ALGAE BIOMASS EVALUATION IN AERATED FACULTATIVE POND AND MATURATION POND IN THE TREATMENT OF PIGGERY WASTEWATER

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Introduction

Piggery wastewater has provided a significant contribution both to the degradation of the natural resources and to the quality of life in the South region of the state of Santa Catarina, Brazil.

These wastes are extremely concentrated and show values in the order of:

- 30,000 mg/L for COD;
- 20,000 mg/L for total solids;
- 2,500 mg/L for total nitrogen;
- 600 mg/L for total phosphorus.
Objective

The focus of this study was to determine some physical-chemical and biological parameters, for a more accurate characterization of their behavior in an aerated facultative pond and a maturation pond treating piggery waste.
MATERIALS and METHODS

The experiment was accomplished in Braço do Norte, a city in the south of Santa Catarina, Brazil, with waste originated in a medium size pig farm, with around 5,000 full-cycle animals (500 matrizes).

The performance of the ponds was monitored during a 13-month period (January 2005 to January 2006).
The complete treatment system:

- Anaerobic Pond
- UASB Reactor
- Aerated Facultative Pond
- Maturation Pond
- Rock Filter
Aerated Facultative Pond:
volume of 360 m³ and deep of 1.20 m

A. WITHOUT AERATION
B. WITH AERATION
Maturation Pond:
Volume of 492 m$^3$ and deep of 0.60 m
## RESULTS

Table 1. Average surface loading rate (SLR); n=33

<table>
<thead>
<tr>
<th>SLR* (kg/ha.d)</th>
<th>Aerated Facultative Pond</th>
<th>Maturation Pond</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Applied</td>
<td>Removed</td>
</tr>
<tr>
<td>COD</td>
<td>636 ± 441</td>
<td>446 ± 348</td>
</tr>
<tr>
<td>N-NH₃</td>
<td>247 ± 144</td>
<td>140 ± 91</td>
</tr>
<tr>
<td>P-PO₄</td>
<td>47 ± 30</td>
<td>21 ± 14</td>
</tr>
</tbody>
</table>

* Calculating by area half depth
# RESULTS

Table 2. Average results in the treatment systems (AFP + MP); n=33

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Influent AFP</th>
<th>Effluent AFP</th>
<th>Effluent MP</th>
<th>Removal Rate(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C)</td>
<td>23 ± 5</td>
<td>22 ± 5</td>
<td>22 ± 5</td>
<td>-</td>
</tr>
<tr>
<td>pH</td>
<td>7.7 ± 0.2</td>
<td>8.5 ± 0.3</td>
<td>8.6 ± 0.6</td>
<td>-</td>
</tr>
<tr>
<td>DO (mg/L)</td>
<td>0.6 ± 1.4</td>
<td>1.6 ± 1.9</td>
<td>4.7 ± 3.5</td>
<td>-</td>
</tr>
<tr>
<td>COD (mg/L)</td>
<td>1977 ± 899*</td>
<td>642 ± 337**</td>
<td>337 ± 166**</td>
<td>83</td>
</tr>
<tr>
<td>N-NH₃ (mg/L)</td>
<td>788 ± 360</td>
<td>343 ± 208</td>
<td>119 ± 87</td>
<td>85</td>
</tr>
<tr>
<td>P-PO₄ (mg/L)</td>
<td>146 ± 67</td>
<td>80 ± 45</td>
<td>51 ± 27</td>
<td>65</td>
</tr>
<tr>
<td>Chlorophyll a (µg/L)</td>
<td>22 ± 12</td>
<td>488 ± 230</td>
<td>906 ± 511</td>
<td>-</td>
</tr>
<tr>
<td>Algae (cells/mL)***</td>
<td>1.3x10⁴</td>
<td>1.2x 10⁶</td>
<td>2.4x10⁶</td>
<td>-</td>
</tr>
<tr>
<td>Chlorella sp. - Abundance (%)</td>
<td>74 ± 20</td>
<td>74 ± 19</td>
<td>75 ± 18</td>
<td>-</td>
</tr>
</tbody>
</table>

* COD total (mg/L); ** COD soluble (mg/L); *** geometrical mean.
Figure 1. Box-plot of Chlorophyll \(a\) (\(\mu g/L\)) along the treatment system.
Figure 2. Box-plot of Algae Cells/mL along the treatment system.
The predominance of *Chlorella sp.* occurred during the whole experimental period, with a median abundance between 77 and 80% (Figure 3) and frequency of 100%.

*Figure 3.* Box-plot of *Chlorella sp.* - Abundance (%) along treatment system
Other general algae were found, however with lower frequency:

* Chlorella sp., Chloridella sp., Euglena sp., Carteria sp.,
* Scenedesmus sp., Micractinium sp., Chlorobotrys sp.,
* Chlamydomonas sp., Chloromonas sp., Cosmarium sp.,
* Dunaliella sp., Dysmorphococcus sp., Mesotaenium sp.,
* Monoraphidium sp., Oocystis sp., Planctonema sp.; Chlorophyceae.
CONCLUSIONS

• The piggery wastewater treatment system, consisting of an Aerated Facultative Pond (AFP) and a Maturation Pond (MP) in series, was efficient in the removal of organic substance and nutrients (nitrogen and phosphate).

• Algal population was not affected by the organic load variation applied during monitoring and showed an increase in the concentration of Chlorophyll *a* throughout the treating system.

• The predominance of *Chlorella sp.* occurred during the whole experimental period, with abundance between 77 and 80% and with a frequency of 100%.

• The system, after 1 year of operation, showed a trend toward stabilization, with an adequate removal efficiency and maintenance of the algal biomass, even in climatic and organic load variation, a common feature in a real scale piggery wastewater treatment system.