

# Performance of a laboratory UASB reactor in the treatment of sludge from recirculating aquaculture system

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## Introduction, materials & methods

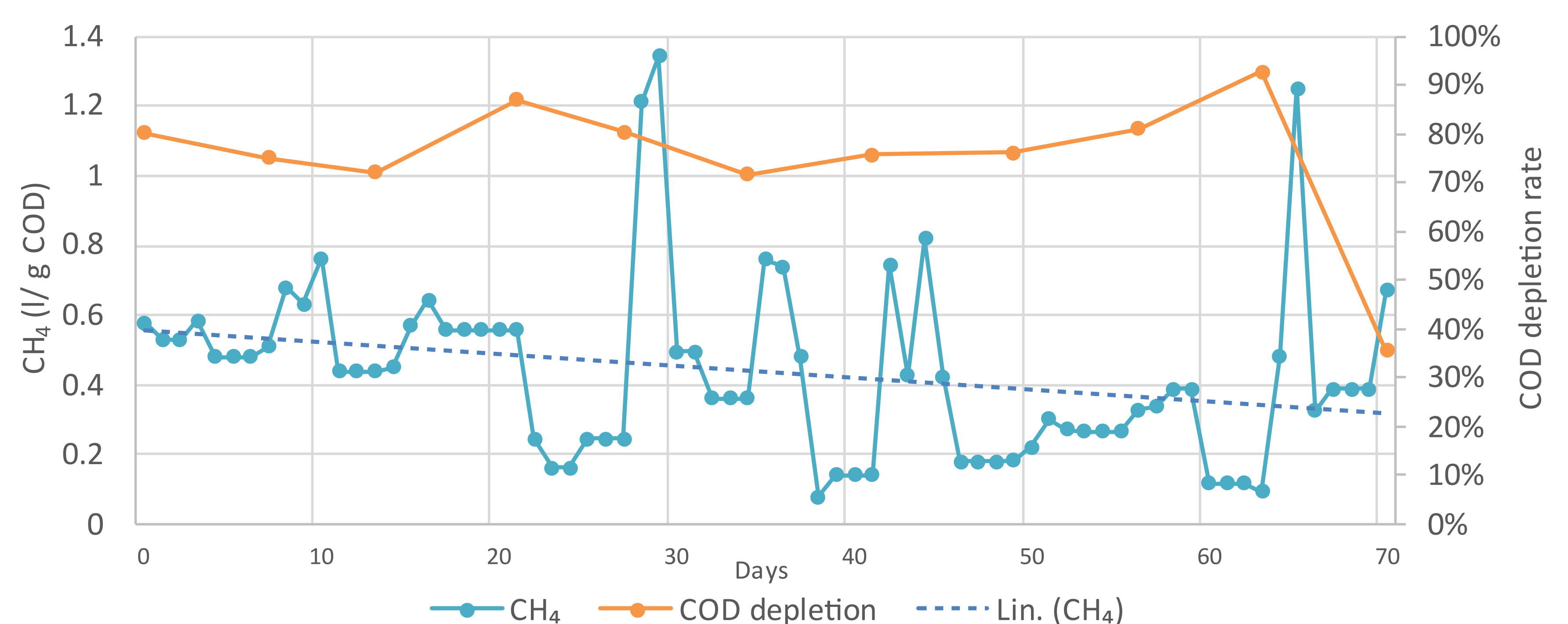
In recirculating aquaculture systems (RAS), nutrients and organic matter mostly end up in the by-products, largely in sludge. Anaerobic digestion (AD) is an established technology, and particularly Upflow Anaerobic Sludge Blanket (UASB) is suitable for dilute streams. Ideally, microbes in the UASB process convert biodegradable organic matter—measured as chemical oxygen demand (COD)—into methane. At the same time, phosphorus could be retained in the granular sludge.

A 6-liter UASB reactor was used to treat RAS sludge in an 11-week experiment. Two hydraulic retention times 36 h and 24 h were tested. The quality of the feedstock varied over the course of the experiment:

TSS 0.44-1.73 g/l;  
COD 0.47-1.51 g/l;  
 $N_{\text{tot}}$  0.09-0.15 g/kg;  
 $P_{\text{tot}}$  0.05-0.08 g/kg;  
 $NH_4\text{-N}$  0.03-0.05 g/kg.



**Figure 3.** Flocculated solids disrupted the gas separation.



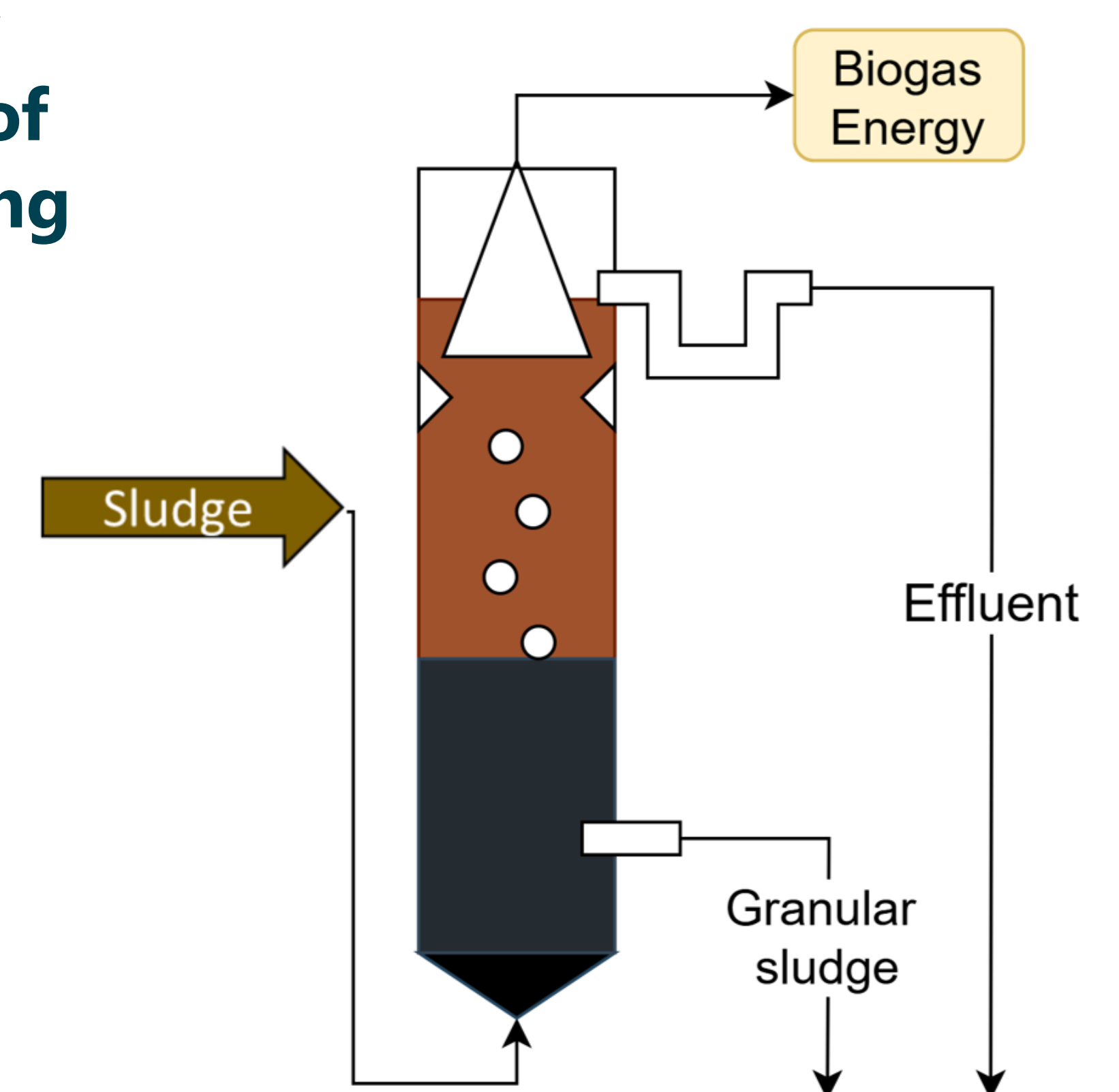
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**Besides producing renewable energy and recycled fertilizers, the removal of organic matter facilitates the following processing steps.**

## Results

COD depletion rates fluctuated due to the inconsistency of the sludge but averaged about 75% throughout the experiment. Methane yield results varied widely, ranging from 0.1 l/gCOD to 1.3 l/gCOD, and averaging  $0.5 \pm 0.25$  l/gCOD.

AD is known for its ability to solubilize nitrogen: the proportion of  $NH_4\text{-N}$  in the  $N_{\text{tot}}$  increased in the process, being 17-44 % in the influent and up to over 80 % in the effluent. Phosphorus retention was indicated by the characteristics of granular sludge; its P concentration was notably higher than that of the influent. However, P-depletion was not evident in effluent ( $P_{\text{tot}}$  0.03-0.44 g/kg). Similarly,  $N_{\text{tot}}$  concentrations of the effluent were variable and high (0.09-0.48 g/kg) compared to influent.



**Figure 1.** UASB reactor performance: specific methane production (l  $CH_4$ /gCOD) and COD depletion rate (%).

**Figure 2.** Schematic diagram of the UASB reactor used in the experiment.

## Conclusions

Nutrient-rich RAS sludge showed potential for energy production using a UASB reactor. A large variation in the results was observed for all the monitored parameters, likely due to changes in the feedstock and the dissolution of granular sludge. Therefore, experiments using a uniform feed over a longer testing period are needed.