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# Catalytic Oxidation of Phenol Using Iron-Supported Illite: Optimization of Parameters for Efficient Wastewater Treatment

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## INTRODUCTION & AIM

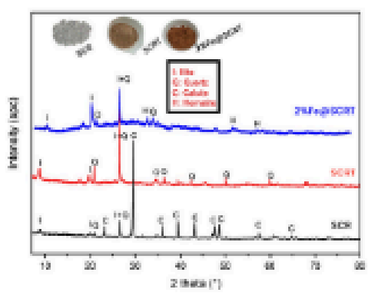
Phenol is a common and hazardous pollutant found in industrial wastewater. Conventional treatment methods are often inefficient or costly. This study aims to investigate the catalytic oxidation of phenol using illite clay supported with iron as a low-cost, eco-friendly, and effective catalyst. The primary objective is to optimize key operational parameters—such as pH, catalyst dose, hydrogen peroxide concentration, and reaction time—for maximum phenol degradation.

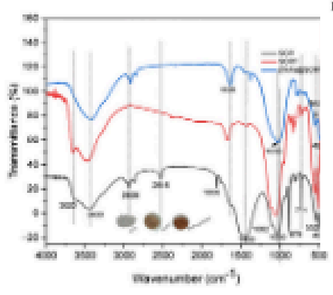
## METHOD

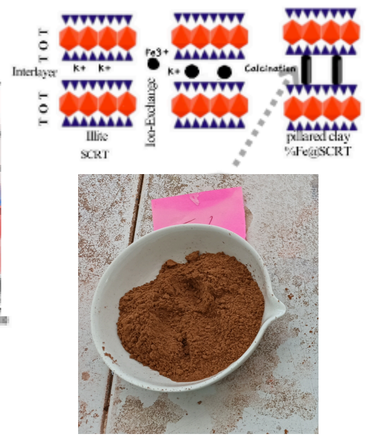
**Catalyst Preparation:**
Natural illite clay was purified and impregnated with $Fe(NO_3)_3 \cdot 9H_2O$ using wet impregnation, followed by drying and calcination at 450°C.

**Oxidation Procedure:**
Experiments were performed in batch reactors under ambient conditions. The degradation of phenol was conducted using $H_2O_2$ as the oxidant, and Fe/illite as the catalyst.

**Optimization**:
A full factorial design was employed to study the effect of pH (3–9), catalyst dose (0.1–1 g/L), $H_2O_2$ concentration (10–100 mM), and reaction time (0–180 min). Phenol concentration was monitored via UV-Vis spectroscopy at 270 nm.




## RESULTS & DISCUSSION

Catalytic Activity: The Fe/illite catalyst significantly improved phenol degradation compared to blank and non-catalyzed reactions.

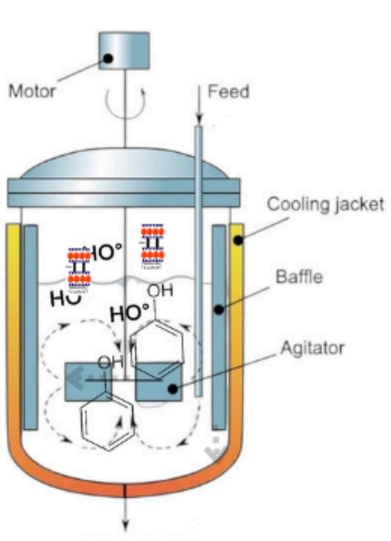
Effect of pH: Optimal degradation occurred at pH 3.

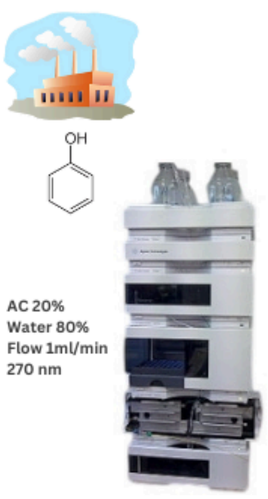
Catalyst Dose: 0.5 g/L was sufficient for over 90% degradation within 120 minutes.

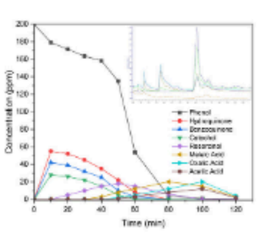
Oxidant Dose: An optimum at 50 mM $H_2O_2$ was identified; higher doses led to scavenging effects.

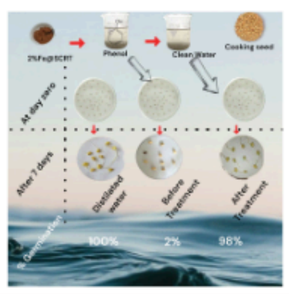
Kinetics: The reaction followed pseudo-first-order kinetics with $R^2 > 0.98$.

Reusability: Catalyst retained over 80% activity after three cycles.




## CONCLUSION

The Fe/illite catalyst offers a promising route for the oxidative removal of phenol in wastewater. It is low-cost, reusable, and efficient under mild conditions. Parameter optimization played a key role in achieving high degradation efficiency.

## FUTURE WORK / REFERENCES

Application to real industrial wastewater.
Characterization of intermediate by-products.
Extension to other organic pollutants.

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