Evaluating Wastewater Treatment Efficiency using Aerobic Granular Sludge in A/O/A/O Process

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1. Introduction

The technology using aerobic granular sludge is being developed and focused for wastewater treatment and has been successfully applied for 30 years in batch mode operation. There are few report about using aerobic granules in continuous mode because of the failure of granules shape. In order to evaluate the applicability of aerobic granules in continuous mode through nutrient removal efficiency, the sludge was operated during 40 days under various conditions with A/O/A/O process.

2. Materials and method

A reactor using in this work had a 30.25L of working volume and was divided into 4 equal chambers with one stirrer and one air stone for each chamber. Real wastewater was collected from Yongin wastewater treatment plant, Gyeonggi Province, Korea. The influent contained a TCOD of 100 to 250 mg/L and SCOD of 80 to 160 mg/L and around 20 mg/L of nitrogen concentration. Aerobic granule collected from SBR in laboratory scale used as a seeding sludge. As shown in Table 1, the CSTR mode reactor was started-up in various conditions at room temperature and 7.1±0.5 of pH. The samples were periodically collected and analyzed according to standard methods. Photographs were taken by digital camera to show the characteristics under different HRT operational conditions.

Table 1. various conditions for real wastewater treating in reactor II

<table>
<thead>
<tr>
<th>Day</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRT (hrs)</td>
<td>3</td>
<td>3</td>
<td>8</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>MLSS (mg/L)</td>
<td>4000</td>
<td>4000</td>
<td>4000</td>
<td>4000</td>
<td>8000</td>
</tr>
<tr>
<td>Anoxic/Oxic condition</td>
<td>4oxic chambers</td>
<td>2A/2O</td>
<td>2A/2O</td>
<td>2A/2O</td>
<td>2A/2O</td>
</tr>
</tbody>
</table>

3. Results and discussion

3.1. Organic removal efficiency

An external recycle with flow rate of twice (2Q) was applied since period II. The organic removal rate of real wastewater was change in large range which from 44 to 96%. The highest removal rate of 96% was observed at period V because of higher MLSS (8g/L). A stable removal rate was obtained under HRT of 6 hours both 4 g/L and 8 g/L of MLSS.

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3.2. Nitrification and denitrification process

Nitrification process in reactor was occurred well. The high ammonia removal rate was recorded during 40 days of operation with 82 to 100% of percentage. A very low NO$_2^{-}$-N concentration and a high NO$_3^{-}$-N concentration in all periods point out a good nitrification process. Most of NO$_2^{-}$-N were transformed to NO$_3^{-}$-N instantaneously and completely. Denitrification process was occurred during period II, but not in other periods. This result indicate that sufficient organics is needed to simultaneous nitrification and denitrification.

![Fig 1. Nitrogen removal process under various conditions](image)

4. Conclusions

Aerobic granules show a good removal rate in treating real wastewater using continuous mode. Nitrification was occurred well during all periods and denitrification was observed under condition II.

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References
