

**Table S1.** Review of previous studies on methanogenesis and sulfidogenesis under mesophilic and thermophilic conditions.

| Mesophilic (30–37°C)   |                     |                                   |                    |                  | Electron flow <sup>a</sup> |                |                                           |
|------------------------|---------------------|-----------------------------------|--------------------|------------------|----------------------------|----------------|-------------------------------------------|
| No.                    | Substrate           | COD/SO <sub>4</sub> <sup>2-</sup> | Reactor type       | Temperature (°C) | Methanogenesis             | Sulfidogenesis | Reference                                 |
| 1                      | Methanol            | 0.5                               | UASB <sup>b</sup>  | 35               | 49.8%                      | 34.3%          | Wu, Liu, Feng, Kong, Jiang and Li [4]     |
| 2                      | Acetate and ethanol | 1                                 | UASB               | 35               | 23.5–51.8%                 | 30.9–71.0%     | Wu, Niu, Li, Hu, Mribet, Hojo and Li [15] |
| 3                      | Acetate and ethanol | 1                                 | UASB               | 35               | 48.5–70.0%                 | 28.4–51.5%     | Jing, Hu, Niu, Liu, Li and Wang [14]      |
| 4                      | Ethanol             | 2–15                              | UASB               | 30               | 13–69%                     | 31–87%         | Hien Hoa, Liamleam and Annachatre [16]    |
| 5                      | Synthetic vinasse   | 2                                 | DFSBR <sup>c</sup> | 30               | 29–38%                     | 35–37%         | Godoi, Foresti and Damianovic [13]        |
| Thermophilic (50–65°C) |                     |                                   |                    |                  | Electron flow <sup>a</sup> |                |                                           |

| No. | Substrate                         | COD/SO <sub>4</sub> <sup>2-</sup> | Reactor type | Temperature (°C) | Methanogenesis | Sulfidogenesis | Reference                                       |
|-----|-----------------------------------|-----------------------------------|--------------|------------------|----------------|----------------|-------------------------------------------------|
| 1   | Methanol                          | 0.5                               | UASB         | 50               | 81.3%          | 8.6%           | Wu, Liu, Feng, Kong, Jiang and Li [4]           |
| 2   | Methanol                          | 0.5                               | UASB         | 55               | 38%            | 53%            | Vallero, Camarero, Lettinga and Lens [17]       |
| 3   | Methanol                          | 0.5                               | UASB         | 65               | N.D.           | 96%            |                                                 |
| 4   | Formate                           | 0.5                               | UASB         | 65               | 91%            | 9%             |                                                 |
| 5   | Acetate, propionate, and butyrate | 0.57                              | UASB         | 55               | 12%            | 62%            | Visser, Gao and Lettinga [18]                   |
| 6   | Methanol                          | 5                                 | UASB         | 55               | 85%            | 13%            | Vallero, Treviño, Paulo, Lettinga and Lens [11] |

<sup>a</sup> Calculated on the basis of COD conversion.

<sup>b</sup> Up-flow anaerobic sludge blanket

<sup>c</sup> Down-flow fixed-structured bed reactor

**Table S2** Physicochemical characteristics of inoculum and substrates.

| Parameters  | Units          | Anaerobic<br>sludge     | <i>Ulva</i> substrate used at each OLRs (g COD/L·d) |             |              |              |
|-------------|----------------|-------------------------|-----------------------------------------------------|-------------|--------------|--------------|
|             |                |                         | 0.25                                                | 0.4         | 0.75         | 1.0          |
| Total COD   | mg/L           | 27789 (72) <sup>a</sup> | 4,997 (102)                                         | 8,046 (89)  | 15,101 (312) | 20,991 (148) |
| Soluble COD | mg/L           | 2737 (124)              | 945 (67)                                            | 1695 (12)   | 3,094 (35)   | 5,239 (112)  |
| TS          | mg/L           | 39050 (71)              | 5,000 (141)                                         | 8,100 (141) | 14,900 (141) | 24,050 (71)  |
| TVS         | mg/L           | 23700 (283)             | 4450 (71)                                           | 7100 (141)  | 12900 (424)  | 19700 (283)  |
| TSS         | mg/L           | 30833 (707)             | 3300 (141)                                          | 2567 (236)  | 10500 (707)  | 19000 (0)    |
| VSS         | mg/L           | 20333 (471)             | 3100 (141)                                          | 4000 (0)    | 9000 (471)   | 17167 (236)  |
| Carbon      | % <sup>b</sup> | 27.8 (0.5)              |                                                     |             | 31.7 (0.1)   |              |
| Hydrogen    | %              | 4.4 (0.1)               |                                                     |             | 4.6 (0.2)    |              |
| Nitrogen    | %              | 5.4 (0.1)               |                                                     |             | 2.0 (0.1)    |              |
| Sulfur      | %              | 1.0 (0.2)               |                                                     |             | 1.8 (0.6)    |              |
| Oxygen      | %              | 22.2 (0.6)              |                                                     |             | 44.2 (0.3)   |              |

<sup>a</sup> Standard deviation (in parenthesis)<sup>b</sup> A dry weight basis