**ELECTRON BEAM TREATMENT AS A FUTURE ECO-TECHNOLOGY FOR MICROPLASTICS REMOVAL IMPROVEMENT IN WASTEWATER AND SEWAGE SLUDGE**

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**I. THE MECHANISM OF THE ELECTRON BEAM ACTION**

**DIRECT:** damage to DNA and RNA

**INDIRECT:** production of large quantities of reactive species

\[ \text{H}_2\text{O} \rightarrow \text{OH}^\bullet + \text{e}_\text{aq} + \text{H}^+ + \text{H}_2\text{O}^+ + \text{H}_2 + \text{H}_2\text{O}_2 \]

Oxidising agents: \( E(V(\text{OH}^\bullet + \text{H}_2\text{O})) = -2.72 \text{V} \)

Reducing agents: \( E(V(\text{H}_2\text{O}^+ + \text{H}^+)) = -2.9 \text{V} \) and \( E(V(\text{H}^+ + \text{e}^-)) = -2.3 \text{V} \)

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**Table 1**

<table>
<thead>
<tr>
<th>pH</th>
<th>Water radiolysis products</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OH(^\bullet)</td>
</tr>
<tr>
<td>1</td>
<td>2.9</td>
</tr>
<tr>
<td>10</td>
<td>2.8</td>
</tr>
</tbody>
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**II. POLYMER STRUCTURE CHANGES**

**Molecular Weight Decrease**

- Polymer molecular weight inversely proportional to irradiation dose

**Thermal stability changes**

- Before (left) and after (right)

**III. MICROPLASTICS SEDIMENTATION PROPERTIES IMPROVEMENT**

**Induced plastic sedimentation**

**Density increase**

87% of sinking PS plastic after the irradiation at 56kGy compared to 13% of non-treated sample

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**IV. MICROPLASTICS DEGRADATION**

**Plastics mass loss**

- Partial plasticizer removal

**Plastics discoloration**

- Plastic yellowing

**V. CONCLUSIONS**

Electron beam treatment is a potential future tool for ecological, risk-free treatment of contamination in wastewater and sewage sludge, capable of microplastics modifications, removal (by coagulation and sedimentation) efficiency improvement and plasticizer extraction.