kWth

ELIQUO | HYDROK

INNOVATION REALISED.



ELIQUO | HYDROK

TECHNOLOGIES INTEGRATED.

WASTEWATER MANAGEMENT

CSO / EO screens

- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]

Flow controls (foul, service and river flows)

- [illegible]
- [illegible]

Sewer flushing

- [illegible]
- [illegible]
- [illegible]

Storm tank cleansing

- [illegible]
- Tipping buckets
- Flushing gates

CLEAN WATER MANAGEMENT

Raw water intake screens (static, air purged)

Some filtration applications (filter not yet DWI approved)

S/S reactor tanks

WASTEWATER TREATMENT

Preliminary stage treatment

- Inlet Screening

Primary stage treatment

- S/S package settlement tanks
- [illegible]

Secondary stage treatment

- Fine bubble diffusers and pipework
  - [illegible]
  - [illegible]
- Coarse bubble s/s diffusers
- [illegible]
- Lift-out grids
- [illegible]
- [illegible]
- HySAF package treatment plant
- [illegible]
- [illegible]
- [illegible]

Tertiary stage treatment

- S/S package settlement tanks
- [illegible]
- [illegible]
- Mecana Filtration TSR
- [illegible]

SURFACE WATER MANAGEMENT

Flow control (float regulated)

Screening (non powered vortex)

Sediment flushing

Flood protection

Flood attenuation

SLUDGE TREATMENT

LysoTherm® thermal hydrolysis plant (THP without steam)

EloPhos® controlled struvite precipitation and removal

EloDry® low temperature sludge drier

PYREG® dried sludge pyrolysis

PEARL P-removal fertilizer production

Liquor treatment plants

Coarse bubble diffusers for sludge mixing

HIRE EQUIPMENT

Mecana filtration TSR, pilot and full scale

HySAF package treatment plant

Lift-out aeration grids

ELECTRICAL

Control panels

Kiosk assemblies

PLC / software

MISCELLANEOUS HARDWARE

Penstocks

Float controlled flap valves

Non return flap valves

Weir and baffle plates

Stainless steel package manhole chambers

Stainless steel pipework

Walkway and access structures

Miscellaneous CNC machining, profiling, forming, welding, fabrication etc.

GENERAL SERVICES

2D, 3D design and modelling services

Mechanical install works

Tank cleaning, redundant plant removal

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