Organic matter and nitrogen recovery from landfill leachate using coagulation flocculation followed by granular activated carbon and ion exchange

Violet Oloibiri¹,²,³, Sam Deconinck³, Stijn DeWandel³, Michael Chys³, Kristof Demeestere², Stijn Van Hulle¹

¹ LIWET, Department of industrial biological sciences, Ghent university — campus Kortrijk, Graaf Karel De Goedelaan 5 8500 Kortrijk Belgium
² ENVOC, Department of sustainable organic chemistry and technology, Ghent University, coupure links 653, Ghent Belgium
³ Kenya industrial research and development institute P.O. Box 30650 — 00100 Nairobi Kenya

Introduction

• Current landfill leachate treatment facilities focus on the removal but not on the potential for recovery of important resources such as organic matter and ammonium nitrogen from landfill leachate.
• Therefore, this study seeks to investigate the effectiveness of a sequence of coagulation-flocculation (CF), granular activated carbon (GAC) and ion exchange (IE) to recover organic matter and ammonium from landfill leachate whilst reducing the pollutant load of landfill leachate to the required discharge limits.

Materials and methods

• Performance of the treatment sequence was evaluated at analysis point (AP) 1, 2, 3 by measuring COD, α₂₅₄, Ni, NH₄⁺ - N
• Initial concentration (mg/L) of pollutants in raw leachate – COD: 3152, Ni: 3.65, NH₄⁺ - N: 1885 and α₂₅₄: 18.41 cm⁻¹

Results and Discussion

• The overall removal efficiency of pollutants increases when CF is combined with GAC and IE.
• IE is effective in removing NH₄⁺ - N from landfill leachate. Up to 98% ammonium nitrogen is retained in the column
• Treatment of landfill leachate by CF and GAC before ion exchange improves the capacity of the IE column to retain ammonium nitrogen, COD and Ni
• FeCl₃ is the best coagulant to use to pre-treat leachate before AC and IE

Future perspectives

• Regeneration of the ion exchange column with a suitable solution to recover the retained NH₄⁺ - N
• Carry out an economic analysis of the entire treatment chain

Key Findings

Table 1: Number of bed volumes treated by the IE column before passing the Flemish environmental discharge limits

<table>
<thead>
<tr>
<th></th>
<th>COD</th>
<th>Ni</th>
<th>NH₄⁺ - N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw leachate</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>FeCl₃ treated leachate</td>
<td>11</td>
<td>&gt; 12</td>
<td>9</td>
</tr>
<tr>
<td>PACl treated leachate</td>
<td>4</td>
<td>&gt; 12</td>
<td>10</td>
</tr>
</tbody>
</table>

Key Findings

Contact: Violet.Oloibiri@UGent.be