Industrial scale-up, automatization and validation of high-performance multi-stage anaerobic reactor for treatment of wastewater from food and drink SMEs

J.B. Carbajo[1], M. Navajas[1], B. Goicoechea[1], A. Torres[1], C. Bengoechea-Cuadrado[2], A. Martínez[2], M. Miana[2], S. Izquierdo[2], O.G. Chenaru[3], G. Florea[3], L. Ocheana[3], A. Domínguez[4]

1. AEMA| 2. ITAINNOVA | 3. SIS | 4. EGA | Email address: jbcarbajo@aemaservicios.com

INTRODUCTION

Food and Drink small and medium enterprises (F&D SMEs) are highly water-intensive sector, that urgently needs an eco-efficient solution to treat their wastewater and decrease the associated energy costs.

The aim of this study was the industrial scale-up, automatization and validation of a ground-breaking high-performance multiphase anaerobic reactor for treatment of industrial wastewater from F&D SMEs.

MATERIALS & METHODS

Industrial wastewater to be treated by Multi-AD reactor (110 m^3) was produced by a winery located in Fuenmayor (La Rioja, Spain), which discharges around 40,000 m^3 per year through different seasons.

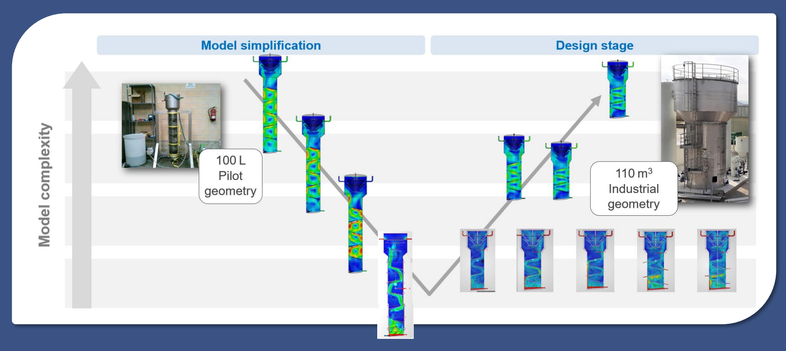
Table 1. Main physic-chemical parameters of winery wastewater.

Parameter	Unit	Mean
pH	upH	5.29
Suspended solids	mg/L	648
Soluble chemical organic demand	mg/L	11,025
Chemical organic demand	mg/L	13,450
Total Kjeldahl total	mg/L	52.2
Orthophosphate	mg/L	22.8
Sulphate	mg/L	165

RESULTS

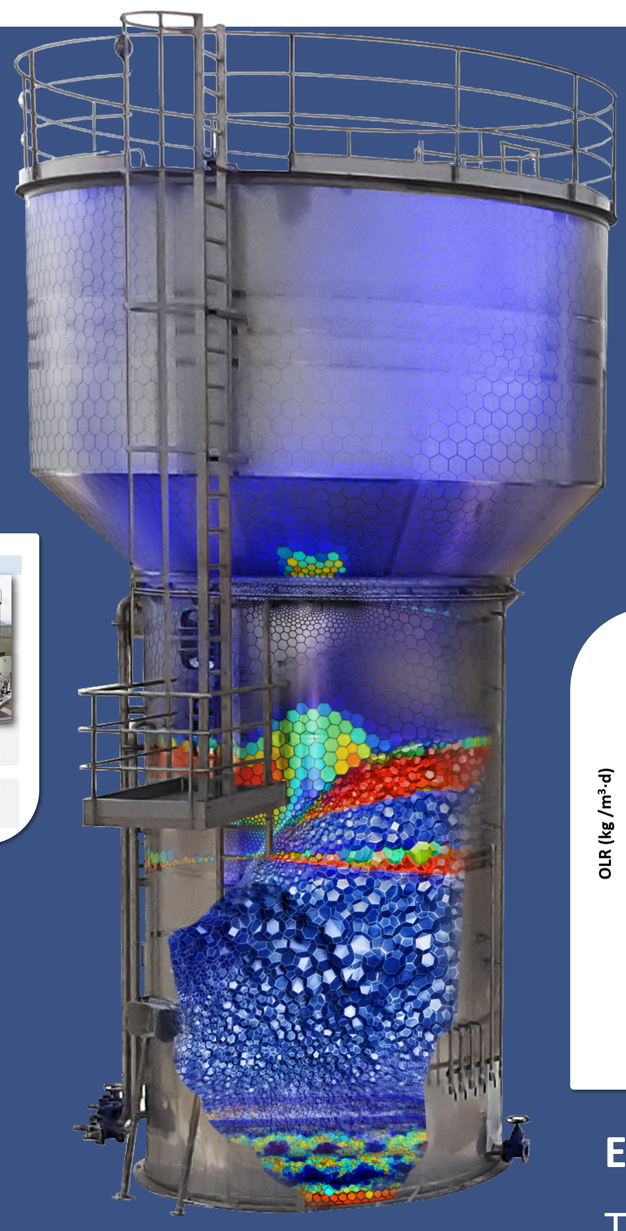
Scaling-up

An analysis of numerical simulations showed that different modifications should be done in designing the industrial-scale Multi-AD reactor in order to achieve a cost-effective technology.



Automatization

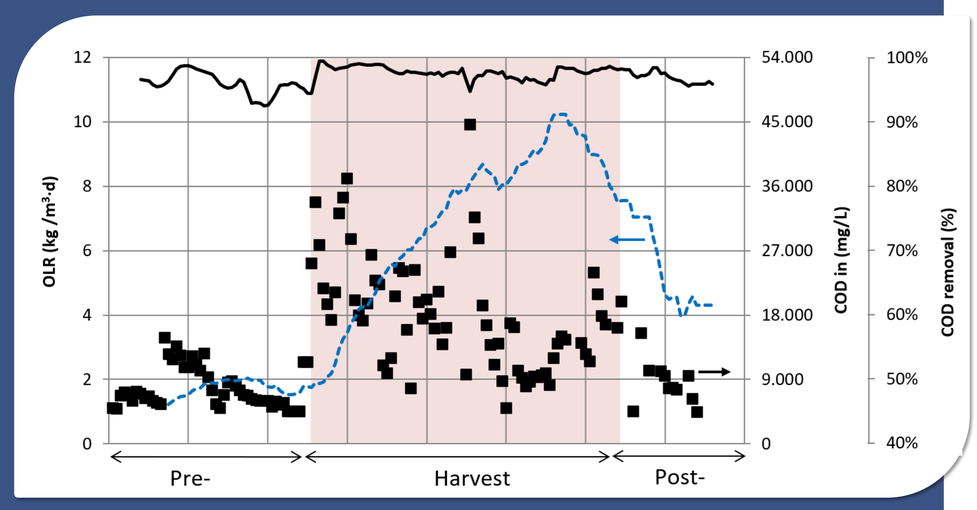
An advanced control system was designed and developed in order to optimise Multi-AD reactor performance. The control logic allows to operate the innovative solution at constant organic load by means of a mass balance over the Multi-AD reactor.



Validation

Multi-AD innovative solution was operated in continuous mode for four months, treating more than 5,000 m^3 at different organic load rate (OLR).

The effluent COD was always lower than 600 mg/L, which results in degradation efficiencies above 93%.



Economic assessment

The Multi-AD scenario would achieve OPEX savings higher than 50,000€/y comparted to base line aerobic scenario.

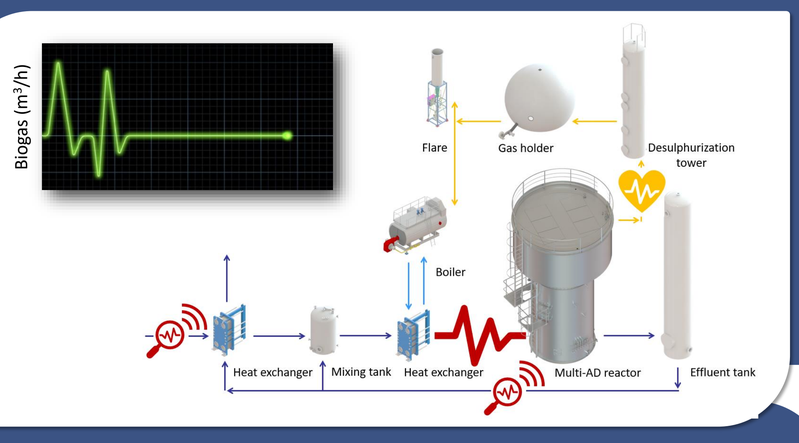


Table 2. Operational expenditures for base line and Multi-AD scenario considering water flow of 100m^3/d.

Cost line	Baseline (aerobic process)		Multi-AD (anaerobic+aerobic process)		Savings	
	(€/m^3)	(€/y)	(€/m^3)	(€/y)	(€/y)	(%)
Chemicals	1.43	49,798	0.45	15,806	33,992	68
Energy	1.26	44,018	0.46	16,114	27,904	63
Biosolids	0.49	17,444	0.11	4,037	13,407	77
Analysis	0.08	2,641	0.10	3,415	-774	-29
Taxes	0.27	9,500	0.27	9,500	0	0
Staff	0.93	32,694	1.44	50,343	-17,649	-54
Total	**4.46**	**156,095**	**2.83**	**99,215**	**56,880**	**36**

CONCLUSIONS

Multi-AD reactor allows SMEs to count with decentralized, automatized and eco-innovative technological solution for treatment of their wastewaters, allowing them to save energy and operational costs.

LIFE MULTI-AD

Scan to discover the official website of the project

Project co-financed by European Union through LIFE programme LIFE+17 ENV/ES/331