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Abstract

## Digesting sludge from A/B process: comparison to conventional primary and mixed sludge.

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**Keywords:** anaerobic digestion, AB sludge, primary sludge, mixed sludge

### Outline

The AB (Adsorption-Biosorption) Process for wastewater treatment was developed by Böhnke *et al.* (1977). It consists in a two-stage activated sludge: A and B stages, each composed of a bioreactor and a clarifier. The A stage hosts a biosorption process for early entrapment of the organic matter, which can be directly transferred to the digesters, maximizing the recovery of the biodegradable carbon contained in the wastewater. In the present study, biosorption sludge (*i.e.* A sludge) and B sludge are compared with conventional primary sludge and conventional mixed sludge and biological sludge in terms of main characteristics and, afterwards, through continuous 5-Liter reactors operating under mesophilic conditions (37°C). The data presented here demonstrate that a AB system coupled to anaerobic digestion is able to produce a higher amount of energy by anaerobic digestion than a conventional activated sludge process.

### Material and methods

The conventional primary and mixed sludge are sampled from the conventional Water Reclamation Plant of Kranji in Singapore. The A and B sludge comes from a 50m<sup>3</sup>/d AB process pilot plant on the same WWTP and treating the same raw wastewater. The digesters were inoculated with the digestate of a 3m<sup>3</sup> pilot plant digester at mesophilic conditions fed with Kranji WRP mixed sludge.

Several sludge samples were characterized in terms of total and volatile solids, total and soluble COD, VFA, alkalinity and BMP (Biochemical Methane Potential). The digestion tests were performed in three 5-L reactors working in continuous mode (one feeding sequence per day) at 37°C, operated at 16 days HRT and at an organic loading rate of 1.5 kg<sub>VS</sub>.m<sup>3</sup>/d. For the semi continuous tests, only the A-sludge, primary and mixed sludge were tested.

### Results and discussion

From their global characteristics, A sludge is very similar to primary sludge. On the opposite, B sludge is close to biological sludge.

- The COD/MV ratio of A sludge and primary sludge were 1.98 and 2.01 respectively;
- The BMP was 335±6 and 290±9 L<sub>CH<sub>4</sub></sub>STP/kg<sub>VS</sub>, showing a higher intrinsic biodegradability for A sludge compared to primary sludge.
- The BMP for B sludge was 201±3 against 220±2 L<sub>CH<sub>4</sub></sub>STP/kg<sub>VS</sub> for biological sludge, and very similar characteristics were reported.

For the continuous tests, the primary sludge reactor and the A sludge reactor presented equivalent overall performances, both in terms of removal rates and specific methane production. The specific methane production reached 290 L<sub>STP</sub> CH<sub>4</sub>/kg VS<sub>in</sub> for the A sludge digester, and 300 L<sub>STP</sub> CH<sub>4</sub>/kg for the primary sludge digester.

The VS, COD removal rates and the specific methane production of the anaerobic digestion of A sludge are respectively 33%, 32% and 27% higher than for mixed sludge.

All the results are summarized in the table 1.

**Table 1:** Overall performances of the three reactors

|                                      | A Sludge<br>Reactor | Primary<br>Sludge<br>Reactor | Mixed Sludge<br>Reactor |
|--------------------------------------|---------------------|------------------------------|-------------------------|
| VS Removal                           | 48,5%               | 45,3%                        | 36,4%                   |
| TS Removal                           | 43,0%               | 40,6%                        | 30,6%                   |
| COD Removal                          | 42,8%               | 47,2%                        | 32,5%                   |
| L biogas / kg VSin                   | 470                 | 494                          | 380                     |
| L CH <sub>4</sub> / kg VS in         | 290                 | 301                          | 229                     |
| L CH <sub>4</sub> / kg COD in        | 150                 | 156                          | 112                     |
| L CH <sub>4</sub> / kg COD destroyed | 345                 | 343                          | 336                     |

### Conclusions

In the AB process, the mixed sludge produced contains 85% of A sludge and 15% of B sludge. A conventional activated sludge wastewater treatment line produces a mixed sludge composed of 65% primary sludge and 35% of secondary sludge. It is also believed and to be proven on future experiments that the AB process produces more sludge than the conventional system. Adding to these facts that the AB sludge has a higher methane production than conventional mixed sludge, the whole AB process should enable to produce more methane, and thus a higher energy yield per m<sup>3</sup> of wastewater treated, than a conventional wastewater treatment system.

### References

Böhnke, B., Schulze-Rettmer, M.R., Zuckut, S.W. 1998 « Cost-effective reduction of high-strength waste water by adsorption-based activated sludge technology. *Water Engineering Management* 145, 31-34.