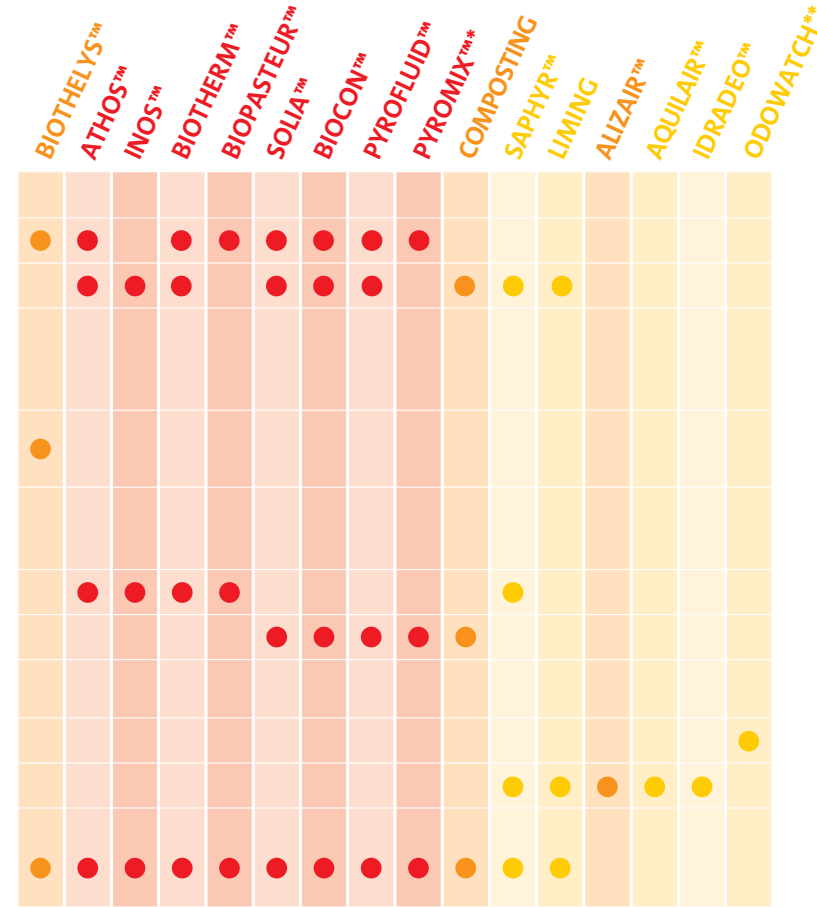


Veolia Water Solutions & Technologies helps you select sludge treatment solutions **that protect your processes and outlets**, and offers you valuable advice on **4 major areas** of concern:

- **Sludge recycling**
energy recovery
matter recycling
- **Reducing sludge quantities**
directly at source:
solutions built into the water
treatment process
within the existing sludge
treatment process:
for thickened sludge
for dewatered sludge
- **Reducing odor nuisances**
measurement solutions
treatment solutions
- **Improving health & safety**
and sludge quality



● thermal solutions ● biological solutions ● chemical solutions

* Co-incineration of sludge and household waste
** OdoWatch™ is an Odotech Inc. brand marketed under exclusive licence, in the water treatment field by Veolia Water Solutions & Technologies



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YVank Concept, 01 40 45 70 15 - 10/2006 - Photos: WW - VE Photo Library



Sludge Treatment solutions

- sludge-to-energy/matter recovery
- reducing nuisances
- health & safety



For further information on our solutions visit:
www.veoliawaterst.com



The future of sludge a major environmental challenge

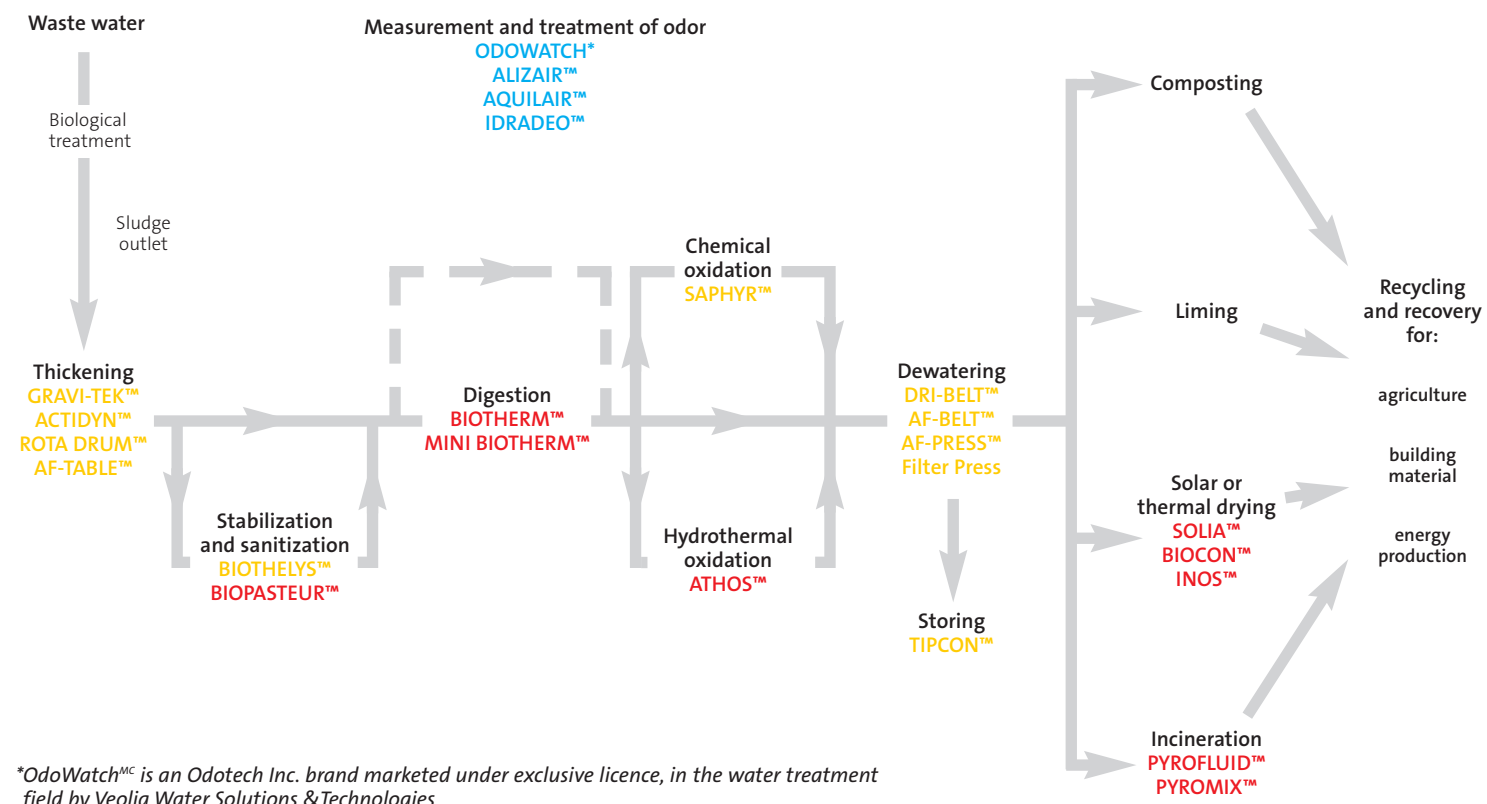
In the face of the concerns and expectations of citizens, ever-expanding annual production, and a tougher legislative and prescriptive context, sludge treatment is increasingly being seen by municipalities as a major element that needs to be built into the water treatment process at the design stage.

Veolia Water Solutions & Technologies helps you make a responsible choice

With 70 years of experience in water treatment engineering, Veolia Water Solutions & Technologies (VWS) has the expertise to find the perfect balance between specific local constraints and your water/sludge issues to help you choose a sludge treatment process appropriate to your needs.

VWS offers a wide range of technological solutions to help you reduce the quantities of sludge produced and odor nuisances. Its offer guarantees optimum health & safety as well as recycling sludge matter and energy recovery.

You therefore have the power to act upon the whole treatment process in line with your plant layout. Veolia Water Solutions & Technologies gives you the ability to make an informed decision about the best combination of technologies for your needs.



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ATHOS™

- sludge-to-energy/matter recovery
- reducing nuisances
- health & safety



Removing overall sludge production

ATHOS™, liquid phase oxidation

With less than an hour retention time in the reactor, the ATHOS™ process results in:

- high mineralization (less than 5% organic carbon content in the solid residue),
- an easily biodegradable liquid that can be returned to the biological treatment process (equivalent to $\approx 15\%$ total COD* in the sludge),
- continuous and safe oxidation, under continuous mixing,
- phase separation between gas and inorganic sludge.

The heat released by the oxidation reaction is recovered to heat the sludge, with no external energy supply.

*COD: Chemical Oxygen Demand

Process principle

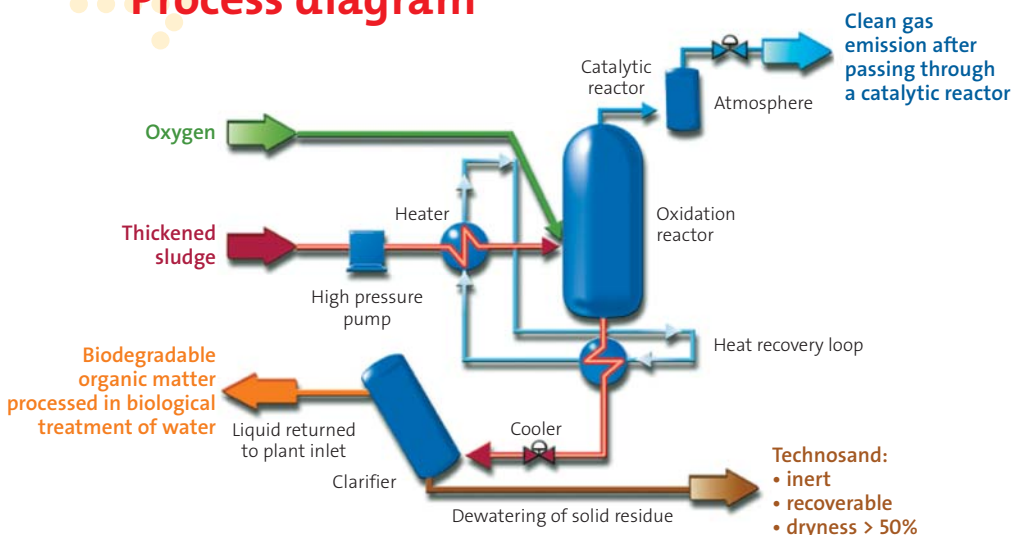
The ATHOS™ process is based on the principle of hydrothermal oxidation (HTO), an oxidation process in liquid phase that involves heating an effluent to a high temperature (250 to 300°C) and high pressure (70 to 150 bar) in the presence of an oxidizing gas (air or oxygen).

ATHOS™ is a new process combining HTO with biological treatment, which mineralizes the organic matter in the sludge under moderate conditions of temperature (235°C) and pressure (45 bar) in the presence of pure oxygen.

It generates 3 stable and/or recyclable by-products:

- clean gas emission,
- a biodegradable organic liquid,
- a primarily mineral-based solid.

Process diagram





Performance

The ATHOS™ process complies with all regulations on the disposal of wastewater treatment sludge whilst remaining cost effective. It benefits from the technological expertise and track-record of Veolia Water, the world leader in the treatment of urban effluents.

An environmentally friendly process

ATHOS™ is a clean technology; all the sludge components are recycled, recovered or discharged to the natural environment with no adverse effects:

- final result: a concentrate of inorganic matter (technosand) accounting for only 1% to 2% of the initial liquid sludge quantity,
- opportunities of recycling the technosand in building materials,
- heavy metals stabilization in a non-leachable form (inert waste) in the solid residue,
- zero emission of polluted fumes or harmful by-products (nitrogen oxides, dioxins, furans),
- reduction in the greenhouse effect (50% drop in CO₂ emissions compared with incineration),
- destruction of toxic and malodorous (hydrogen sulphide, mercaptan, etc.) and organic micropollutants.

Reference plants

- *Toulouse-Ginestous, France (1998) - 50,000 P.E. **
- *Brussels-North, Belgium (2002) - 1.1 million P.E.*
- *Trucazzanno, Italy (2003) - 300,000 P.E.*
- *Epernay, France (2003) - 150,000 P.E.*
- *Aix-en-Provence, France (2005) - 150,000 P.E.*

*P.E.: Population Equivalent

www.veoliawaterst.com/athos

A cost-effective thermal process

Operating costs are reduced by:

- moderate operating conditions (temperature and pressure, limited O₂ consumption),
- reducing the dewatering stage (restricted only to the inorganic fraction of the sludge), with no chemicals addition.

A flexible process

ATHOS™ provides high operational flexibility:

- treats all types of thickened sludge (primary, biological, fresh or digested, urban),
- possibility of adjusting retention time, temperature and the O₂/organic pollution ratio,
- advanced automation.

A compact process

Due to its compact design, ATHOS™ can be fully integrated into the wastewater treatment plant and provides continuous sludge processing, as well as its by-products treatment.

ATHOS™ unit at Epernay (France)



BIOCON™

- sludge-to-energy/matter recovery
- reducing nuisances
- health & safety



Drying / Energy Recovery of sludge

Applications

The BIOCON™ Dryer treats municipal dewatered sludge at low temperature and in complete safety for the operator. The BIOCON™ Dryer consists of two moving belts that allow the sludge to reach levels of dryness of between 65% and 90% using hot air circulation.

The dried sludge can be stored and recycled again in agriculture, without further treatment. Sludge can also be reused in a BIOCON™ Energy Recovery System (ERS), installed downstream from the drying unit. With this system, the energy recovered is utilized for drying the sludge, without an external energy supply.

The BIOCON™ Dryer

- For dewatered sludge (10-30% Dry Solids)
- Drying at a temperature below 180°C
- Retention time of more than one hour for disinfection
- Delivery of granules or pellets

The BIOCON™ ERS

- For dried sludge
- No external energy supply
- Automated operation
- Production of inert and recyclable ash
- Flue gas emission according to EU-regulations



BIOCON™ energy recovery plant at Mora (Sweden)



Performance

- Reduction of initial sludge quantity to less than 5% (when combined with an Energy Recovery System)
- No odor nuisances
- Sludge disinfection (US EPA class A)
- No equipment abrasion
- No dust (no sludge movement)
- Quiet process
- Energy recovery
- Low operating costs
- Risk control

Reference plants

Dryer

- Randers, Denmark (1999) - 100,000 P.E.*
- Roskilde, Denmark (2001) - 103,000 P.E.
- Haapavesi, Finland (2006) - 50,000 P.E.
- Draguignan, France (2006) - 70,000 P.E.
- Mystic Lake, USA (2006) - 18,500 P.E.
- Zdroje, Poland (2007) - 140,000 P.E.
- Wloclawek, Poland (2007) - 123,000 P.E.

Dryer + ERS

- Brønderslev, Denmark (1995) - 35,000 P.E.*
- Hundested, Denmark (2001) - 18,000 P.E.
- Falu, Sweden (2003) - 61,000 P.E.
- Moravatten AB, Sweden (2003) - 19,000 P.E.
- Szczecin, Poland (2007) - 417,000 P.E.

*P.E.: Population Equivalent



Sludge treated by the BIOCON™ dryer



Residual matter from the BIOCON™ Energy Recovery System

www.veoliawaterst.com/biocon

INOS™

- sludge-to-energy/matter recovery
- reducing nuisances
- health & safety



Sludge dewatering and drying

Process principle

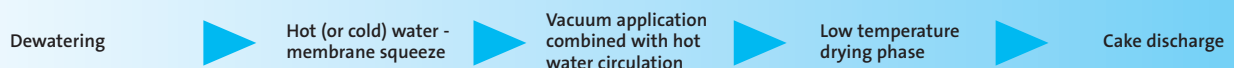
INOS™ uses a simple and energy efficient technology, which combines, in a single unit, both filter press dewatering and thermal drying of sludge / biosolids.

The sequence of operation starts with a membrane filtration phase, using water as the membrane inflation media, which produces a sludge cake. Then the combined use of hot water circulation (85°C) with the application of a vacuum via the filtrate manifold helps deliver a dry cake, at a low temperature, in total security.

INOS™ can be applied to all types of municipal sludge (including sludge produced by drinking water plant), and permits control of the cake dry solids output up to 97%.

INOS™ increases potential for cake recycling and secures future outlet. It fulfils the time / temperature objectives to give Class A sludge to US EPA 503 Regulations and the ADAS Matrix.

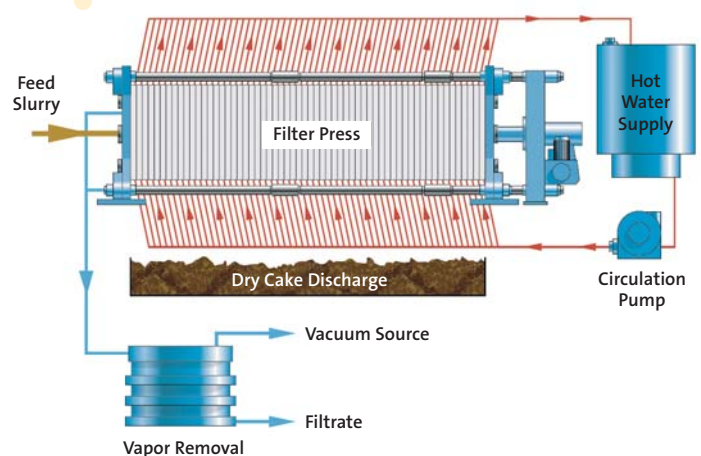
Sequence of operation



INOS™, sludge dewatering and drying in a single plant

- Dewatering of thickened sludge
- Drying by internal recirculation of hot water at 85°C and conduction from the filter plates
- Cake dry solids output up to 90%
- Flexible design allowing a staged implementation:
 - dewatering stage alone,
 - further upgrade for drying stage

Process diagram



Performance

- Safe operation (process containment, low temperature environment compared to a thermal dryer)
- Minimizes material handling and quantities, which decreases haulage costs
- Controlled drying profile
- Retrofits to existing filter presses, maximizing existing assets and buildings
- Low temperature drying, providing a stable sludge
- Standard plant and equipment
- Low energy consumption
- Low whole life costs, compared to alternative drying technologies
- Easy operation through full automation

Reference plants

- *Silver Hill Foods, Ireland (2004) - 8250 kg DS/d**
- *Philips, Drachten - Netherlands (2006) - 250kg DS/d*
- *Waterford Crystal - Ireland (2006) - 500 kg DS/d*

* Dry Solids per day

www.veoliawaterst.com/inos

PYROFLUID™

- sludge-to-energy/matter recovery
- reducing nuisances
- health & safety



Sludge incineration, energy recovery and ash recycling

PYROFLUID™, a safe process

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

- recycled for use within road construction,
- used for concrete production,
- discharged to landfill.

The type of flue gas treatment will depend on the facility's incineration capacity and includes at least dust extraction and removal of acid pollutants, using a dry or wet process. It complies with the most rigorous European regulations on the incineration of sludge.

Applications

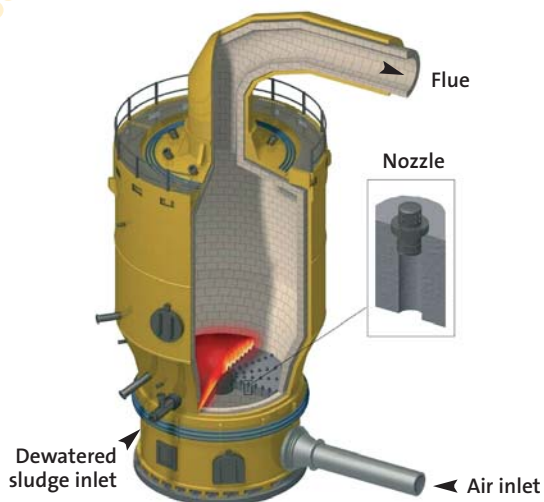
PYROFLUID™ is a thermal treatment solution that oxidizes organic matter contained within sewage sludge. It is a fluidised-bed incinerator (where sand is maintained in suspension by a constant up-flow of air) that operates at approximately 900°C in order to incinerate sludge within a matter of seconds.

PYROFLUID™ is able to:

- 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 most strict emission standards.

*tonne of dry solids / hour

Process diagram



Saint-Petersburg (Russia) - The PYROFLUID™ incinerator combined with thermal exchanger





Performance

- Total mineralization of sludge
- 100% reduction of initial sludge quantities combined with mineral by-product recycling (road construction and civil engineering projects)
- Total destruction of pathogens
- Energy recovery:
 - recycling within the combustion process (in order to reduce the need for additional fuel)
 - heat distribution
 - production of electricity (to meet the plant's energy needs)
- No odor
- Low maintenance costs
- Long-term reliability: excellent resistance to high temperature, erosion and corrosion (no moving parts in the hot zones)
- Easy operation (automated)
- 24/7 operation

Reference plants

A small selection of references:

- Saragossa, Spain (1992) - 4.6 t DS/hr*
- Seine-Aval, France (1995)
- Lyon Saint-Fons, France (1995) - 3.6 t DS/hr
- Coleshill, United-Kingdom (1996) - 5 t DS/hr
- Rouen Petit-Quevilly, France (1997) - 3 t DS/hr
- Amphitria Cap-Sicié, France (1997)
103,000 m³/d - 550,000 P.E.
- Colombes, France (1998) - 8 t DS/hr
- Le Mans, la Chauvinière, France (1999)
54,130 m³/d - 315,000 P.E.
- Lundtofte, Denmark (2001) - 0.4 t DS/h
- Toulouse Ginestous, France (2004) - 2 t DS/hr
- Saint-Petersburg, Russia (2006) - 8 t DS/hr

*t DS/hr: tonne of dry solids / hour

Colombes (France) - The PYROFLUID™ incinerator



www.veoliawaterst.com/pyrofluid

PYROMIX™

- sludge-to-energy/matter recovery
- reducing nuisances
- health & safety



Energy recovery from co-incineration of sludge and domestic waste

Applications

Veolia Water Solutions & Technologies and Veolia Environmental Services have pooled their expertise within CRPE – Veolia Environnement's research center serving the company's Energy Services and Environmental Management divisions – to develop the PYROMIX™ solution.

PYROMIX™ injects pasty sludge directly into the waste incinerator using compressed air sprayed through an injection pipe inserted in the incinerator wall. The air pressure and flow rate are set to ensure an even dispersal of the sludge in the form of fine droplets over the domestic waste.

The sludge is incinerated with the waste, without:

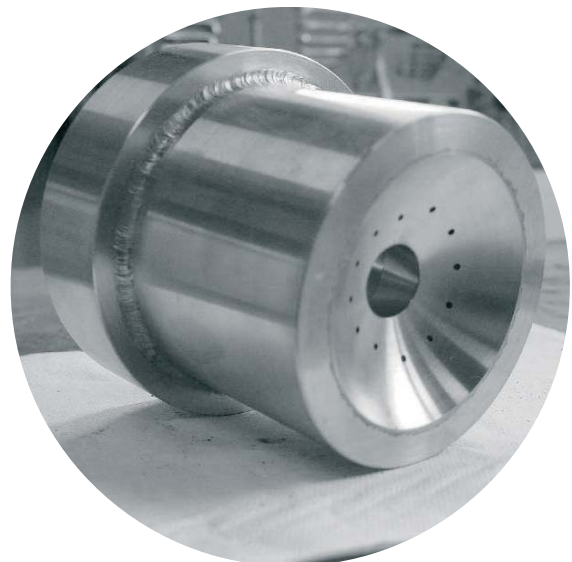
- increasing the production of waste gas treatment residue,
- modifying the nature of the bottom ash.

Up to an additional 20% (weight) of household waste can be allocated to sludge, without altering the thermal capacity of the incinerator.

With PYROMIX™, facilities can be used for the co-incineration of all types of municipal waste. The process thus offers an additional reclamation option for sludge disposal.

Using PYROMIX™ to feed a waste-to-energy plant with WWTP sludge

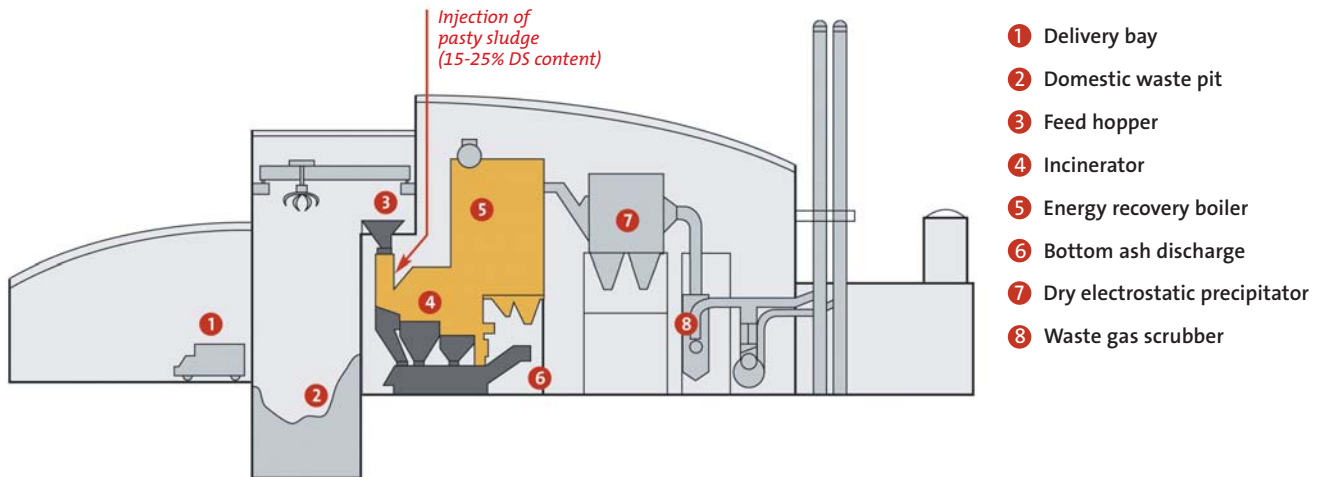
- Injection of sludge at 15-25% DS content
- Up to 20% of household waste tonnage
- No impact on bottom ash quality
- No change in thermal capacity of the incinerator
- Easy incinerator operation (improved thermal stability)
- Optimized steam generation
- Complete destruction of sludge



PYROMIX™ injector nozzle



Process diagram



Performances

- Elimination of sludge drying phase
- No grab handling (direct spraying of sludge into the incinerator)
- Sludge injected in the form of fine particles and evenly spread over the household waste
- Injector adaptable to all types of grate incinerators
- Easy maintenance (single injection system)
- Simple installation and reduced investment cost
- Alternative option to basic sludge disposal outlets
- Sludge-to-energy recovery system

Reference plants

- Syctom at Quimper, France (2004) - 2 PYROMIX™ injectors
- Fribourg, Switzerland (2004) - 2 PYROMIX™ injectors
- Cluses, France (2005) - 1 PYROMIX™ injector

PYROMIX™ injector at Quimper (France) - Injection pipe in raised position



SAPHYR™

- sludge-to-energy/matter recovery
- reducing nuisances
- health & safety



Reducing odors throughout the sludge treatment process

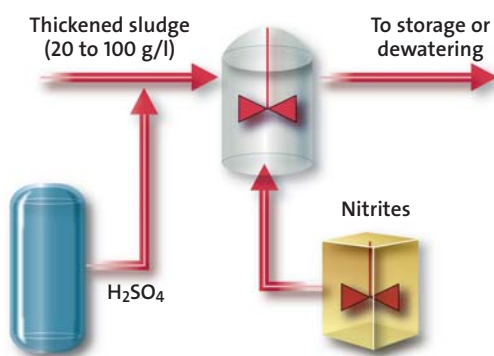
Applications

The SAPHYR™ process is used to stabilize and sanitize thickened sludge generated by wastewater treatment plants. SAPHYR™ reduces the odors generated by the sludge production process through to its final destination.

SAPHYR™, a chemical oxidation

- For thickened sludge
- In the presence of NO_2^-
- Under acidic conditions (pH 2-3)

Process diagram



Reference plants

- Cortina d'Ampezzo, Italy (1998) - 9,000 P.E.*
- Ustaritz, France (2003) - 13,000 P.E.
- Aussonnelle, France (2006) - 75,000 P.E.

*P.E.: Population Equivalent

Performance

- Long lasting odor reduction
- Reduced evacuation quantities compared to liming
- Removal of faecal contamination germs and sporulated forms
- Improved dewatering
- Subsequent incineration or co-incineration
- Possible combination with a composting unit
- Simple design and easy to operate

Your contact:

V/Anik Conseils 01 40 45 79 75 - 10/2006 - Photos : VWS - Pascal VOUPÉZ



SOLIA™

Greenhouse solar sludge drying

- free and unlimited energy source
- simple operation



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www.veoliawaterst.com/solia



Solutions & Technologies



Process principle

Veolia Water Solutions & Technologies has enhanced the efficiency of greenhouse solar sludge drying by coupling two well-known processes: air drying and aerobic fermentation.

- Under the effect of **solar radiation** and the action of an automated windrow turner (SOLIAMIX™), water evaporates from the sludge for subsequent removal from the greenhouse by a powerful air draft.
- The **fermentation step** is promoted by regular turning of the sludge windrows; the energy released by the oxidation of organic matter in the sludge accelerates the evaporation process.

A unique windrow turning system

Once unloaded in the greenhouse, the automated SOLIAMIX™ system piles the dewatered sludge into windrows. In order to renew the exchange surface and for aeration, the windrows are turned at regular intervals.



The SOLIAMIX™ range of windrow turners is available in 3 sizes and their operation may be automated.

Smart storage

Triangular windrow shaping offers a larger exchange surface area than sludge drying beds for the same amount of greenhouse space, resulting in a faster drying process. Furthermore, a higher quantity of sludge can be stored.



*Greenhouse drying:
a cost-efficient and
environmentally-friendly
option*

- Improves sludge appearance, facilitates handling and storage operations
- Reduces the amount of sludge, limits transportation and treatment costs
- Opens the way to multi-outlet disposal options, such as agricultural land application or energy recovery and, hence, adopts a sustainable development approach

Perfectly sanitized end-product

The exothermal reactions occurring during the fermentation process generate a high temperature increase (50 to 60°C), thereby promoting sludge sanitization in parallel with drying.

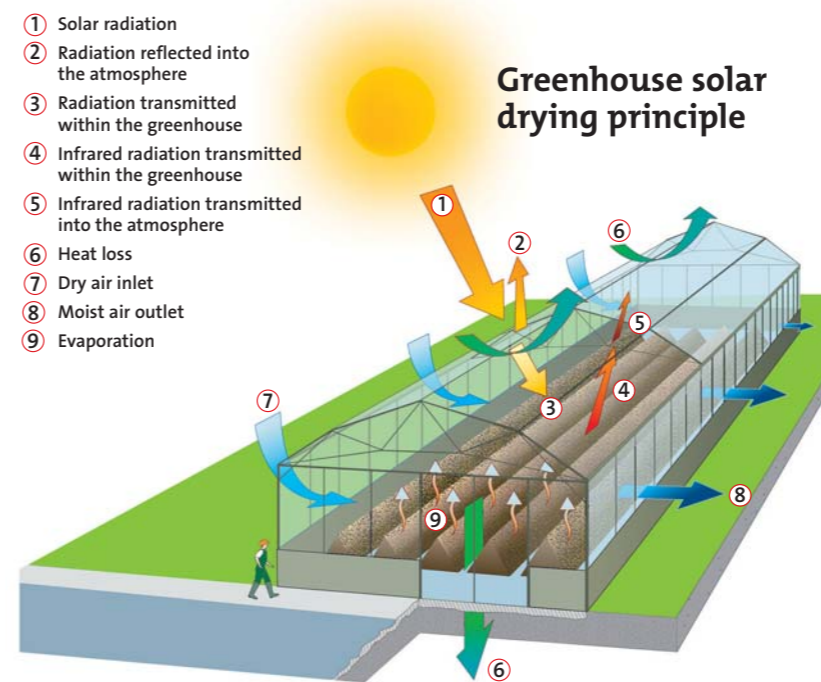
The dried sludge quality will fully comply with the requirements of the future European Directive on agricultural land application of sewerage sludge.



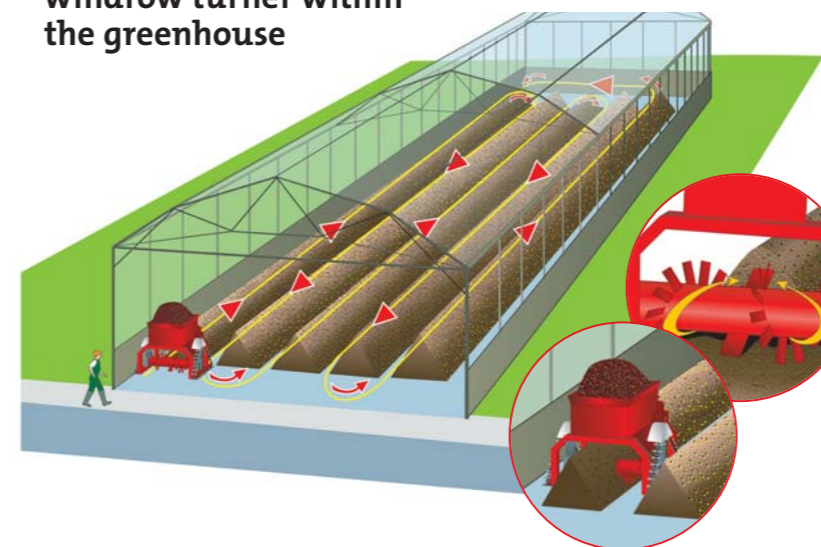
Optimized drying via dual ventilation

The greenhouse is fitted with two types of ventilation system:

- ventilation designed to break-up the air layers and guarantee optimum homogenization of the greenhouse atmosphere
- forced ventilation for moist air extraction



Typical pass of the SOLIAMIX™ windrow turner within the greenhouse



Reference plants

- Chateaulin, France - 2,100 m² / 25,000 PE*
- Fonsorbes, France - 1,000 m² / 9,000 PE*
- Forbach, France - 250 and 4,800 m² / 70,000 PE*
- Le Veron, France - 1,300 m² / 17,000 PE*
- Pechbonnieu, France - 700 m² / 6,500 PE*
- Verdun, France - 4,000 m² / 56,000 PE*
- Saint-Paul-Trois-Châteaux, France - 1,000 m² / 13,000 PE*
- Mareuil-sur-Lay, France - 600 m²/400 t HM/year**

*P.E.: Population Equivalent

**tonne of humic matter per year

SOLIA™ highlights

- Optimized drying surface with sludge windrow layout
- 3 to 5 fold reduction in sludge quantity
- Sludge storage prior to agricultural reuse
- Operational flexibility:
 - high efficiency for all sludge types
 - adjustable final dryness: 45 to 90% dry solids content
 - can be sized to meet local weather conditions using a climate control tool
- “Zero nuisance” solution:
 - odor control
 - safe natural drying throughout the year
 - sanitization and stabilization of sludge
- End-product traceability
- Reduced operating costs
- Anticipation of the future European Standard

SOLIA™ is a flexible solution that can be adapted to local requirements:

- multiple options for greenhouse control
- wide range of SOLIAMIX™ automated turners
- dry solids content of the end-product