Investigation of the Effectiveness of Electrooxidation for the Treatment of Domestic Wastewater
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INTRODUCTION

Electrochemistry = important, wide field of science (redox reactions)

Electrochemical methods nowadays widely used in municipal/industrial WW treatment (simple operation, high efficiency)

**Electrooxidation (EO)** quite popular (high efficiency, minimized sludge production)

**EO:**
- (directly/indirectly) achieve oxidation with the gases ($O_2$ & $H_2$) released by using the non-melting electrodes
- direct anodic EO: 1<sup>st</sup> step=pollutant adsorption onto anode; 2<sup>nd</sup> step=electron transfer from anode
- indirect anodic EO: intermediates (e.g. $Cl_2$, HOCl, $H_2O_2$) likely to be placed on anode → affect organic material oxidation
INTRODUCTION

EO

• Anode = active role → catalytic activity = most influential aspect

• Target pollutant removed by hydroxyl radicals (·OH) generated in the anode

• (·OH) attack organic matter & break down pollutants

• Wastewater initial pH highly important: effect on electrolytic reactions!!!

• (·OH) radicals: pH first affected & possibly changed because of reactions

\[
\begin{align*}
M + H_2O & \rightarrow M(\cdot OH) + H^+ + e^- \\
M(\cdot OH) + \text{organics} & \rightarrow M + \text{oxidation products}
\end{align*}
\]
OBJECTIVES

i) examine EO efficiency for lab-scale treatment of domestic wastewater

ii) define optimal treatment operating conditions (e.g. wastewater initial pH, current)
MATERIALS & METHODS

- Wastewater: storm drain in Ataturk University Campus Area (Erzurum, Turkey)
- Continuous electrolytic glass cell
- 5 stainless-steel (cathode) & 5 titanium (Ti) (anode) electrodes

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>COD</td>
<td>mg L⁻¹</td>
<td>900-1,150</td>
</tr>
<tr>
<td>BOD</td>
<td>mg L⁻¹</td>
<td>95-210</td>
</tr>
<tr>
<td>Specific conductivity</td>
<td>µS cm⁻¹</td>
<td>665-1,230</td>
</tr>
<tr>
<td>Turbidity</td>
<td>NTU</td>
<td>59.2-170</td>
</tr>
<tr>
<td>pH</td>
<td>-</td>
<td>3, 5, 7, 9</td>
</tr>
</tbody>
</table>

Removal efficiency (%) = \(((C₀ - Cₜ)/C₀) \times 100\)

*C₀ = initial COD value (mg L⁻¹), Cₜ = COD value at time t

Schematic diagram of the experiment setup; 1: Multiparameter, 2: DC power supply, 3: Wastewater, 4: Ti anode electrode, 5: Steel cathode electrode.
RESULTS

Effect of different values for the initial wastewater pH (3, 5, 7 & 9) with different current value applied each time (10, 15 & 20 A)

COD samples were taken & measured after 120 min

**10 A**

COD removal=49% at pH=3

COD removal=66% at pH=9
RESULTS

15 A

COD removal = 60% at pH = 3

COD removal = 77% at pH = 9

20 A

COD removal = 63% at pH = 3

COD removal = 85% at pH = 9
RESULTS

Variations in the solution pH during the EO for each one of different initial wastewater pH values applied (20 A)

- pH generally ↓ during the EO, independently of how high the initial wastewater applied value

Effluent pH=3.5 for an initial WW pH=9
Effluent pH=2.5 for an initial WW pH=5

Highest COD removal under these (acidic) conditions
CONCLUSIONS

1. initial WW pH value $\uparrow \rightarrow$ COD removal $\uparrow$;
   effluent pH value under weak acidic conditions at the end of reaction

2. Current value also important since it impacts on intensity of chemical oxidation; 10 A $\rightarrow$ 20 A resulted in $\uparrow$ COD removal & $\downarrow$ effluent pH values

✓ EO oxidation = effective treatment for domestic WW
✓ Simple installation & operation
✓ Potential to achieve high
THANK YOU
FOR
YOUR ATTENTION