**Table 5. S1:** Kinetic constants for substrate (COD) removal in An-HMBR

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Models  Grau Second order | Wastewater | Reactors | HRT (d) | OLR  kgCOD/m3d | T (˚C) | Kinetic Parameters | | | | | | Reference |
| **a b k2** | | | | | |
|  | Molasses | AHR | 0.50-2.00 | 1-10 | - | 0. 033 | | 1.192 | | | 10.81 | [25] |
|  | Simulated cotton textile | UASB | 0.25-4.16 | 1.0-15.8 | 37 | 0.562 | | 1.095 | | | 0.337 | [38] |
|  | 2,4 dichlorophenol | UASB | 0.08-0.83 | 6-34 | 37 | 0.541 | | 0.98 | | | - | [37] |
|  | Formaldehyde containing  wastewater | UAFB | 0.41-0.5 | 0.18–3.16 | 30 | 0.64 | | 9.36 | | | 3.2 | [42] |
|  | Synthetic wastewater | AMBR | 1-10.38 | 0.31–3.25 | - | 0.096 | | 1.07 | | | 0.654 | [43] |
|  | Poultry slaughterhouse  Wastewater | SGBR | 1.5-2.5 | 0.64–4.97 | AT | 0.173 | | 1.155 | | | - | [27] |
|  |  |  |  |  |  |  | |  | | |  |  |
|  | Pharmaceutical wastewater | AHR | 0.12-1.25 | 3.2-32.256 | 30-35 | 0.031 | | 1.067 | | | - | [15] |
|  | Municipal wastewater | UASB | 0.20-1 | 1.2–11.7 | 17.1–  21.0 | 0.260 | | 1.025 | | | - | [44] |
|  | Synthetic wastewater | An-HMBR  (suspended growth) | 0.33-2 | 1.06-6.4 | 35 | 0.0709 | | 1.0295 | | | 0.80 | This study |
| Kb  Umax | | | | | | | | | | | | |
| Modified Stover Kincannon | Paper mill wastewater | AF | 0.25-1 | 1.07–12.25 | 35 | 104.2 | | 86.2 | | | | [45] |
| Paper mill wastewater | AF | 0.25-1 | 1.07–12.25 | 55 | 843.9 | | 666.7 | | | | [45] |
| 2,4 dichlorophenol | UASB | 0.08-0.83 | 6-34 | 37 | 9.8×10-3 | | 0.01 | | | | [37] |
| Poultry slaughterhouse  wastewater | SGBR | 1.5-2.5 | 0.64–4.97 | AT | 177.2 | | 164.5 | | | | [27] |
| Synthetic wastewater | AMBR | 1-10.38 | 0.31–3.25 | - | 31.6 | | 29.5 | | | | [43] |
| Formaldehyde containing  wastewater | UAFB | 0.41-0.5 | 0.18–3.16 | 30 | 4.6 | | 3.4 | | | | [42] |
| Milk permeate | AMBBR | 1.97-27.56 | 2.0–20.0 | 35 | 102.3 | | 89.3 | | | | [26] |
|  | Food processing wastewater | MCAR | 1.06-5.11 | 1.1–5.0 | 35 | 23.6 | | 22.9 | | | | [29] |
| Municipal wastewater | UASB | 0.20-1 | 1.2–11.7 | 17.1–  21.0 | 1.5 | | 2.0 | | | | [44] |
| Antibiotic fermentation broth | UASB | 13.3 | 0.33–7.43 | 35 | 445.5 | | 399.0 | | | | [46] |
| Simulated polluted surface water | aMBR | 0.1-0.04 | 0.06-0.34 | 27.1 | 0.10-0.76 | | 0.013-0.26 | | | | [47] |
| Synthetic wastewater | An-HMBR  An-HBR  Suspended growth | 0.6-3.9  0.5-3  0.33-2 | 1.06-6.4  1.06-6.4  1.06-6.4 | 35  35  35 | 32.54  34.14  93.6 | | 32.25  33.78  45.45 | | | | This study  This study  This study |
| First order | **k** | | | | | | | | | | | |
| Simulated textile wastewater | UASB | 0.25-4.16 | 1.01–16.86 | 37 | 0.615 | | | | | | [38] |
| Antibiotic fermentation broth | UASB | 13.3 | 0.81-4.41 | 35 | 0.448 | | | | | | [46] |
| ConventionalMonod |  |  |  |  |  | **Y Kd Kmax Ks** | | | | | |  |
|  | Pharmaceutical wastewater | AHR | 0.12-1.25 | 3.2-32.25 | 30-35 | 0.0175 | 0.5618 | | 2.36 | 1.83 | | [15] |
|  | 2,4 dichlorophenol | UASB | 0.08-0.83 | 6-34 | 37 | 0.78 | 0.093 | | 0.213 | 560 | | [37] |
|  | Synthetic wastewater | An-HMBR (Attached growth) | 0.16-1.3 | 1.06-6.4 | 35 | 0.18 | 0.01 | | 0.185 | 65.6 | | This study |

AT-ambient temperature; ABBR: Anaerobic bioreactor with biomass recycle AHR: anaerobic hybrid reactor. AFBR: down-flow anaerobic fixed bed reactor.at: ambient temperature; AF: Anaerobic filter; aMBR- attached growth membrane bioreactor; AMBBR: Anaerobic moving bed biofilm reactor; AMBR: Anaerobic migrating blanket reactor; An-HMBR: anaerobic hybrid membrane bioreactor; An-HBR: anaerobic hybrid bioreactor; APCR: Anaerobic packed column reactor; BFFR: Biphasic fixed film bioreactor; MACR: High-rate mesophilic anaerobic N contact reactor; UASB: up-flow anaerobic sludge blanket reactor