VALORIZATION OF SEWAGE SLUDGE AS SECOND GENERATION PRODUCTS. TOWARDS A CIRCULAR ECONOMY IN GRAN CANARIA ISLAND

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INTRODUCTION

The considerable increase of the quality of life and the incessant increase of the water and energy consumptions, has a consequent repercussion and staggered in the high production of sludge and waste around the world.

The sludge production ratio is between 15-20 kg dry matter/year (0.2 kg DM / m3 purified water). A historical in Gran Canaria shows that in 2008, the production of sludge from wastewater reached 77,106 tonnes (26% dry matter/year). Data that continues to rise to reach 86,358.61 tons in 2012 and continues to increase to the present.

This work shows the current situation in Gran Canaria, focusing specifically on the content and quality of the sludge generated by them. After the subsequent legislative revision, the investigation analyzes the technological alternatives available for the treatment of this kind of waste in the incorporation to the circular economy as new by-products

Legislation in Gran Canaria Island

LEGISLATON	COMMUNITY NORMS	SPANISH NORMS
Health	Directive 2000/54/EC	Royal Decree 849/1986.
	Directive 2000/60/EC	Royal Decree 1/2001
		Royal Decree 1620/2007
Environmental	Directive 86/278/EC	Royal Decree 1310/1990
		Royal Decree 1481/ 2001
	Directive 99/31/EC	Law 16/2002
		Orden/MAM/304/2002
	Directive 2008/98/EC	Royal Decree 9/2005
		Law 22/2011
	Directive 2010/75/EU	PEMAR 2016/2020
		Orden AAA/1072/2013
Climate Change	CMNUCC, 1992	Law 1/2005
	Kyoto protocol, 1997	2020 Horizont, 2007
	EU 2020, 2010	
Biogas Use	Directive 2009/28/EC	Plan EE.RR 2011-2020
		Royal Decree law 9/2013
	Directive 2009/73/EC	Orden IET/149/2013
		Royal Decree 413/2014
	Directive 2012/27/EU	Orden IET/1045/2014
Digestate Use	Directive 91/676/EC	Royal Decree 261/1996
		Royal Decree 824/2005
	Directive 2008/98/EC	Royal Decree 506/2013
		Orden AAA/1072/2013

Gran Canaria Wastewater treatment plants legislative aplications

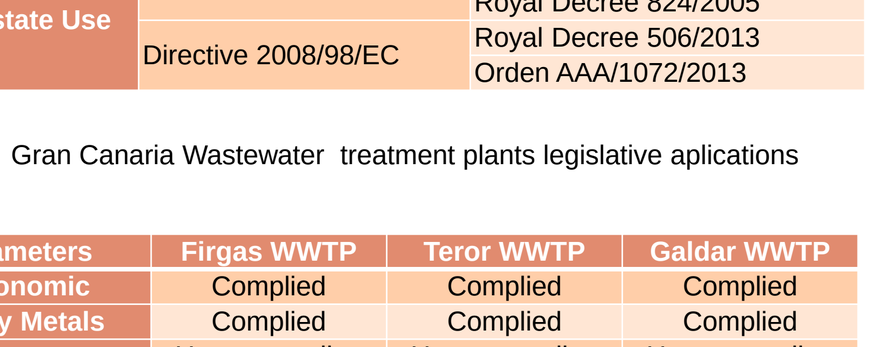
Parameters	Firgas WWTP	Teror WWTP	Galdar WWTP
Agronomic	Complied	Complied	Complied
Heavy Metals	Complied	Complied	Complied
Pathogens	Uses according LD*	Uses according LD*	Uses according LD*
Organic Pollutants	Complied	Complied	Complied
Ecotoxicity	It isn´t ecotoxic	It isn´t ecotoxic	It isn´t ecotoxic

By-products recovery technologies

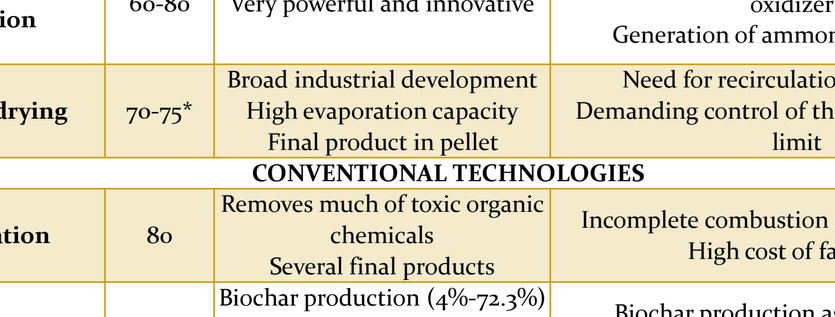
TECHNOLOGY	SLUDGE REDUCTION (%)	ADVANTAGES	DISADVANTAGES
A. CLASSIFICATION			
Catalytic membrane biorreactor	85-100	Maximum Sludge Reduction	Not adaptable to installations Need for high space; Under Patent
Thermal hydrolysis with integrated gasification	85	Maximum efficiency when combining hydrolysis reactor with turbo-digester	High energy cost; Wide space occupied
B. CLASSIFICATION			
Bioreactor with external ultrafiltration membranes	30	Generates 70% of sludge compared to conventional treatments	The optimum points should be fine-tuned Not very commercialized
Ozonolysis	30	Under patent it manages to reduce 80%	High cost of implementation Difficulty of physical space
Wet Oxidation	30	Versatility in the nature of sludge	Production of a residual product "tecnosabbia" High operating cost
Thermal hydrolysis + Centrifuge	28-35	Positive energy balance thanks to recovery of gasification	Energy cost; Space occupied
Ultrasonic Homogenization	30	Innovative, Easy to implement	Focused on improving the performance of anaerobic digestion; High energy consumption
Supercritical Water Oxidation	60-80	Very powerful and innovative	High safety risk in the use of O_2 or H_2O_2 as oxidizers Generation of ammonia; High costs
Thermal drying	70-75*	Broad industrial development High evaporation capacity Final product in pellet	Need for recirculation of dry mud Demanding control of the self-combustion limit
CONVENTIONAL TECHNOLOGIES			
Incineration	80	Removes much of toxic organic chemicals Several final products	Incomplete combustion generates dioxins High cost of facilities
Pyrolysis	27	Biochar production (4%-72.3%) Not dangerous by-product formation	Biochar production as a function of temperature
Gasification	80-85	No energy input is necessary Don´t need for supplemental fuel	Significant amount of aerosols is generated, giving rise to problems of some volatile elements entering into the vapor phase
Anaerobic Digestion	45	Industrial development Variety of final products	Anaerobic bacteria show slow growth and are sensitive to changes in the environment

Wastewater treatment process in Gran Canaria Island.

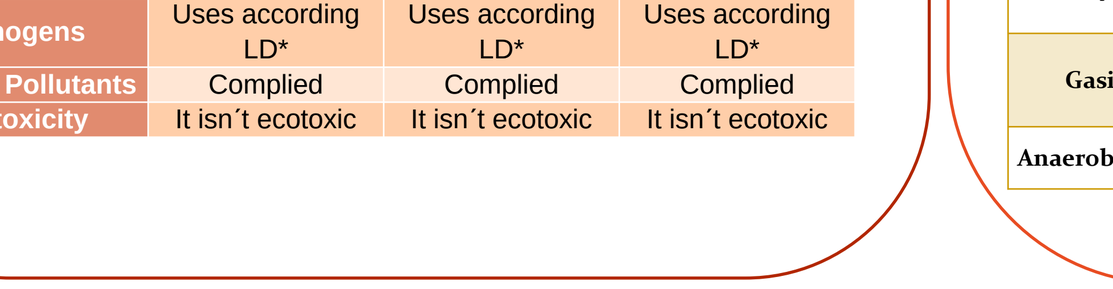
Secondary treatments in Gran Canaria WWTPs



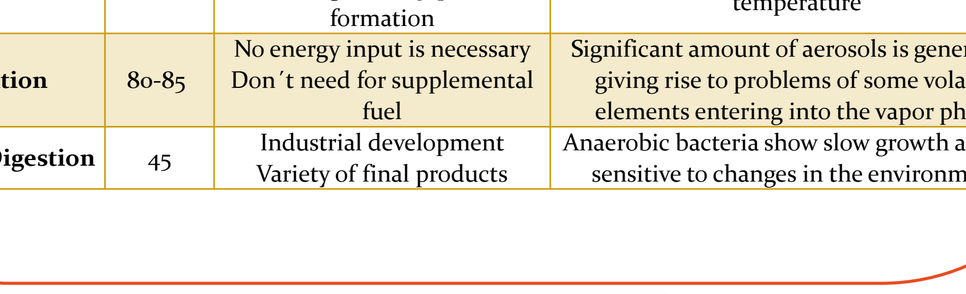
Sludge production weights by islands



Destination of the sludge generated in the islands



Sludge Production in Gran Canaria WWTPs



CONCLUSIONS

- ❖ This investigation contributes to the flagship initiatives that forming part of Europe 2020 strategy, whose purpose is to generate smart, sustainable and inclusive growth. A new circular economy has been implemented, based on "closing the life cycle" principle. The waste obtained in wastewater treatment plants, contribute high quality byproducts.
- ❖ Gran Canaria is responsible for 26% of the 86,358 tonnes of residual sludge generated by the Canary Islands annually.
- ❖ Using all the waste generated by the WWTPs, Gran Canaria can be compost 132.077 Has, which corresponds to 8.45% of the total island area. Focusing on the 69,000 hectares declared as a biosphere reserve by UNESCO in 2005, half of the annual sludge would be able to provide quality compost for this area of special care.
- ❖ Using the sludge as a fertilizer reduces by 77.67% the mud produced in the archipelago. The nutrition of the hectares dedicated to the management of greenhouses will be achieved (6,708.27 Ha).
- ❖ As far as the Gran Canaria Island is concerned, 34,020 tonnes of sludge are needed to fertilize 3,402 Ha of greenhouses, covering 66% of all sludge produced by it.
- ❖ In order to improve the conditions of the 88,520 hectares of soils that in Gran Canaria are characterized by severe water erosion, with the sludge produced by the island WWTPs can be treated about 1,123 Ha. This value that amounts to 4,426 Ha, using the entire archipelagic sludge. It improves therefore 5% of damaged Ha of insula.
- ❖ Within forestry section, it is possible to cover the 7,700 hectares practicable forest, reusing 1,024 tons of treated sludge, which represents 4.6% of the total of the mud produced in the island.
- ❖ To contribute with embankments construction using sludge as a construction material, and making use of the ratio obtained in previous section, each year we can tackle 1,870 kilometers of roads.

ACKNOWLEDGMENTS

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