OPTIMIZATION OF COLOR AND COD REMOVAL FROM LEACHATE BY ELECTRO-COAGULATION TREATMENT

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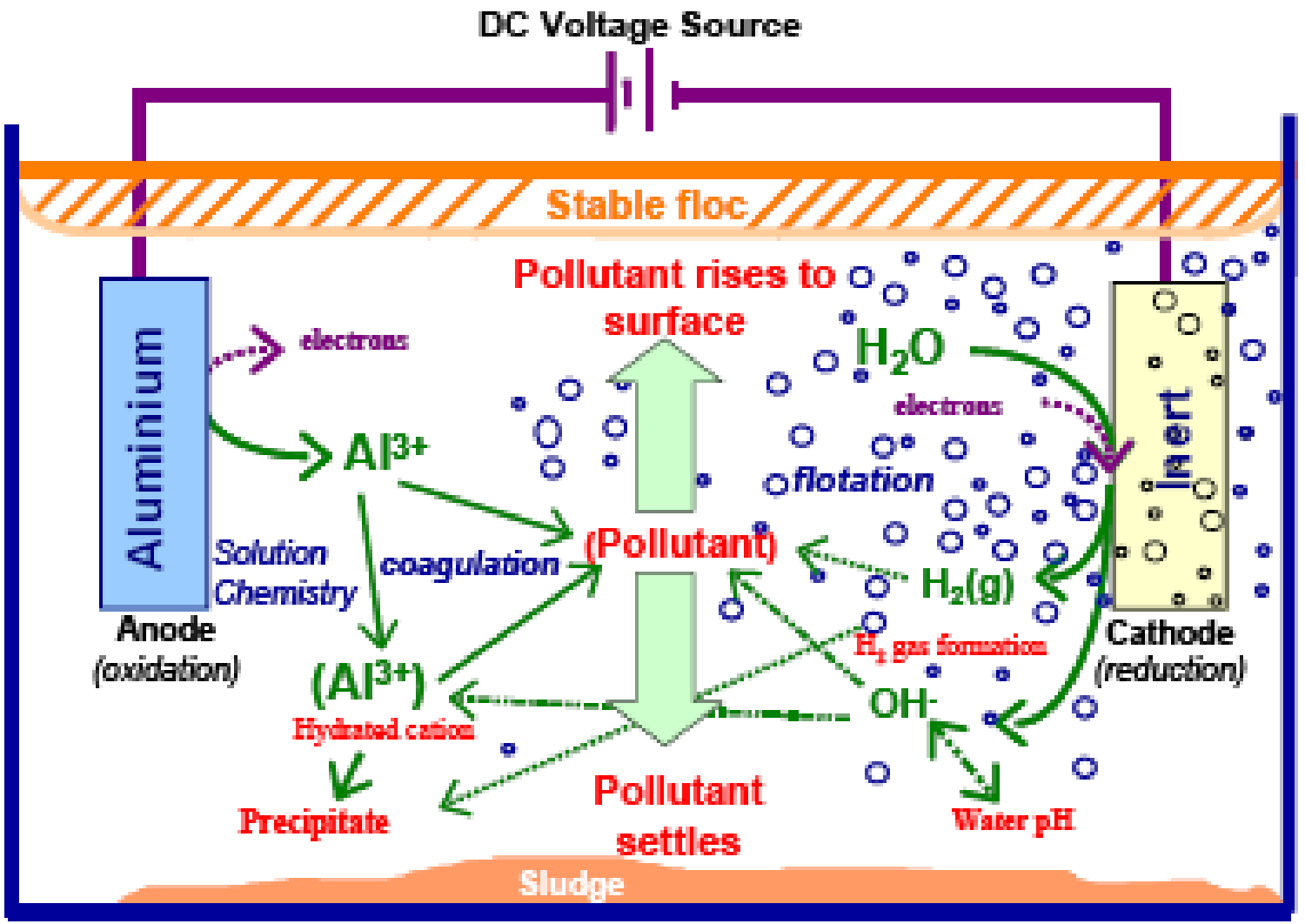
Landfill Leachate

- Leachate is leading of “hard to treat” wastewaters as it shows a complex structure and changes with the age of landfill.
- Therefore many treatment methods have been proven to supply a satisfying treatment requirement.
- This study performs on it electro-coagulation (EC). There is a need to optimize time and pH to get adequate effluent quality and make minimum the cost.

Electrocoagulation (EC)



Operational Parameters for EC

- Initial pH
- Current Density
- Reaction Time
- Electrode Type (Aluminum, Iron)
- Conductivity

The study

- Tretability data obtained by EC experiments:

  - % COD and color removal

  - operational conditions (contact time, current density, initial pH)

- Optimization search by statistical analysis (StatGraphics Centurion XV)

Material and Methods

- Reactor (70 mm x 70 mm x 150 mm)
- Electrodes (2 mm x 50 mm x 150 mm)
- Opening between electrodes (65 mm)
- Effective Volume in Reactor (450 ml)
- Effective Electrode Area (50 cm2)
- Electrode Type (Aluminum)

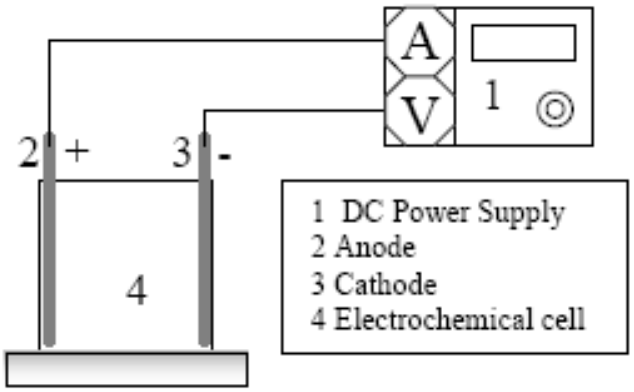


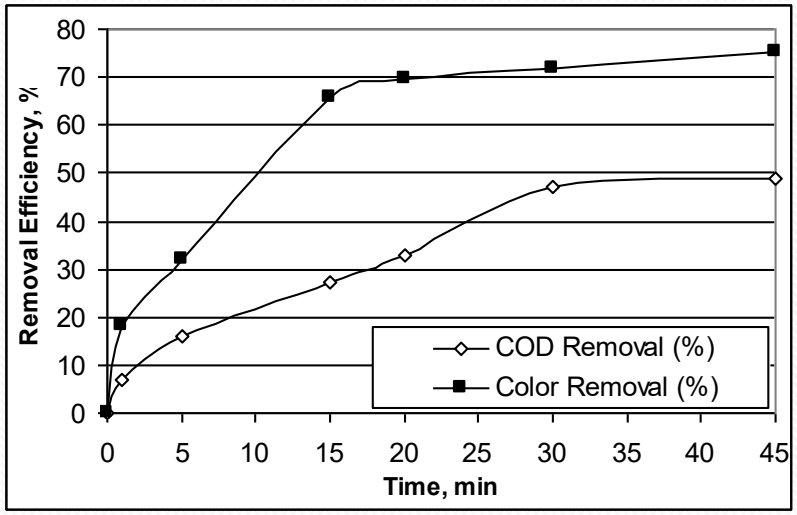
Figure 1. Experimental Setup

Parameter	Unit	Concentration
pH	-	8.15
COD	mgL^{-1}	13100
BOD_5	mgL^{-1}	5240
BOD_5 / COD	-	0.40
TKN-N	mgL^{-1}	2200
Ammonia-N	mgL^{-1}	1900
Color	Hazen	3900

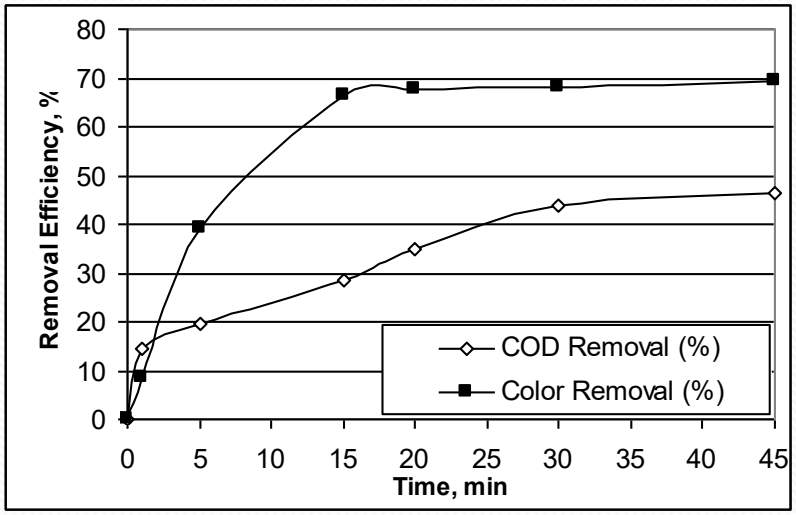
Study Programme

Run #	Electrode Type	Current Density (mA/cm2)	Time (min)	Initial pH
1	Al	40	0	3.0
2	Al	40	15	3.0
3	Al	40	30	3.0
4	Al	40	45	3.0
5	Al	40	0	5.0
6	Al	40	15	5.0
7	Al	40	30	5.0
8	Al	40	45	5.0
9	Al	40	0	7.0
10	Al	40	15	7.0
11	Al	40	30	7.0
12	Al	40	45	7.0
13	Al	40	0	8.0
14	Al	40	15	8.0
15	Al	40	30	8.0
16	Al	40	45	8.0
17	Al	40	0	9.0
18	Al	40	15	9.0
19	Al	40	30	9.0
20	Al	40	45	9.0
21	Al	60	0	8.0
22	Al	60	15	8.0
23	Al	60	30	8.0
24	Al	60	45	8.0

Results of obtained for different operational parameters

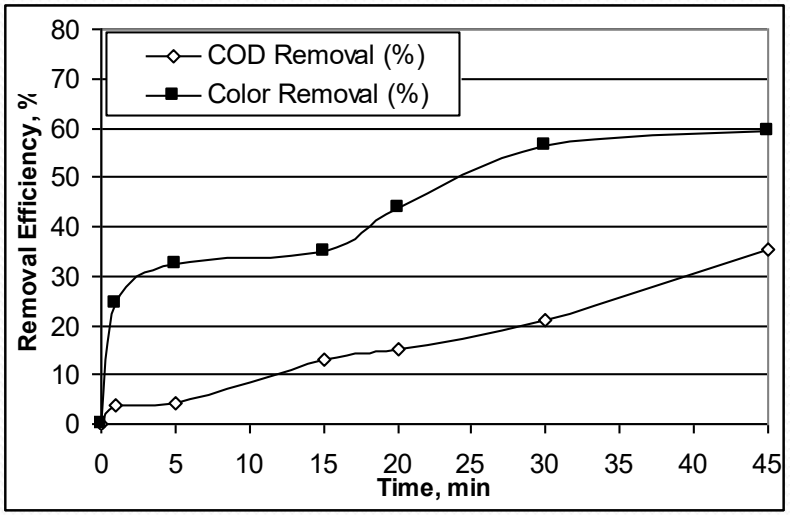


40 mA/cm², pH:3.0

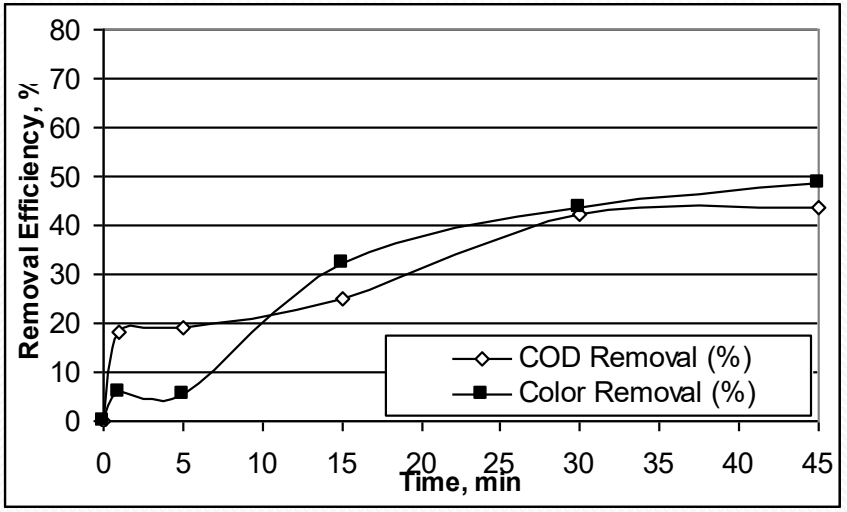


40 mA/cm², pH:5.0

Results of obtained for different operational parameters

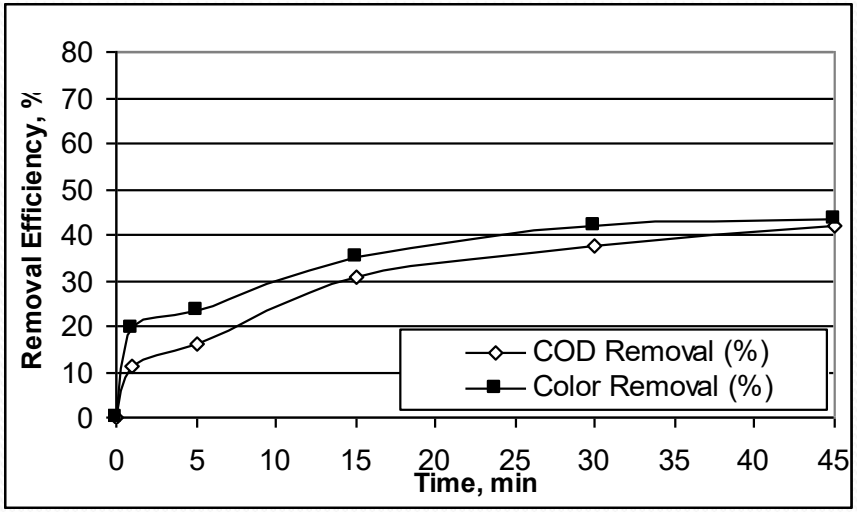


40 mA/cm², pH:7.0

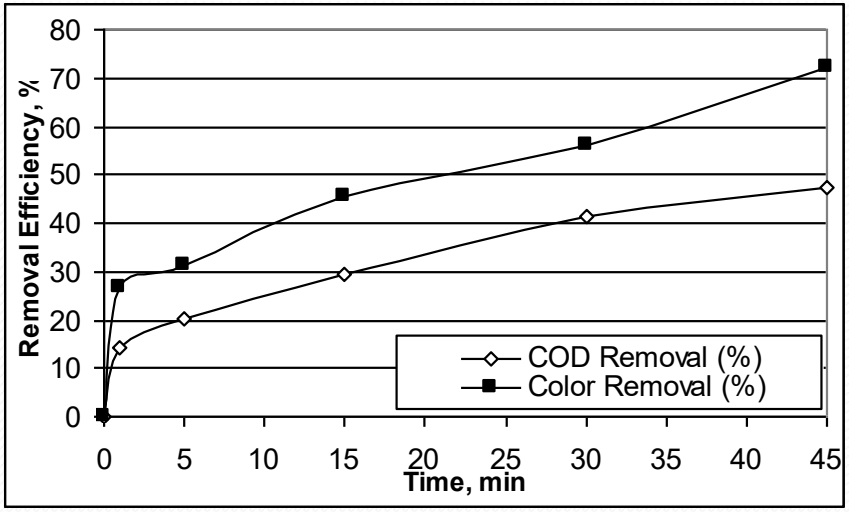


40 mA/cm², pH:8.0

Results of obtained for different operational parameters



40 mA/cm², pH:9.0



60 mA/cm², pH:8.0

Optimization of EC process

- Removal efficiencies of COD and color that are dependent on process time, current density and pH.
- The removal efficiencies increase generally by 30 minutes.
- The pH of the solution also governs the EC reactions.
- These reasons require an optimization in EC process parameters

Statistical Survey for Optimum Treatment

- Achievement of relationships COD and color removal data with process time, initial pH and current density will be useful for efficient treatments.
- Such a research is supplied by statistical analysis. Model surveys by taking

- Dependent Variable:
  - COD Removal
  - Color Removal,
- Independent Variables:
  - A: Initial pH
  - B: Current density
  - C: Process Time

The model for COD removal

- The equation of the model fitted by multiple linear regression :

$$COD\ Removal = 1.615 - 0.22 \times Currentdensity - 0.869 \times pH_{in} + 0.968 \times Time$$

- Since the P-value in the ANOVA table is less than 0.05, there is a statistically significant relationship between the variables at the 95.0% confidence level.

The model for Color removal

- The output shows the results of fitting a multiple linear regression model to describe the relationship between Color Removal and 3 independent variables. The equation of the fitted model is:

$$Color\ Removal = 19.796 + 0.49 \times Currentdensity - 4.372 \times pH_{in} + 1.293 \times Time$$

- Since the P-value in the ANOVA table is less than 0.05, there is a statistically significant relationship between the variables at the 95.0% confidence level.

Analysis of Variance

for COD Removal

Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Model	6428.06	3	2142.69	33.08	0.0000
Residual	1295.3	20	64.7652		
Total (Corr.)	7723.36	23			

for Color Removal

Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Model	13080.6	3	4360.2	22.10	0.0000
Residual	3946.28	20	197.314		
Total (Corr.)	17026.9	23			

Conclusion

- closely predictable removal rates
- Automation opportunity by the models giving optimum operational conditions

References

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Thank you for listening me

Questions