



Portinho da Costa– A Water Treatment Plant with a cogeneration system for electricity and heating production

SMAS - Water and Wastewater Municipal Services, Portugal

Summary

The Portinho da Costa Water Treatment Plant covers approximately 24% of the residual water treatment in Almada Municipality. The produced biogas is used in a cogeneration system to produce electricity and heat. Thanks to this cogeneration system, the consumptions of natural gas and electric energy have been reduced with 67%. In terms of watts this is equivalent to a reduction of 2000 MWh per year. At environmental level, the use of this technology has reduced the emissions of greenhouse gases (CO₂) with 39% or 687 tons. This Water Treatment Plant has the best and most advanced technologies and has a great treatment efficiency (the percentage to remove organic substance is 96%).

End-user area

- New buildings
- Refurbishment of buildings
- Transport and mobility
- Financial instruments
- Industry
- Legal initiatives (regulations, directives, etc)
- Planning issues
- Sustainable communities
- User behaviour
- Education
- Other

Target Audience

- Citizens
- Households
- Property owners
- Schools and universities
- Decision makers
- Local and regional authorities
- Transport companies
- Utilities
- ESCOs
- Architects and engineers
- Financial institutions
- Other

Technical

- Energy efficiency
- Heating
- Cooling
- Appliances
- Lighting
- CHP
- District Heating
- Solar energy
- Biomass
- Wind
- Geothermal
- Hydro power
- Other

Context

In the Almada Municipality about 100% of the residual water is treated. This goal was concretized due to a strategy of the municipality to cover all council with treatment systems and good drainage systems. For this, the municipality has four Water Treatment Plants. One of these is the Portinho da Costa, which is an ecological friendly and energy efficient plant which transforms residues into heat and electricity.

Objectives

In 2001, Almada Municipality decided to elaborate a greenhouse gas document, "Municipal Inventory of the Emissions of Greenhouse Gases in Almada". With this document it was possible to identify the energy demand and the emissions of greenhouse gases, per economic sectors in Almada.

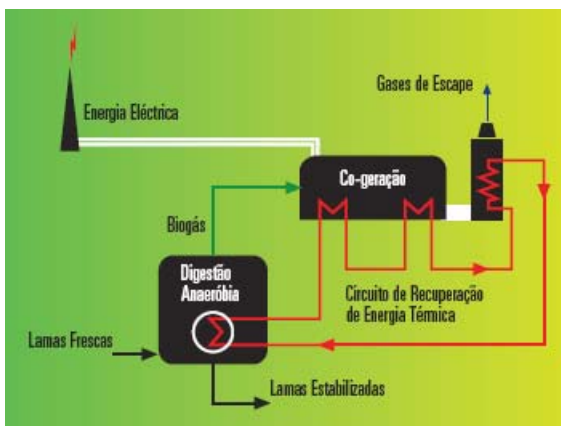
In the Inventory it was mentioned that the Residues Sector was responsible for 1.2% of the total emissions of greenhouse gases and that the existents water treatment plants didn't have capacity to treat all the residual water of the council. Thus it was necessary to build a new water treatment plant to cover all council residual water treatment without increasing the greenhouse gases emissions.



Process

The Portinho da Costa water treatment plant was built with an installation of a cogeneration system that convert biogas into electricity and heat. The biogas is produced by the anaerobic digestion of the mud coming from the residual water treatment.

This Water Treatment Plant covers 24% of the residual water amount in Almada Municipality. With the construction of this plant the Municipality obtain 100% of the residual water treatment without increasing the emissions of greenhouse gases.



Financial resources and partners

Economic data:

Financing

All the costs of the project were supported by the Municipality of Almada.

Capital cost

The total costs of the construction of the Portinho da Costa Water Treatment Plant had been estimated to 14 000 000 Euros.

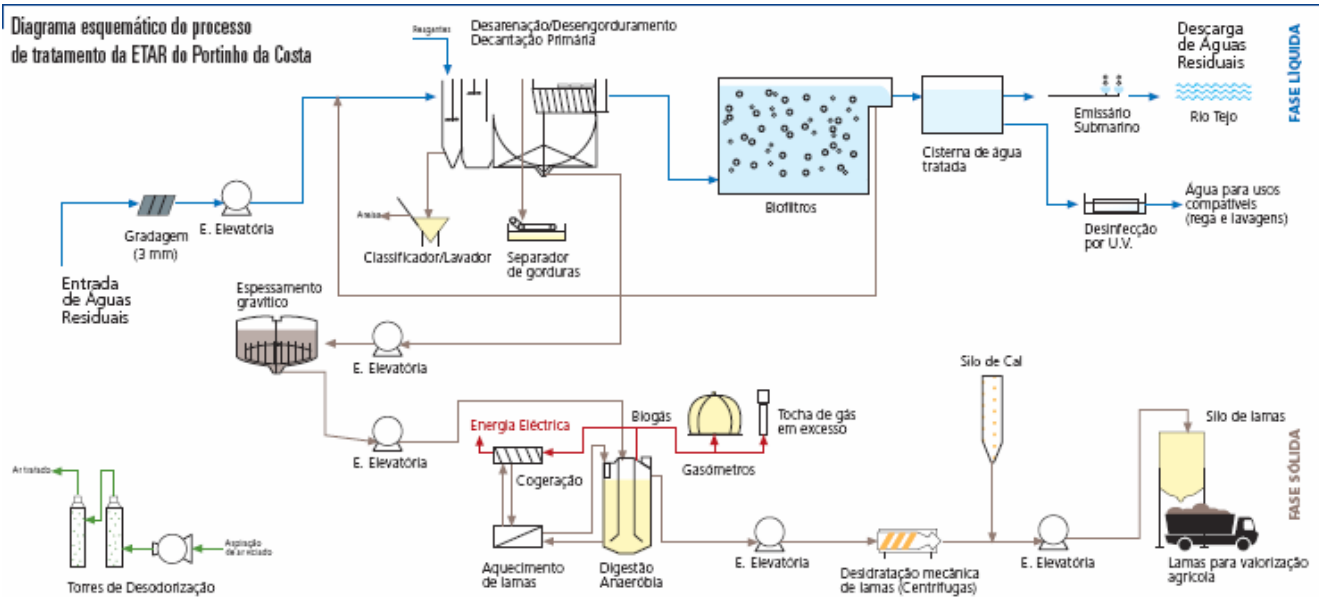
Results

With the use of a cogeneration system, the consumptions of natural gas and electric energy was reduced with 67%, in terms of watts this is equivalent to a reduction of 2000 MWh per year. At environmental level, the use of this technology has reduced the emissions of greenhouse gases (CO₂) with 39% or 687 tons.

The Water Treatment Plant in the Municipality of Almada are now treating all residual water and thanks to the installation of a cogenerations system that transform biogas into electric and thermal energy no greenhouse gases emissions are released to the atmosphere.

Technical details

The picture below shows the schematic diagram of the treatment process in the Portinho da Costa Water Treatment Plant.



In the Portinho da Costa Water Treatment Plant, the muds, (product from the residual water treatment), are used to produce biogas through an anaerobic digestion. Afterward, the biogas is used as a fuel in a cogeneration system to produce electricity and heat.

Energy data

The muds are one of the products from the residual water treatment process and are used to produce biogas. The muds consist of organic substances from the initial sewers and they are the best product for the anaerobic digestion (Biological degradation without oxygen). The end-product from this process is biogas, a renewable energy source, which mainly consists of CH_4 (methane) and CO_2 .

The biogas composition depends of the residue characteristics and the conditions of the anaerobic digestion process, but in average the biogas consists of 60% CH_4 and 40% CO_2 .

In the Portinho da Costa Water Treatment Plant the composition of the biogas is - 69% of CH_4 , 28% of CO_2 and 3% of N_2 and O_2 .

The biogas is used in a cogeneration system that produces electricity and heat. The cogeneration system consists of two power generation lines (2x250 kW) which convert approximately 33 % of the energy contained in the biogas into electricity and about 60% of the biogas energy content is also recovered through the exhaust gases and the engine cooling circuits. The biogas is stored in two double membrane floating gas tanks (2x200m³).

With this cogeneration system it is possible to reduce the consumption of electricity and natural gas with 67%, this value is approximately equivalent to 2000 MWh per year (see table below).

	Energy Form	Consumption (MWh/year)	Energy (MWh/year)	Energy (%)
Without Cogeneration	Electric Energy	1778		
	Natural Gas	1282		
	Biogas (not used)	3007		
With Cogeneration	Electric Energy	967	812	46%
	Natural Gas	51	1232	96%
	Biogas (used)	3007		



The following table summarizes the environmental data, with the use of a cogeneration system and without this system.

	Energy Form	CO ₂ Emissions (tonCO ₂ equi/year)	Total (tonCO ₂ equi/year)	CO ₂ Emissions saved (tonCO ₂ equi/year)	CO ₂ Emissions saved (%)
Without Cogeneration	Electric Energy	959	1223		
	Natural Gas	260			
	Biogas (not used)	4.9			
With Cogeneration	Electric Energy	521	536	687	39
	Natural Gas	10.2			
	Biogas (used)	4.9			

With this system the Municipality reduced its emissions with about 687 ton CO₂equi/year.

Lessons learned and repeatability

Installation of a Water Treatment Plants is almost always associated with an increasing of greenhouse gases emissions. These emissions derives from three different sources - energy consumption in the different phase of the treatment, storage of the muds in landfills and the release of biogas to the atmosphere from the anaerobic digestion of the mud. With an installation of a cogeneration system in a Water Treatment Plant, it is possible to use the biogas for electricity and heat production. This sustainable technique can easy be used also in other countries.

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Printed reports or other literature available:

Title: ELAC_2: Sector dos Resíduos – Co-geração a biogás em ETARs Municipais;

http://www.ageneal.pt/DirEscrita/upload/docs/ELAC_2.pdf

Cost: *download for free*