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Preliminary Study of Up-Flow Anaerobic Sludge Blanket (UASB) Technology for Energy Recovery from Domestic Wastewater

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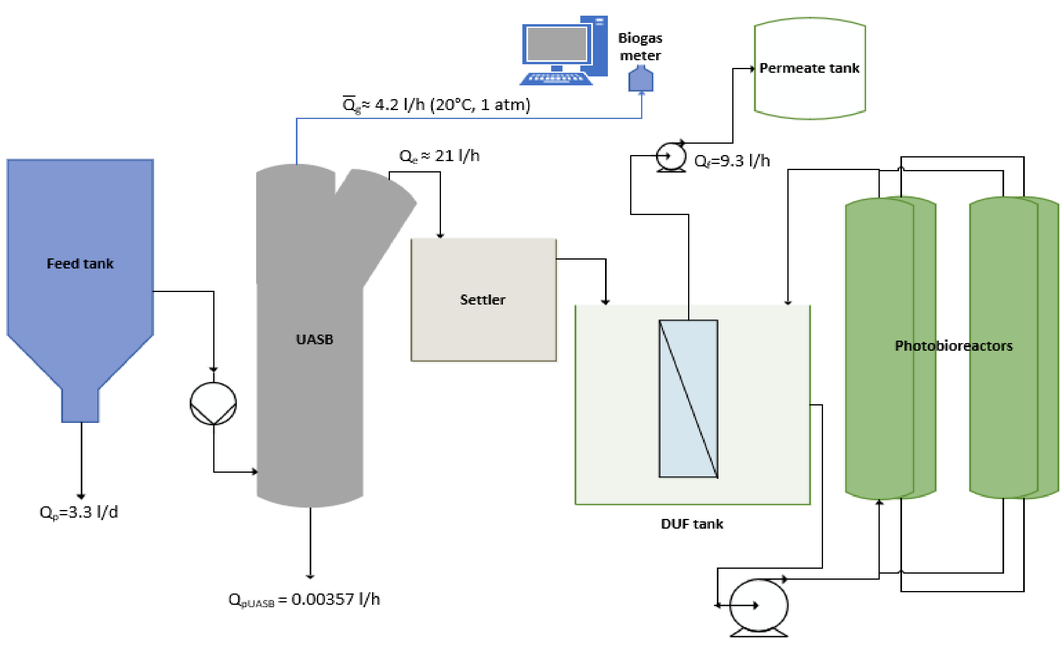
INTRODUCTION

- New efforts are increasingly oriented towards the search for sustainable designs for Wastewater Treatment Plants (WWTP), both in water use and energy recovery. Therefore, in this work the generation of biogas from municipal wastewater has been studied through anaerobic digestion treatment.

- UASB effluent has been fed to a membrane photobioreactor (MPBR) where developed microalgae-bacteria consortia contributes to organic matter and nutrients recovery and membrane allows regenerated wastewater.



METHODOLOGY

- The biomethanization potential (BMP) was studied on a laboratory scale, which indicates the energy production of different treatment processes: concentrate from direct membrane ultrafiltration (DUF) and sludge from conventional membrane bioreactors (MBR), in order to define potentiality of technological trains with UASB reactors.

Incubation temperature (°C)	37
Constant agitation (rpm)	350
Vial volumen (mL)	80
Substrate volume (mL)	10
Addition of micro or macronutrients (mL/L)	1

Throughout the incubation period the following parameters were periodically recorded and determined:

- Volume of biogas
- Environmental conditions: Temperature and air pressure.
- Biogas composition: CH_4, CO_2, O_2.

Biogas yields were calculated and corrected to standard volumes taking into account:

- Environmental conditions.
- Biogas yield of the inoculum.
- Proportion of methane.

$$BMP = \frac{V\ CH_4(L)}{kg\ VSS_{feed}} \qquad BMP = \frac{V\ CH_4(L)}{kg\ COD_{removed}}$$

$$COD_{removed} = COD_i - \left(COD_{f\ assay} - COD_{f\ blank} + COD_{CH_4}\right)$$

RESULTS AND DISCUSSION

- **Incubation periods:**
  DUF reject samples: **42 d**
  MBR sludge samples: **25 d**

- **Methane percentage in biogas:**
  DUF and **MBR** (Fig. 1 and 2)**:**
  60-62% methane in both cases.

- **Average BMP** :
  DUF: It can be Assumed that the hydrolysis had already been completed.
  4.8 kWh/kg SVV.
  3.5 kWh/kg COD removed.
  MBR: Results were worst and indicated an incomplete digestion.
  1.5 kWh/kg SVV.
  1.8 kWh/kg COD removed.

Similar percentage of methane but no the same global production.
Methane production from both type of samples reported, but it was before reported on **MBR sludge samples.**

Table 1. Average physical-chemical properties of samples

	DUF	MBR
pH	7.6	7.2
Total COD (mg O_2 /L)	9378	4426
Soluble COD (mg O_2 /L)	554	132
Turbidity (NTU)	1734	2375
Conductivity (µS/cm)	1745	1086
Total suspended solids (TSS) (mg/L)	5195	4433
Volatile suspended solids (VSS) (mg/L)	4323	3800
HCO_3^- (mg/L)	952	866

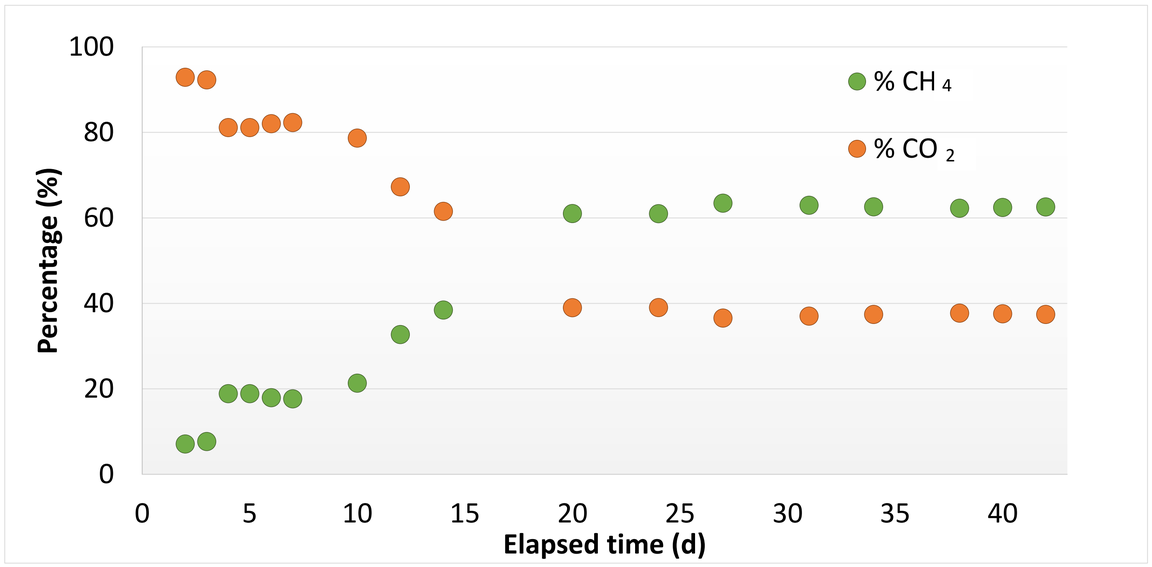


Fig 1. Biogas production from anaerobic digestion DUF sample

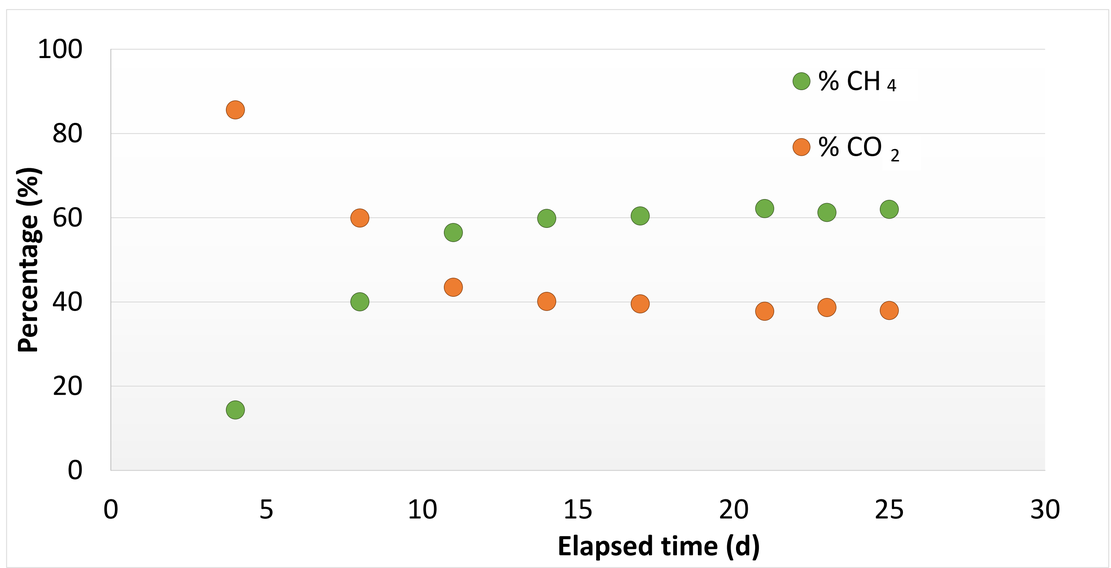


Fig 2. Biogas production from anaerobic digestion MBR sample

CONCLUSIONS

- Preliminary studies showed: **higher organic matter recovery obtained in DUF reject**, regarding to MBR sludge, in terms of COD and VSS. Therefore, energy recovery via anaerobic digestión from DUF technology seems more attactive.
- DUF and UASB effluents share a similar environmental concern: both **exhibit high nitrogen content which limits their discharge to the environment**. In this sense, **membrane photobioreactors for nutrient and residual organic matter recovery** can be an interesting via for enhancing the final effluent quality**.**
- In addition, **the anaerobic digestion of domestic wastewater or DUF reject by the UASB process seems to be a promising strategy to be included in the new WWTP** schemes.

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