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

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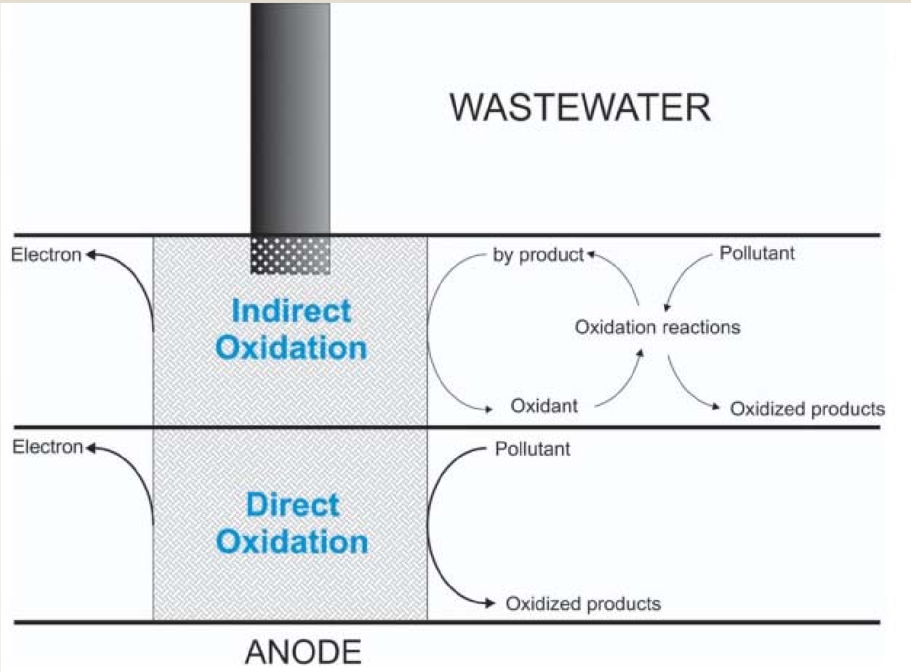
CONTENTS

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: 1st step=pollutant adsorption onto anode; 2nd 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 ($^{\cdot}OH$) generated in the anode
- ($^{\cdot}OH$) attack organic matter & break down pollutants
- Wastewater initial pH highly important: effect on electrolytic reactions!!!
- ($^{\cdot}OH$) radicals: pH first affected & possibly changed because of reactions

$M + H_2O \rightarrow M(^{\cdot}OH) + H^+ + e^-$	**(1)**
$M(^{\cdot}OH) + \text{organics} \rightarrow M + \text{oxidation products}$	**(2)**

OBJECTIVES

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

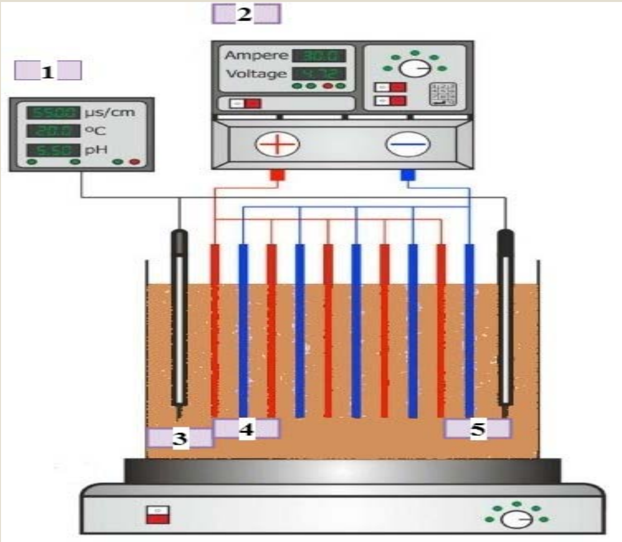
ii) define optimal treatment operating conditions

(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

COD	[mg L^{-1}]	900-1,150
BOD	[mg L^{-1}]	95-210
Specific conductivity	[µS cm^{-1}]	665-1,230
Turbidity	[NTU]	59.2-170
pH	[-]	3, 5, 7, 9



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

Removal efficiency (%) = $((C_0 - C_t)/C_0) \times 100$

*C_0 = initial COD value (mg L^{-1}), C_t = COD value at time t

RESULTS

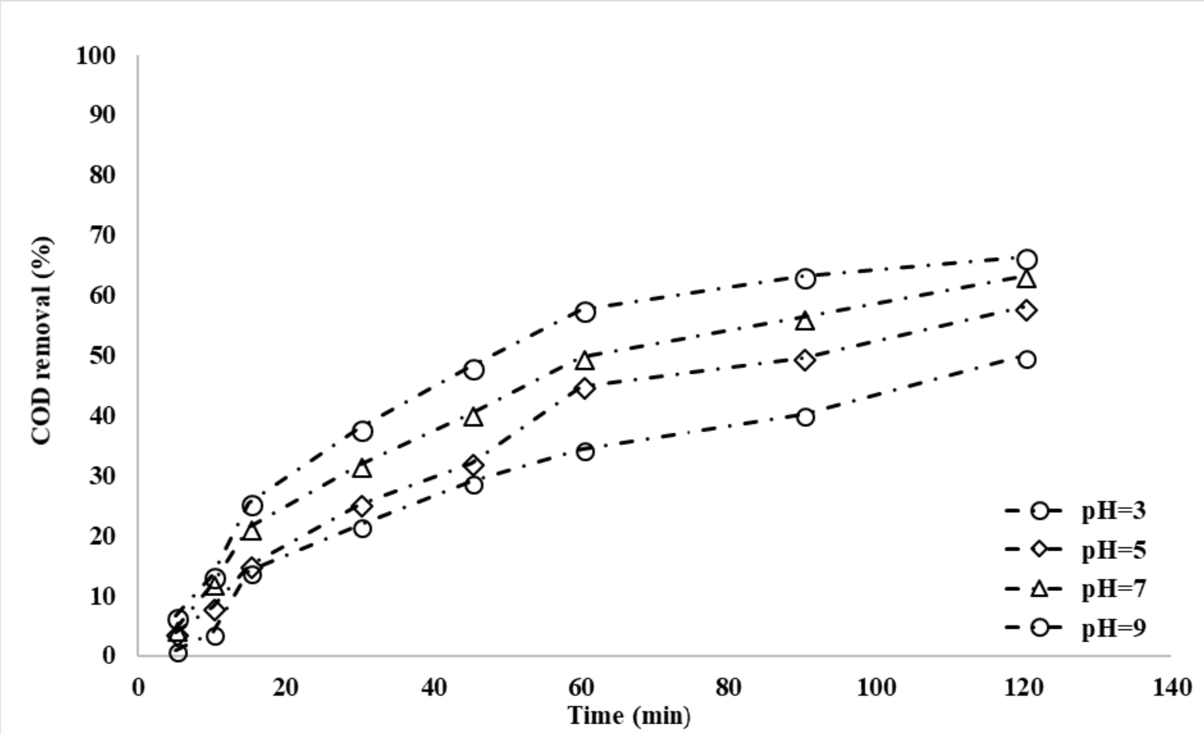
Effect of different values for the initial wastewater pH (3, 5, 7 & 9) with different current value applied each time (10, 15 & 20 A)

COD samples were taken & measured after 120 min

10 A

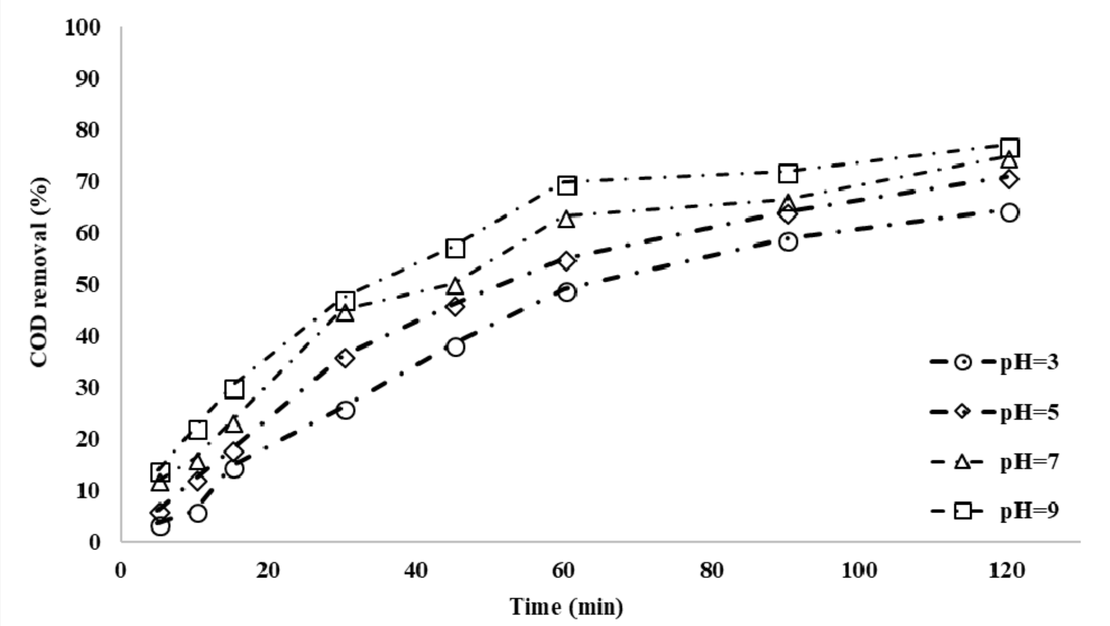
COD removal=49% at pH=3

COD removal=66% at pH= 9

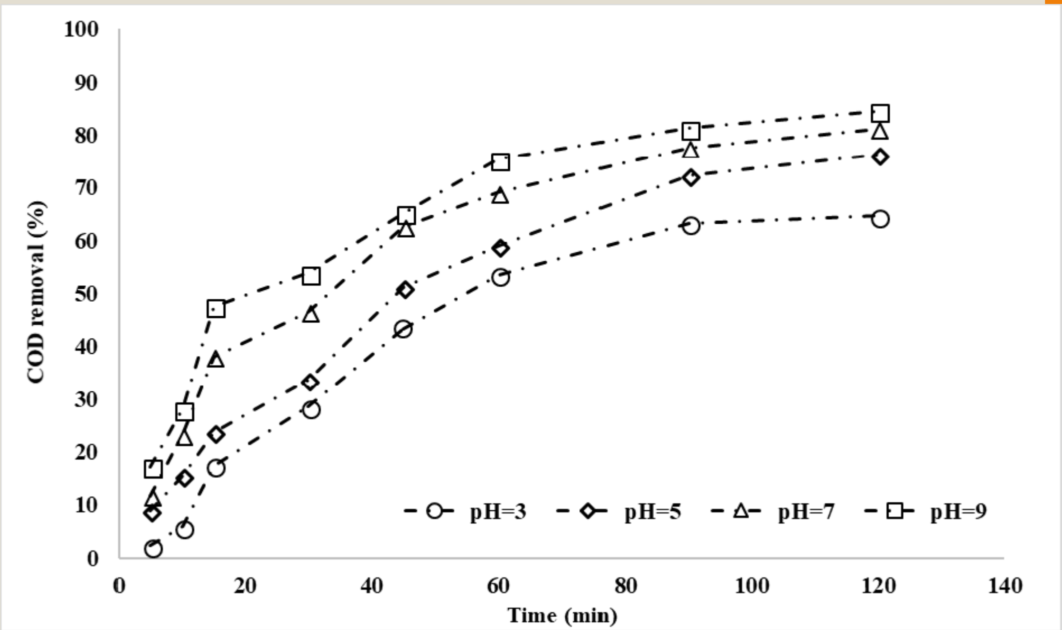


RESULTS

15 A



20 A



COD removal=60% at pH=3

COD removal=77% at pH= 9

COD removal=63% at pH=3

COD removal=85% at pH= 9

RESULTS

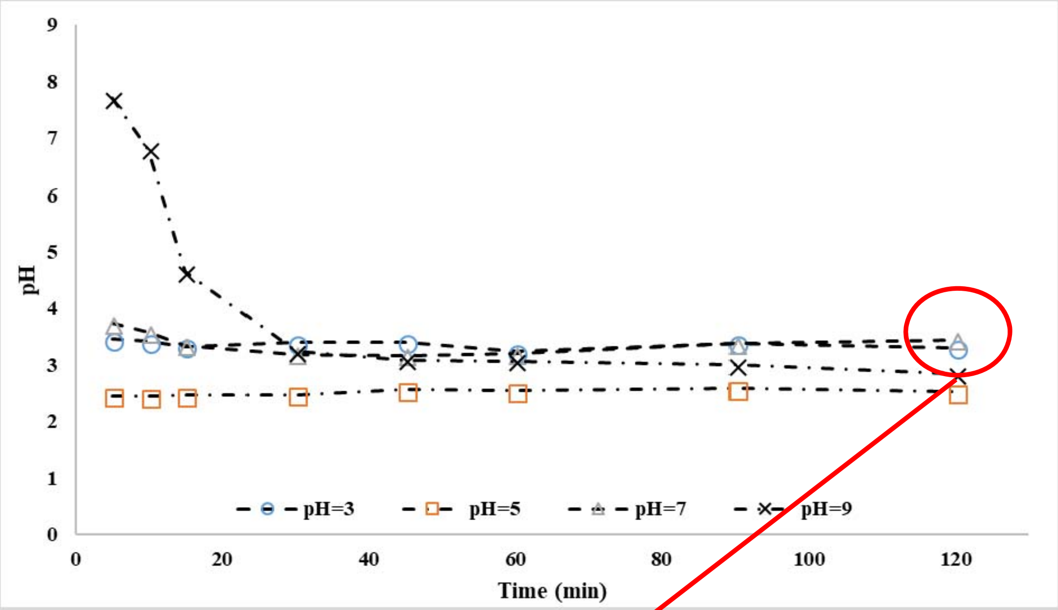
20 A

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 ↑ → COD removal↑; 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 → 20 A resulted in ↑ COD removal & ↓effluent pH values

- ✓ EO oxidation=effective treatment for domestic WW
- ✓ Simple installation & operation
- ✓ Potential to achieve high

THANK YOU FOR YOUR ATTENTION