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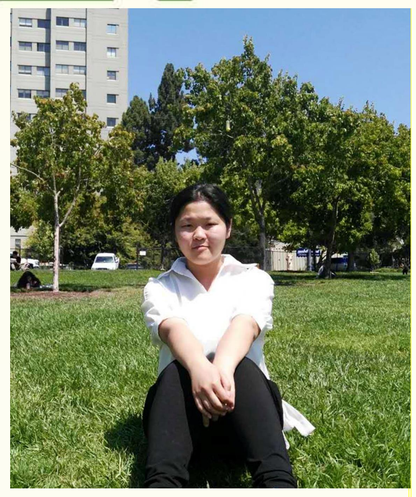
THESSALONIKI2021

Effect of TOC/TN ratio and degradability of substrates on the performance of high-solid anaerobic digestion: gas and methane production



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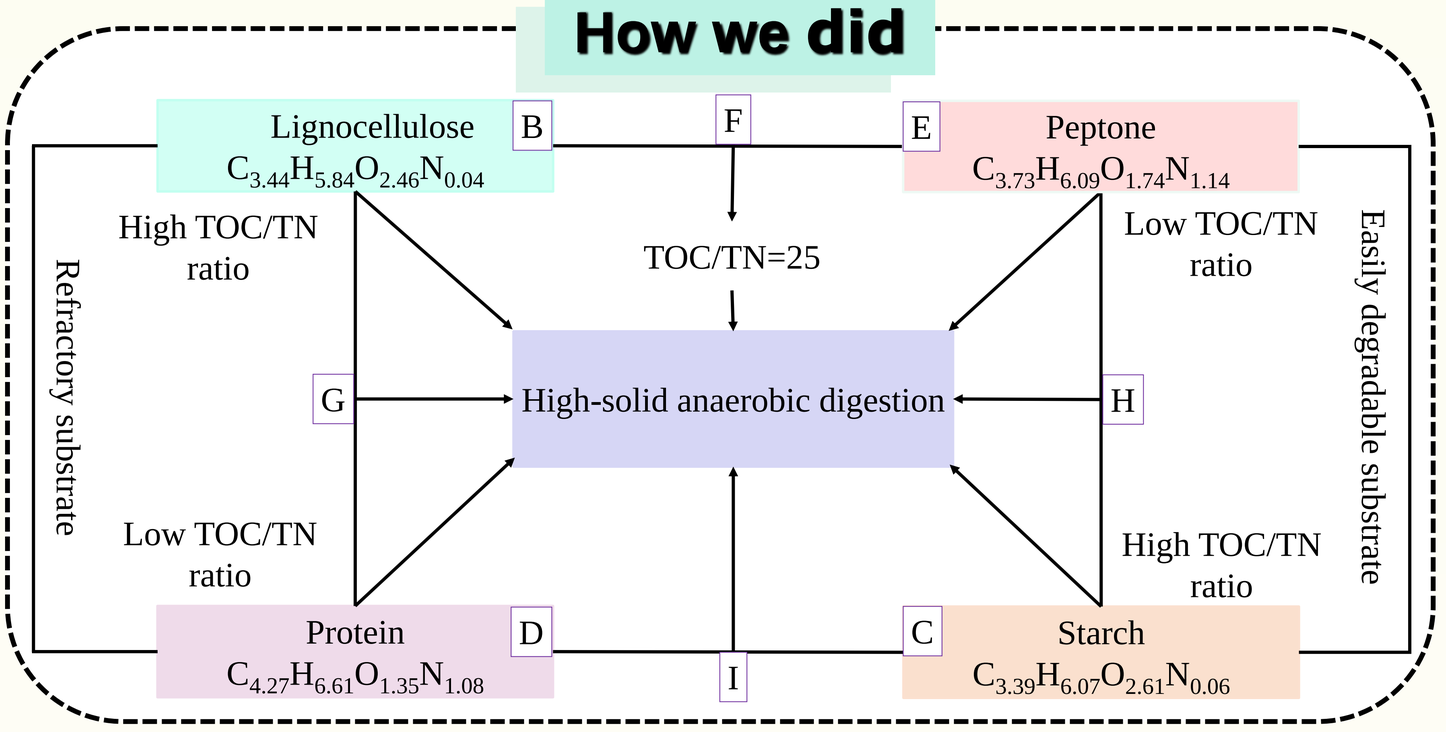
Why we did

- Approximately **11.2 billion tons** of solid waste were collected annually within the earth.
- Conventional anaerobic digestion process have problems dealing with **high TS substrates**.
- High-solid anaerobic digestion (HS-AD) is an alternative way.

TOC/TN ratio and Degradability → How and affect → HS-AD remain **UNCLEAR**

How we did



What we learned

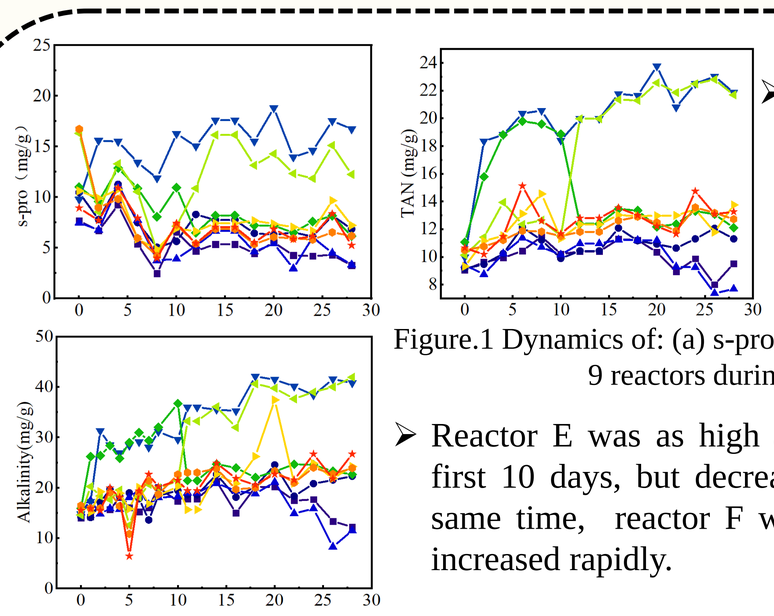


Figure.1 Dynamics of: (a) s-pro, (b) TAN, (c) alkalinity of 9 reactors during HS-AD.

- Reactor D had the highest s-pro, total ammonia nitrogen (TAN), and alkalinity value.
- Reactor E was as high as reactor D during the first 10 days, but decrease rapidly then. At the same time, reactor F which consist by protein increased rapidly.
- In HS-AD system, there was an extremely significant correlation between changes in protein, ammonia nitrogen and alkalinity ($p<0.01$), indicating that ammonia nitrogen was one of the major sources of alkalinity in the HS-AD system.

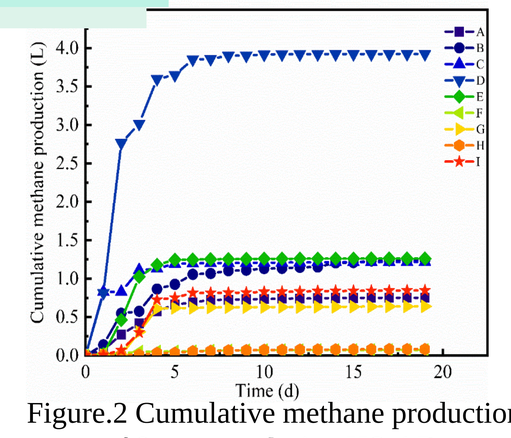
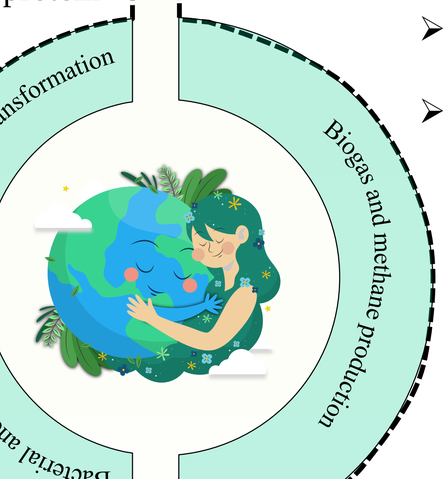


Figure.2 Cumulative methane production of 9 reactors during HS-AD.

- The cumulative methane production showed D>E>B>C>I>A>G>H>F.
- The gas and methane production performance of the substrate under extreme TOC/TN ratio was better than the compound substrate with a TOC/TN ratio of 25. Showed the trend of low TOC/TN ratio > high TOC/TN ratio > balanced TOC/TN ratio.



- The refractory substrate had a high efficiency in producing gas and methane.
- The synergistic effect of different kinds of substrate in HS-AD was poor.

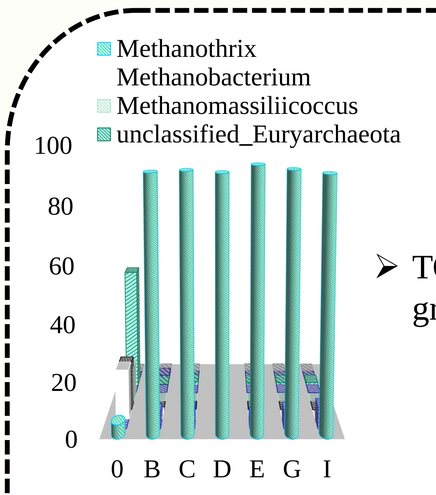


Figure.3 The relative abundance of archaea at the genus level.

- There was a big difference between archaea and bacteria of the original inoculated sludge and the reacted samples.
- TOC/TN and the degree of susceptibility have great impact on bacteria during HS-AD process

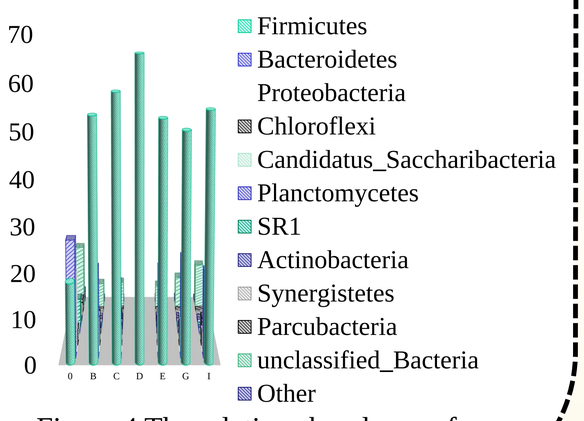


Figure.4 The relative abundance of bacterial at the phylum level.

- The response surface method was used to fit the cumulative gas and methane production results, and the R^2 of each group was greater than 0.9.

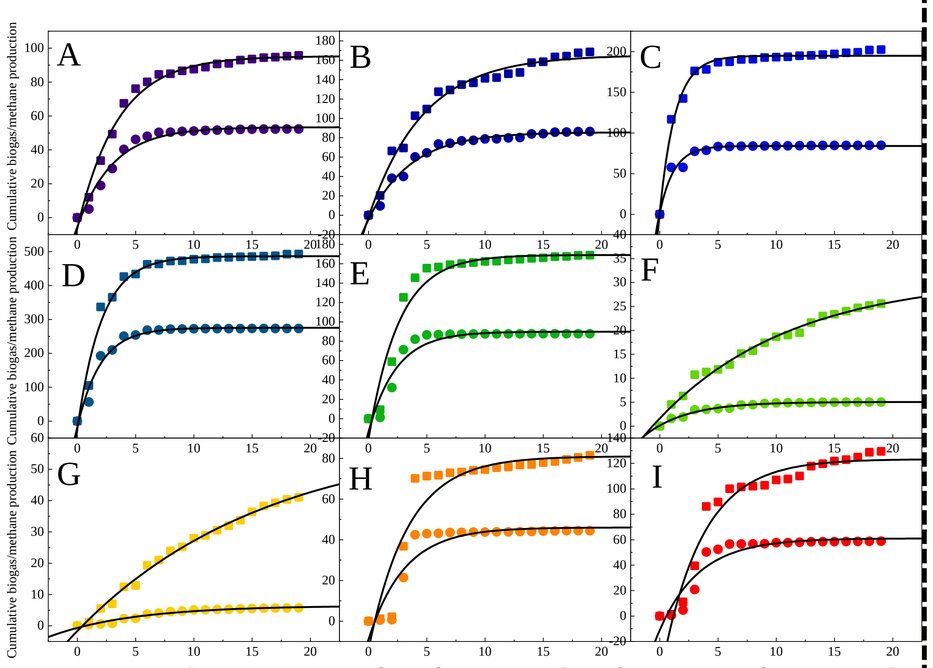


Figure.5 The response surface fitting results of 9 reactors for gas and methane production during HS-AD.

- The fitting results show that the maximum daily methane output of reactor D is the largest, the lag period of reactor D is small, and the lag period of reactors F, G, H, and I is large.

Conclusion

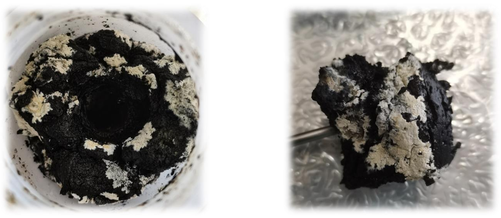


Figure.6 Photo of system and digestate after HS-AD batch experiment.

a) The highest methane yield was obtained by refractory substrates with low TOC/TN ratio.

b) It has been observed that in the HS-AD system with almost no free water, there was an extremely significant correlation between changes in ammonia nitrogen and alkalinity ($p<0.01$).

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