

# Ozone disintegration on waste sludge: enhanced biogas production and energy balance in wastewater treatment plant

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## Introduction

The processing and disposal of wastewater treatment sludge is a problem of major concern in terms of environment, finance and technology. The most traditional method to reduce sludge volumes is anaerobic digestion (Weemaes *et al.*, 2000).

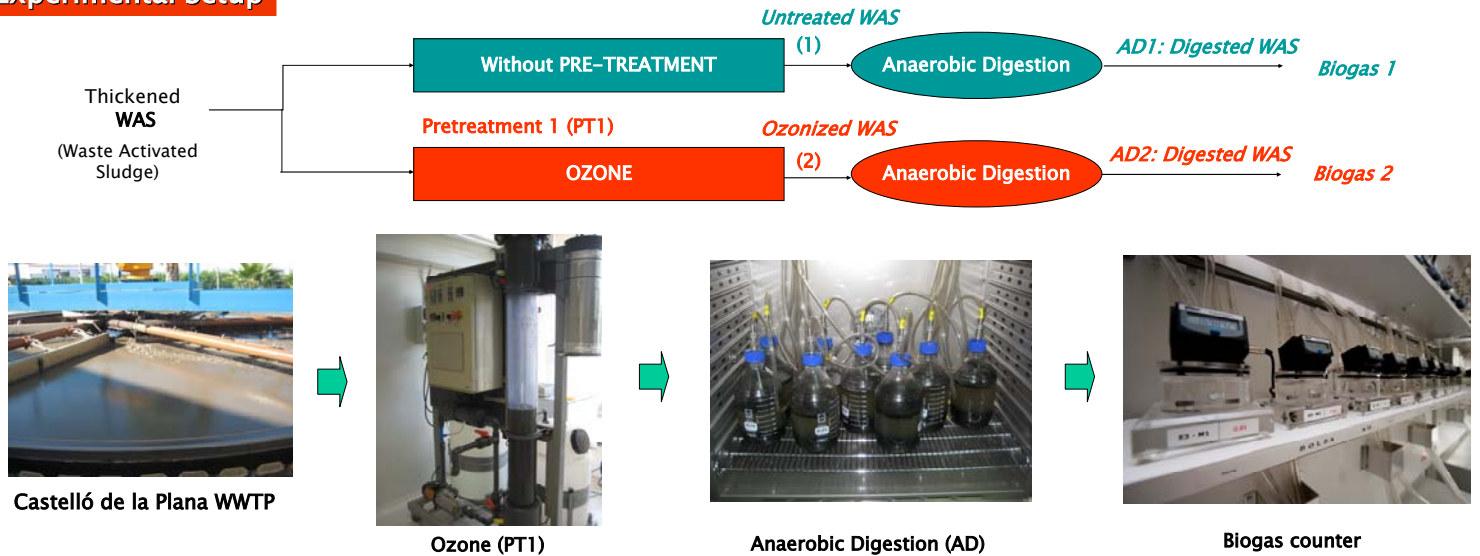
Recently, a lot of interest has been devoted to sludge disintegration and solubilisation techniques to cope with the biological limitations in terms of degradation of particulate matter (Odegaard, 2004).

## Objective

In this study, an ozonation oxidative treatment of sludge is investigated in order to enhance its disintegration and improve the subsequent anaerobic digestion.

The objective of ozonation is to cause the solubilisation of sludge allowing for higher biogas production rates.

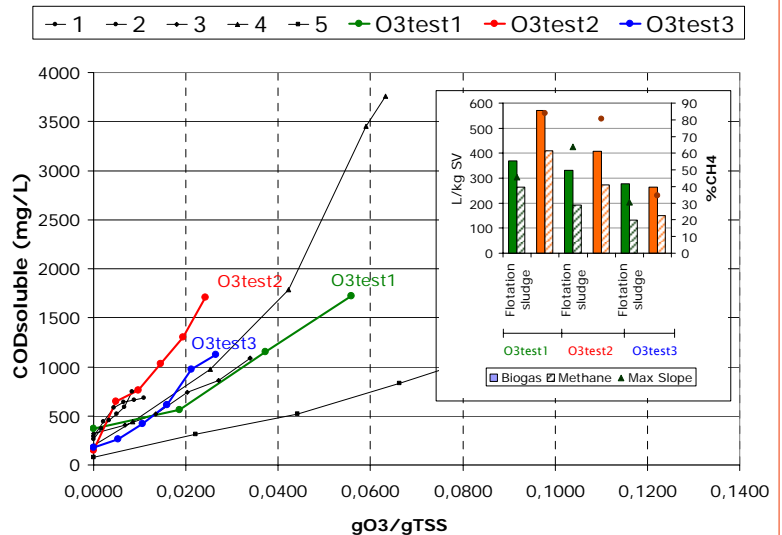
## Experimental Setup



## Results

Results of Ozone+BioMethanePotential tests		O <sub>3</sub> Test 1	O <sub>3</sub> Test 2	O <sub>3</sub> Test 3
Operational Conditions	Volume (Litres)	5	10	10
	Time (hours)	7	5	5
	supplied O <sub>3</sub> (g/h)	0,972	0,950	1,019
	O <sub>3</sub> dosage supplied (g O <sub>3</sub> /g SS initial)	0,059	0,024	0,026
Untreated sludge	Energy consumed (kW-h)	0,048	0,033	0,036
	Suspended Solids (mg/L)	23203	19603	19277
	Volatile percentage (%)	71	78	68
Ozonized Sludge	Soluble COD (mg/L)	372	152	178
	Suspended Solids (mg/L)	21870	19813	17947
	Volatile percentage (%)	70	76	71
A. digestion	Soluble COD (mg/L)	1720	1710	1124
	Potential e. energy production from CH <sub>4</sub> produced	0,05	0,15	0,22
	INDEX A sCOD_final / sCOD_initial (solubilization)	4,62	11,25	6,31
INDEX B	O <sub>3</sub> dosage supplied / Index A ((g O <sub>3</sub> /g SS initial)/ COD solubilization)	0,013	0,002	0,004
INDEX C	Power requirement / Index A ((kW-h)/ COD solubilization)	0,010	0,003	0,006
INDEX D	Specific methane production (L CH <sub>4</sub> / Kg SV)	150	273	410
INDEX E	Specific methane production (untreated WAS/ozonated sludge)	0,884	0,704	0,644
INDEX F	Kinetics of biogas production (untreated WAS/ozonated sludge)	0,879	0,795	0,545

biogas production: all results from 35 days of biomethane potential tests; specific energy consumption of 7kwh/kg O<sub>3</sub> (from Ozonation of water and waste water. Ed Wiley-VCH, 2010)



## Conclusions

- Good degree of disintegration of biological thickened sludge may be achieved with ozone, ratios of O<sub>3</sub>/initialTSS assayed ranged between 0,01 and 0,12 with highest solubilisation efficiency observed for a ratio of around 0,024
- Anaerobic digestion of ozonated sludge yielded better results than untreated sludge in terms of specific methane production and reaction kinetics. An enhancement of methane production between 14% and 55% has been observed.
- For industrial applications it has to be observed the variability of the inlet sludge to the treatment and adjustment of O<sub>3</sub> injection to actual TSS in the sludge so be considered. Since all tests were carried out batch wise, a higher number of experiments and continuous flow testing is needed to further evaluate the operating conditions needed to optimise, not the disintegration of the WAS but the enhancement of the anaerobic digestion.

## References

- Odegaard, H. (2004). Sludge minimization technologies – an overview. *Wat. Sci. Tech.*, **49** (10), 31-40.
- Weemaes, M.; Grootaerd, H.; Simoens, F. and Verstraete W. (2000). Anaerobic digestion of ozonized biosolids. *Wat. Res.*, **34** (8), 2330-2336.

**ACKNOWLEDGEMENTS:** This research project has been partially supported by the Generalitat Valenciana, IMPIVA project IMIDTF/2009/251 and Conselleria d'Industria, Comerç i Turisme project INIDIV/2009/092. The authors also wish to acknowledge the co-operation of Entitat de Sanejament d'Aigües Residuals (EPSAR) and Diputació de Castelló.