

HEAVY METALS REMOVAL FROM INDUSTRIAL WASTEWATER USING DATE SEEDS POWDER AND ALUMINUM CHLORIDE-BASED HYBRID NATURAL/CHEMICAL COAGULATION

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OBJECTIVE

THIS STUDY AIMED TO INVESTIGATE THE PERFORMANCE OF COMBINING DATE STONE POWDER (DSP) AND ALUMINUM CHLORIDE (ALCL₃), TO REMOVE HEAVY METALS FROM INDUSTRIAL WASTEWATER EFFICIENTLY. THROUGH AN OPTIMIZATION PROCESS OF DSP/ALCL₃ DOSAGE AND PH, THE STUDY SOUGHT TO DETERMINE THE OPTIMAL CONDITIONS FOR HEAVY METAL REMOVAL

METHODOLOGY

- THE COAGULATION-FLOCCULATION EXPERIMENTS WERE PERFORMED USING AN ORBITAL SHAKER MANUFACTURED BY PSU-101 (TYPE: PSU-101, NO:010144-1404-0228, LATVIA).
- THE EFFECTS OF THE HYBRID COAGULANT DOSAGE A (7 G) OF DATE COMBINED WITH (0.5, 1, 1.5, 2, AND 2.5 G) OF (ALCL₃) MIXED WITH 1 L OF WASTEWATER FROM THE IRON AND STEEL INDUSTRY, 500 ML BEAKERS WERE EMPLOYED FOR THE EXPERIMENTS.
- THE SELECTED DOSAGES WERE IDENTIFIED BASED ON THE OUTCOMES FROM THE SET OF PRELIMINARY EXPERIMENTS. THE SELECTION OF OPERATIONAL PARAMETERS WAS BASED ON A COMPREHENSIVE REVIEW OF EXISTING LITERATURE IN THE FIELD.
- DURING EACH EXPERIMENT, 200 ML OF THE WASTEWATER SAMPLE WAS PLACED IN A 500 ML BEAKER AND POSITIONED ON THE SHAKER PLATE. THE SAMPLE UNDERWENT A FAST-MIXING PHASE AT 200 RPM FOR 5 MINUTES. THIS WAS FOLLOWED BY A SLOW MIXING PHASE AT 90 RPM FOR 30 MINUTES.

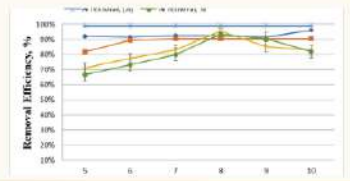
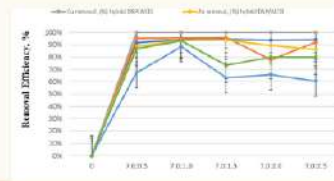
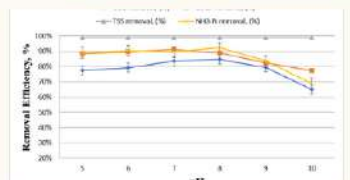
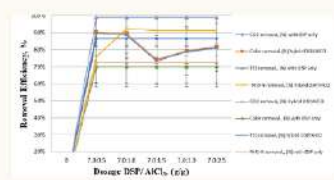
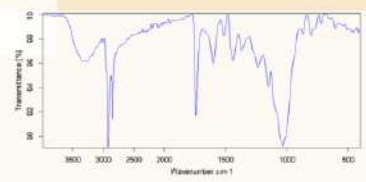
RESULTS

The main findings indicate that a DSP/AlCl₃ dosage of 7:1 (g/g) was the most effective coagulant dosage, resulting in high removal efficiencies for COD (88.56%), color (89.56%), TSS (99.00%), NH₃-N (92.50%), Mn (94.10%), Fe (95.47%), Zn (93.57%), Al (88.42%), and Ni (93.3%) at pH 8. Interestingly, the results of pH optimization showed that no pH modification was necessary, as it already achieved high removal efficiencies for COD (84.57%), color (88.94%), TSS (99.00%), NH₃-N (92.25%), Mn (92.66%), Fe (90.57%), Zn (95.59%), Al (99.00%), and Ni (93.33%).

VISUALS AREA

Table 1: Summary of the main parameters in Industrial Wastewater

Iron and steel effluent parameters	Units	results
pH	-	7.2 - 8.1
Color	Pt-Co	790 - 885
TSS	mg/L	90 - 112
COD	mg/L	640 - 850
Ammonia-nitrogen (NH ₃ -N)	mg/L	36 - 44
Manganese (Mn)	mg/L	5.5 - 7.1
Iron (Fe ²⁺)	mg/L	4.3 - 5.20
Zinc (Zn)	mg/L	5 - 6.1
Aluminum (Al)	mg/L	0.29 - 0.35
Nickel (Ni)	mg/L	0.11



ANALYSIS

- Several essential parameters were analyzed to assess the effectiveness of the hybrid coagulation/flocculation process. These included Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), ammonia-nitrogen (NH₃-N), in the original pH (8) of the iron and steel industry wastewater sample collected for the study.

CONCLUSION

The hybrid DSP/AlCl₃ dosage demonstrated significant potential for treating iron and steel mill wastewater. The experimental results indicated strong coagulation properties of the hybrid DSP/AlCl₃. Overall, these findings highlight the strong coagulation capabilities of the hybrid DSP/AlCl₃ dosage and its potential as an effective treatment for iron and steel mill wastewater treatment. While these findings are promising, further research is essential to validate scalability and explore potential limitations, ensuring the practical viability of this sustainable wastewater treatment approach.