Co-Fermentation
Energy autarkic purification of communal waste water

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Co-fermentation is defined as coinstantaneous fermentation of organic waste materials or liquid manure with communal sewage sludge. Due to the addition of nutrient-rich and easily biodegradable Co-ferments the production of biogas in an existing digester of a sewage treatment plant can be raised drastically.

Introduction

For the first time the combination of co-fermentation and solar-thermal sewage sludge drying was implemented at a purification plant of a design capacity of 70.000 PE.

The following project of the waste water association Knittelfeld, Styria, was awarded the prize for environmental protection of the styrian federal state government in 2007.

Until now the generation of renewable energy based on anaerobic fermentation of organic waste was realized only to an insignificant percentage in Styria, but also in Austria and Europe, because of the high investment cost for new installations. Anyhow, there is a high potential yield of biogas coming from fermentable organic waste.

On the other hand many communal waste water treatment plants like the purification plant in Knittelfeld are equipped with too large dimensioned digesters so that their biogas production could be improved considerably, of course based on adequate process control.

Several experiments in the past have shown the difficulty of an unstable and uncontrolled addition of organic co-substrates, because the anaerobic process normally reacts very sensitive towards changes in the organic volumetric load.

With the installation of a customized take-over station and an improved process control operating problems can be identified immediately or rather predicatively avoided.

Targets

- Sewage sludge: from agricultural use and possible accumulation in the soil towards a sustainable solution for the disposal problem through combustion of dried sludge
- Load relieving of the canalization and of the aerobic step through direct take-over of liquids with high organic content into the anaerobic digester, which is connected to:
- Decreased energy demand in the aerobic section
- Decreased maintenance costs in the canalization
- Minimized emission of smell, methane and hydrogen-sulfide in the canalization

Implementation and results

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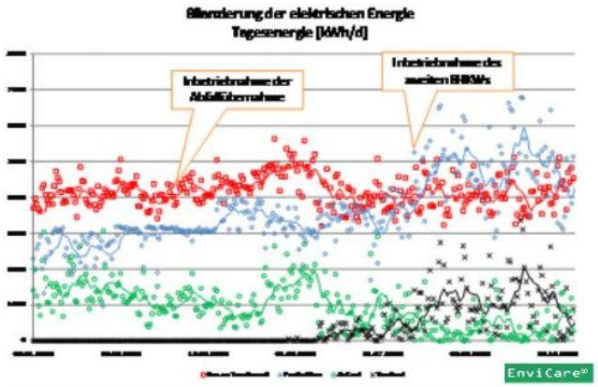
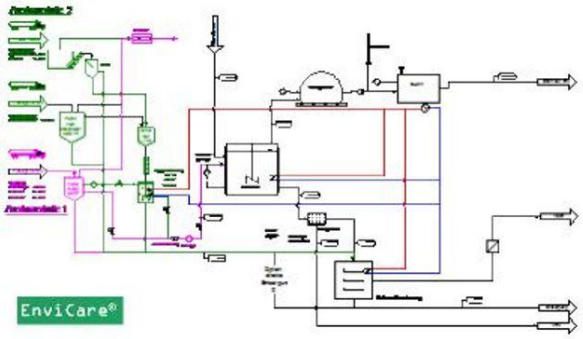
Firmensitz Graz, FN 277966 z Landesgericht für ZRS, Graz

The municipal waste water treatment plant in Knittelfeld has an electrical energy demand of 4.000 kWh/d, which is covered now by its own electricity production in two cogen-units. About 1.900 kWh/d is provided by fermentation of sewage sludge and about 2.100 kWh/d result from fermentation of bio-degradable co-substrates.



This significant increase was possible as the capacity of the existing digester was far below the general design guideline so that the volumetric gas yield could be doubled without major modifications of existing facilities. In other words already executed investments are used in a more economical way now.

Due to the Austrian eco-electricity tariff (5,9 cent/kWh – until 2009) for electricity generated in communal sewage plants, which cannot cover the production costs in a cogen-set, it is not economically reasonable to produce more than the own consumption.



Waste water from dairies, old cooking fat and oil and industrial organic residues are applied as substrates and a certain revenue is obtained.

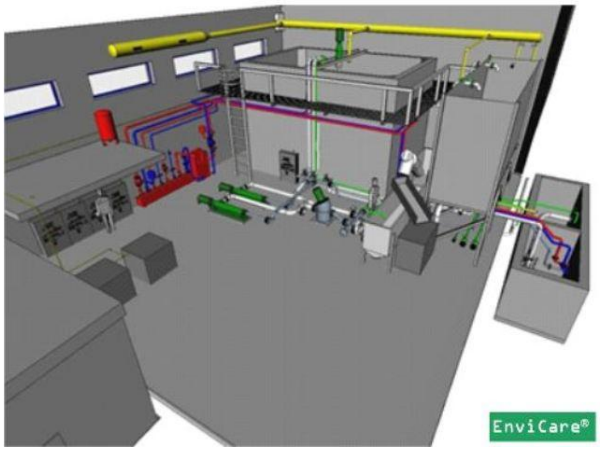
In the past these highly loaded liquid organic waste was discharged into the canalization and reached the aerobic stage of the waste water plant, mostly after causing trouble in the mechanical section. Of course the waste water plant had no revenues but higher treatment costs caused by maintenance and electric power for aeration.

Agricultural use of sewage sludge as it was practiced in the past has now increasingly emerged as critical due to a long-term accumulation of persistent substances and heavy metals in the soil.

Today the dried sewage sludge is industrially incinerated at significantly lower costs so that a restructuring of the disposal of sewage sludge was reached, also due to minimizing the amount by 70 %. The reduction of the accumulated sewage sludge from previous 3.200 t/a to 1.300 t/a today through solar drying represents a basic requirement for an ecologically reasonable thermal reuse of the sludge.

New components

- take-over station for co-substrates
- solar drying facility for sewage sludge
- cogen-unit with 183 kW electric power operated with biogas



The heat produced in the cogen-unit covers the own requirements completely. Excess heat is supplied for drying sewage sludge.

Given that all residues of the anaerobic fermentation of the co-substrates are incorporated in the sewage sludge these remaining substances are finally used in cement kilns and in turn substitute raw material.

Also the recent adaption of the aerobic purification plant to the state of the art by applying a so-called hybrid process shows a positive effect because a higher amount of sewage sludge and a minor energy demand result from that kind of technology.

Reduction of CO_2 due to take over of organic co-substrates

By using organic co-substrates the energy demand of the purification plant is entirely covered today without additional investments going into already existing plant components.

A reduction of CO_2-emissions of 1.300 t_{co2}/a is achieved. This is done by producing 2.100 kWh/d of electricity throughout the year and by saving natural gas for thermal energy during the heating period (about 100 days). Thus electricity from the public grid and natural gas are substituted by renewable energy carriers which otherwise would need to be oxidized in the aerobic stage of the purification plant.

Reduction of CO_2 due to thermal recycling of dried sewage sludge

After a low energetic extensive drying in the solar drying plant sewage sludge has a similar heating value like brown coal (15 MJ/kg) and has to be seen as a renewable energy source with a closed CO_2 cycle.

With an amount of 900 t/a dried sewage sludge 800 t_{CO2}/a can be saved by substitution of fossil energy carries like natural gas, coal or petroleum.

Summing up there are following positive consequences

- CO_2 reduction of 30 $kgCO_2$/(PE.a) in total
- Energy autarkic operation of waste water treatment plant
- Massive decrease of CO2 and methane emission
- Relief of soil as no sewage sludge is applied
- Relief of canalization and reduction of maintenance expenditure as liquids with a high organic fraction are directly taken over into the digester
- Reduction of the energy demand of the aerobic stage as liquids with a high organic content are directly taken over into the digester
- Reduction of smell and methane emissions in the canalization

This project ensures regionally added value, regional employment, and saves CO2 emission and fossil energy!

EnviCare® Engineering was responsible for feasibility study, authority and detail engineering, site supervision as well as for start up.

EnviCare® offers years of knowledge in development, design, installation and operational practice of state of the art environmental technology.

We take care of your environment!