Biomethane Potential of Lignocellulose-Rich Effluents during Anaerobic Treatment

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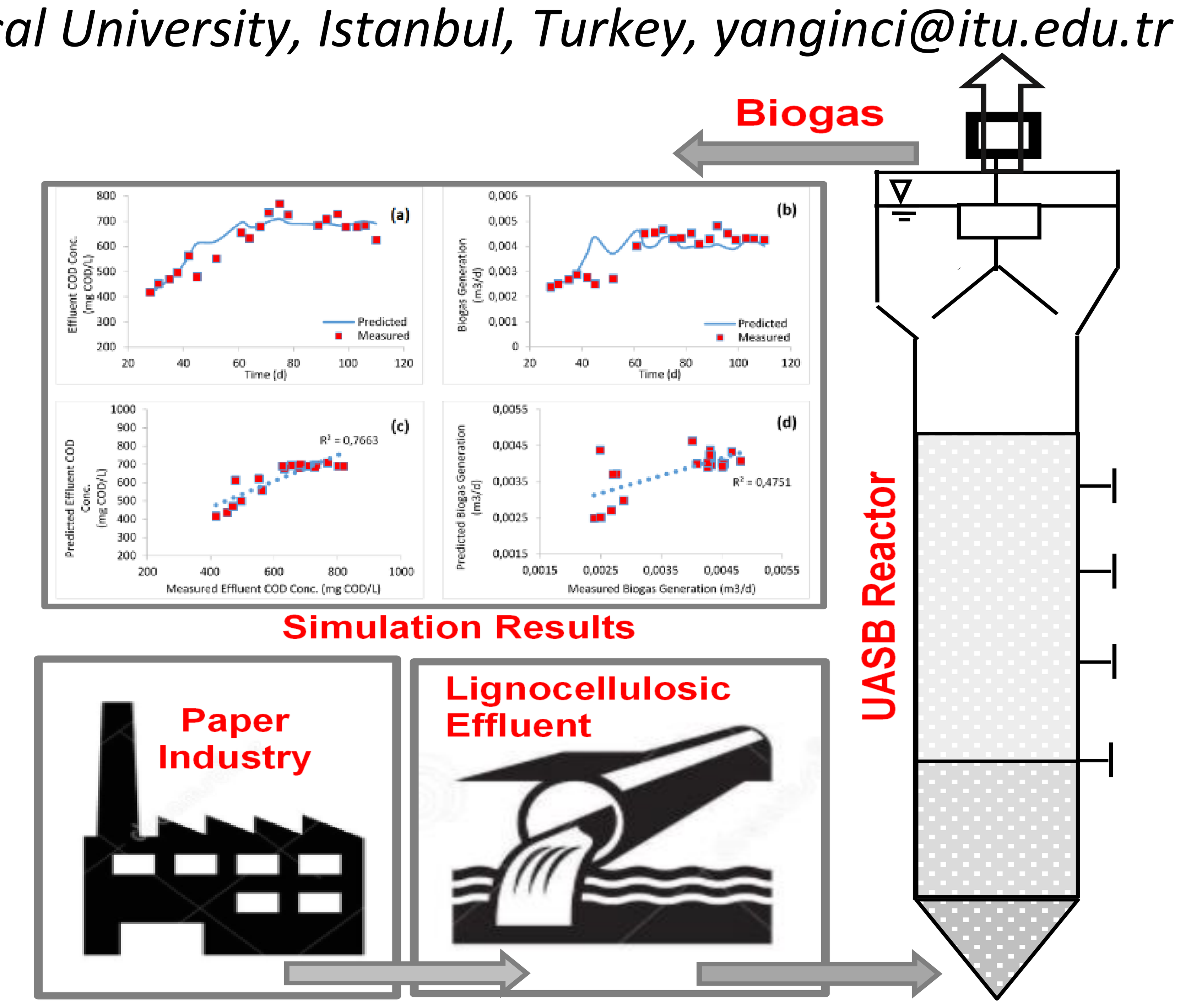
OBJECTIVE

- **evaluate biomethane potential through anaerobic treatment of lignocellulose-rich effluents from paper industries based on the findings of different lab-scale anaerobic reactors operated at different conditions.**



INTRODUCTION

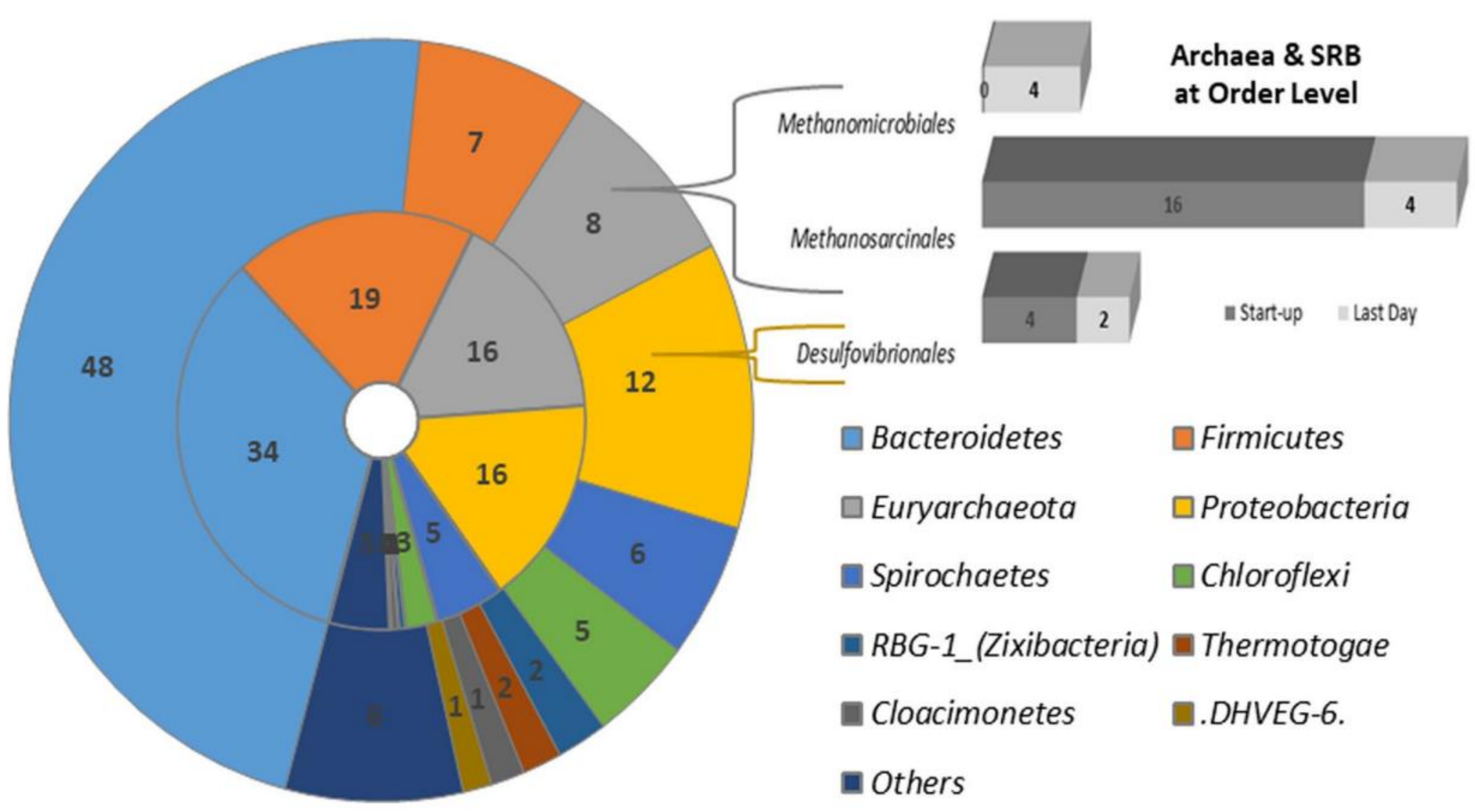
- ➢ Turkish paper & cardboard products industry ⇒ ~ 2% world paper production capacity.
- ➢ Paper products consumption ⇒ > 6 million tons (16th major consumer goods market).
- ➢ High water demand during paper production stage ⇒ 3rd largest wastewater producer.
- ➢ Many organic & inorganic pollutants ⇒ environmental problems such as DO depletion, toxicity, color & turbidity.
- ➢ Lignocellulose-rich effluents with high organic contents ⇒ renewable energy sources (e.g., biogas, biodiesel, bioethanol, etc.) with appropriate treatment technologies such as anaerobic reactors.
- ➢ Although the competition between sulfate reducers & methane producers for available C & H sources leads to stoichiometrically reduced biogas ⇒ anaerobic biotechnology plays important role in industrial wastewater treatment for renewable energy generation.

RESULTS & DISCUSSION

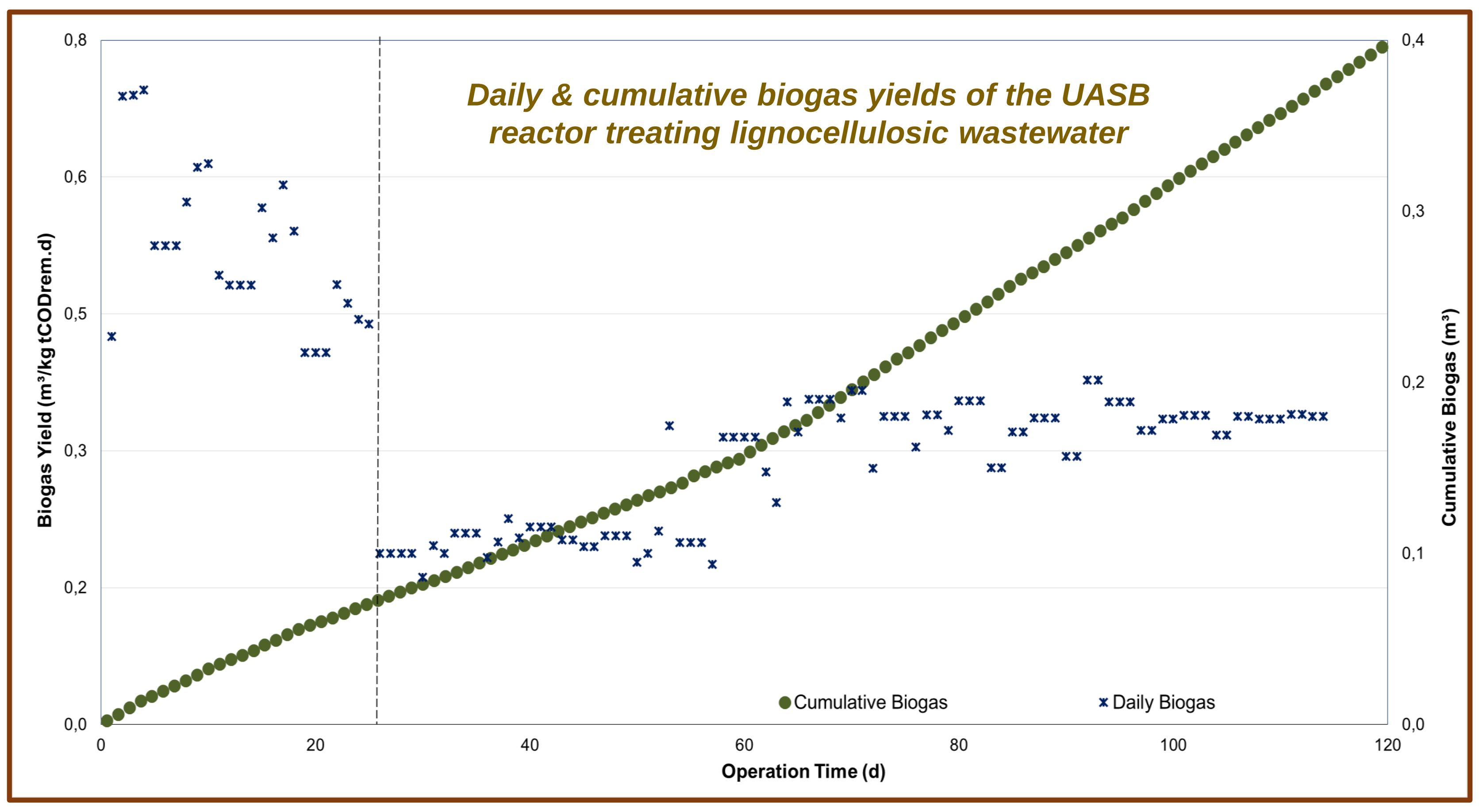
- ➢ High-rate anaerobic systems like upflow anaerobic sludge bed (UASB) reactors ⇒ indicated effective treatment & satisfactory biomethane production while treating lignocellulosic wastewaters.
- ➢ Cumulative biogas production in an UASB reactor ⇒ 160-380 L per 1 kg of COD removed [~25 kWh total energy (electricity+heat) generation per 1 m³ of wastewater treated] at mesophilic (35 °C) condition.
- ➢ Influent & effluent COD ⇒ 26129±2482 & 638±117 mg/L, respectively with more than 95% removal.
- ➢ In a batch anaerobic study ⇒ COD decreased from ~10000 to 580 mg/L with a removal of 94% at a 70-d incubation period (cumulative methane yield of 370 L per kg of total COD removed) at mesophilic (35 °C) condition.
- ➢ Net methane yield ⇒ 490 L per 1 kg of volatile solids (VS) fed at thermophilic (55 °C) batch study.
- ➢ Degradation of the hemicellulose & cellulose contents (i.e., ~60%) by the phyla *Bacteroidetes*, *Firmicutes*, *Proteobacteria*, *Spirochaetes* & *Thermotogae* whereas *Euryarchaeota* domain consist of the methanogens crucial for methane production (Yarsur, 2021).

Mass balance of organic compounds [adapted from Speece (1996)]

C Utilization paths	Load g/d[a]	% of Input C
Input C	13	100
Output C		
Effluent COD[g]	0.3	2.0
Sulfate (SO_4^{2-}) reduction[h]	0.2	1.4
Methane generation (CH_{4gas})[i]	5.1	39
Biomass yield[e]	1.6	12
Total Output C[f]	6.5	55



Relative abundance (%) of microbial cultures in the biomass samples of an anaerobic reactor treating paper industry effluent at start-up and last operating day (outer doughnut)



CONCLUSION

- **Biomethane potential through anaerobic treatment of lignocellulose-rich effluents from paper industries ⇒ revealed significant contribution to sustainable and feasible waste management and energy recovery.**

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