



Removal Efficiency of Pb (II) and Cd (II) Metal Ions from Waste Water Using Unmodified Jack Sawdust

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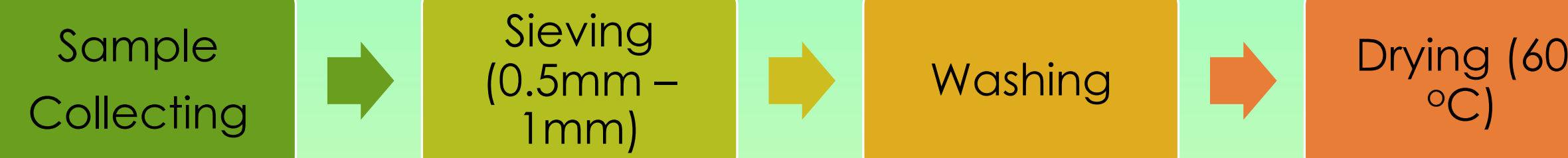
Introduction

- Releasing heavy metals to the water bodies from various industries have become a serious problem.
- Tough conventional methods are available to remove heavy metals from waste water using low cost adsorbent is the highly profitable and eco-friendly method to investigate.
- Adsorption efficiency is mainly affected by pH, dosage of the adsorbent, initial metal ion concentration, time & temperature.
- Applicability of several adsorption kinetics, isotherms & thermodynamic parameters.



Method

1. Sample Preparation



2. Determination of Point of Zero Charge (PZC)

3. Method Validation (LOQ, LOD, Matrix Effect).

4. Batch Sorption Studies.

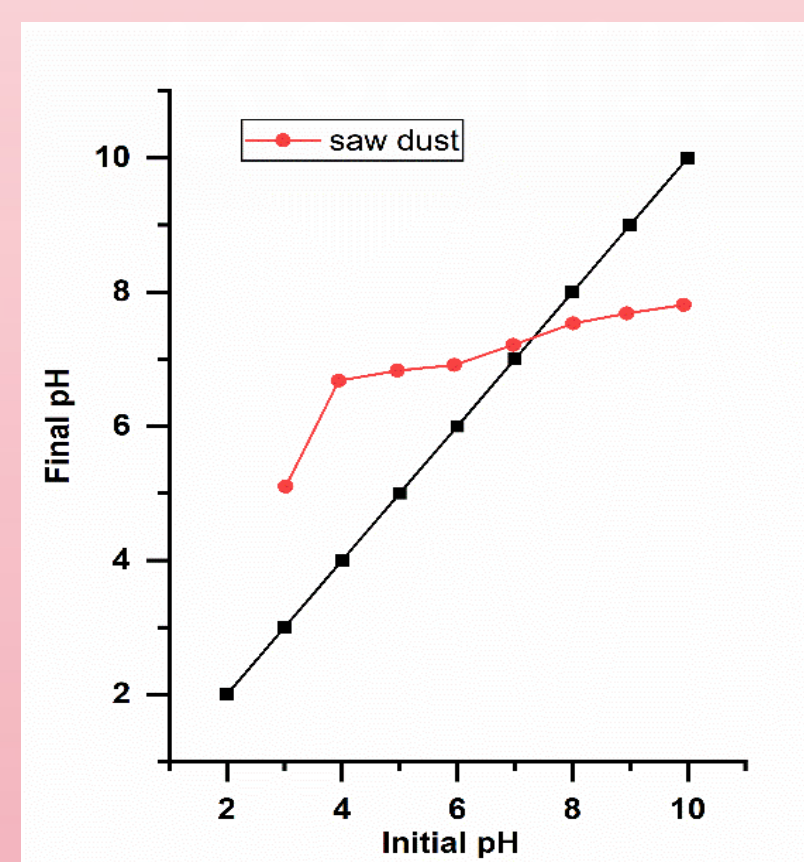
	Pb(II)	Cd(II)
Initial metal ion concentration	10 ppm – 50 ppm	1 ppm – 3ppm
Adsorbent dosage	0.5 g – 2.5 g	
pH	pH 4 – pH 10	
Time	10 min – 250 min	
Temperature	30 °C – 70 °C	

$$\text{Removal Efficiency (\%)} = \left(\frac{C_o - C_e}{C_o} \right) 100\%$$

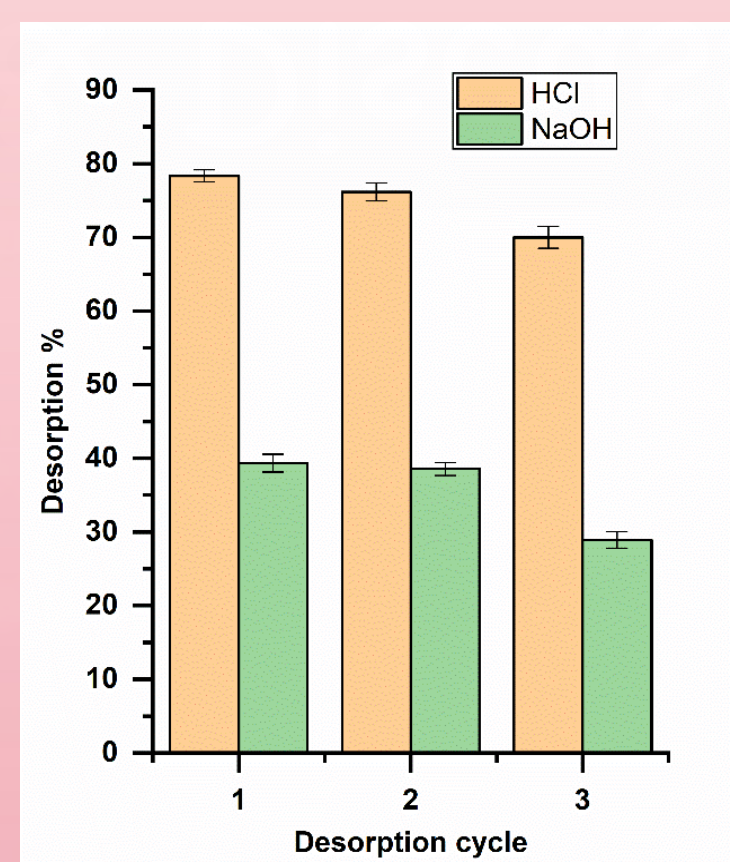
$$\text{Adsorption Capacity} = \left(\frac{C_o - C_e}{m} \right) v$$

- Desorption & Regeneration
- FTIR Analysis
- SEM Analysis

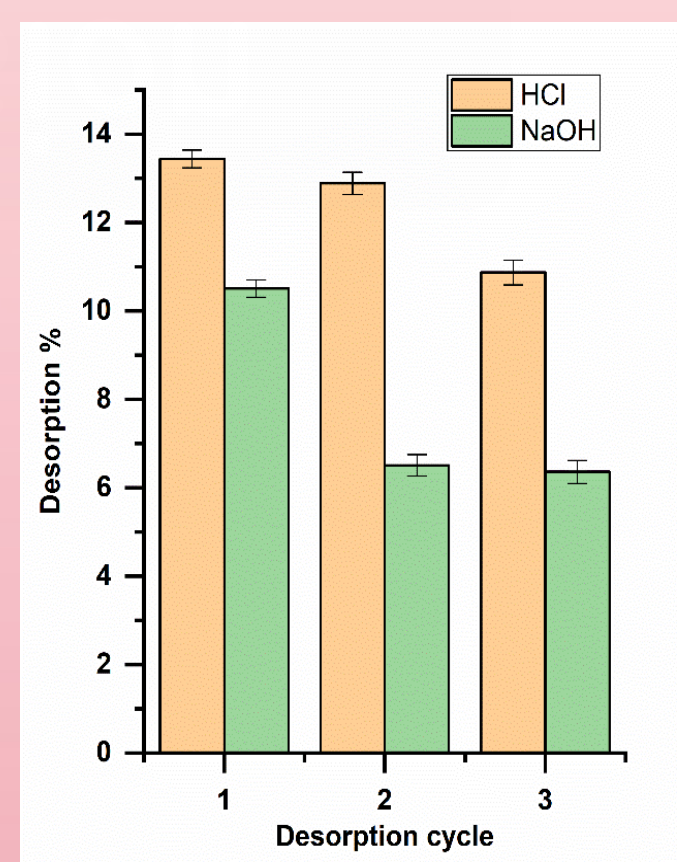
Results & Discussion



Point of zero charge value of jack saw dust samples



Desorption cycle vs Desorption % for Pb(II)



Desorption cycle vs Desorption % for Cd(II)

- Point of zero charge value for jack saw dust sample is 7.3 pH.
- HCl is the best desorption agent in both Pb(II) & Cd(II) removal.

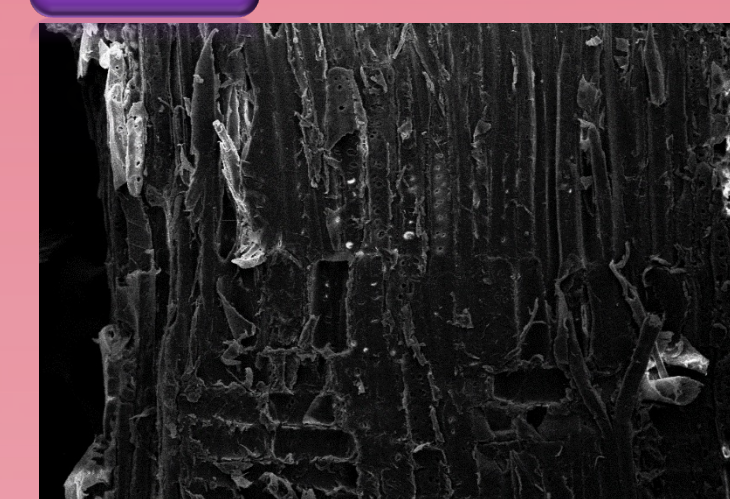
Pb

		Saw Dust	Charcoal
Method Validation	LOD	0.0316 ppm	0.0316 ppm
	LOQ	0.113 ppm	0.115 ppm
	Matrix Effect	6.82%	8.16%
Batch Sorption Studies	Metal ion concentration	30 ppm	50 ppm
	Adsorbent dosage	1 g	1.5 g
	pH	pH 10	pH 10
	Contact time	200 min	150 min
	Temperature	30 °C	30 °C

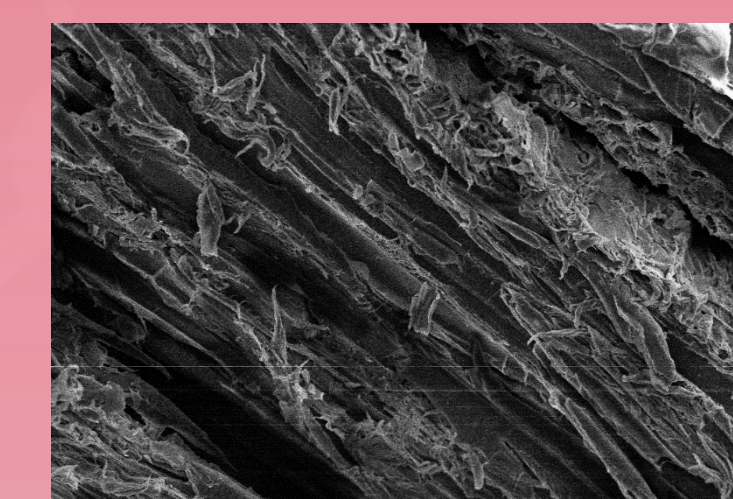
Cd

		Saw Dust	Charcoal
Method Validation	LOD	0.0031 ppm	0.0031 ppm
	LOQ	0.011 ppm	0.011 ppm
	Matrix Effect	4.26%	3.18%
Batch Sorption Studies	Metal ion concentration	3 ppm	5 ppm
	Adsorbent dosage	2.5 g	0.5 g
	pH	pH 10	pH 10
	Contact time	200 min	150 min
	Temperature	30 °C	30 °C

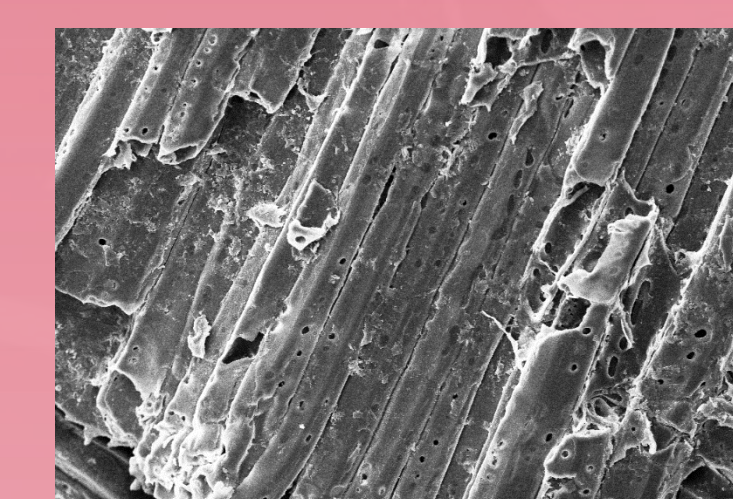
SEM



Unmodified sawdust

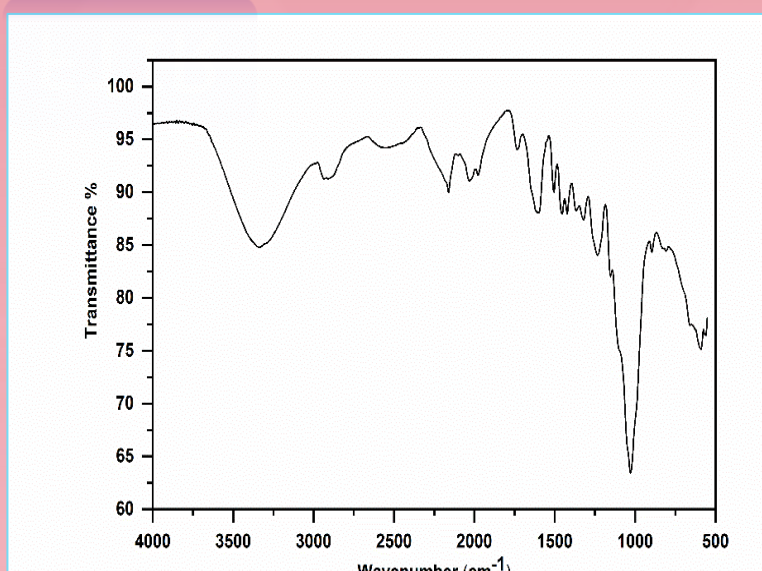


Pb adsorbed sawdust

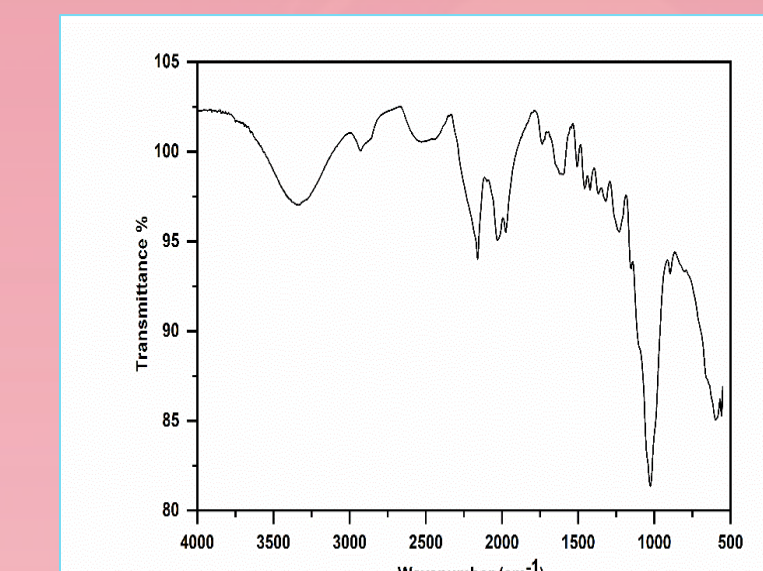


Cd adsorbed sawdust

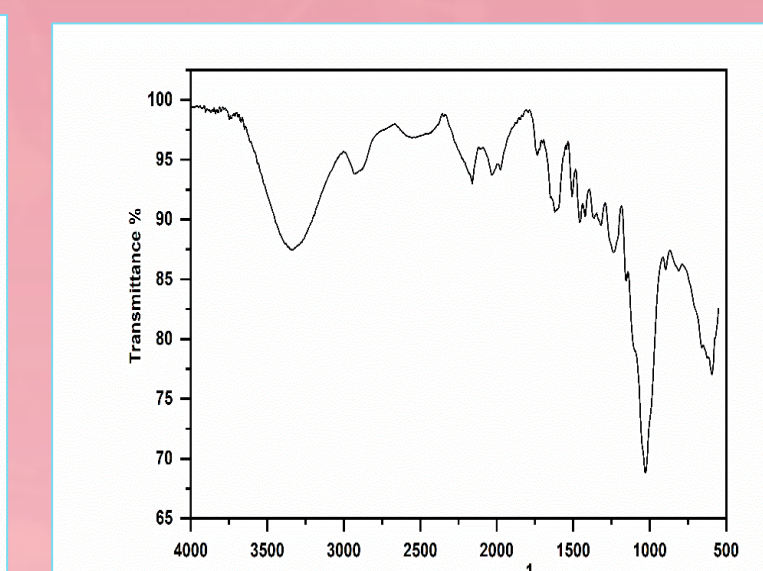
FTIR



unmodified jack sawdust samples

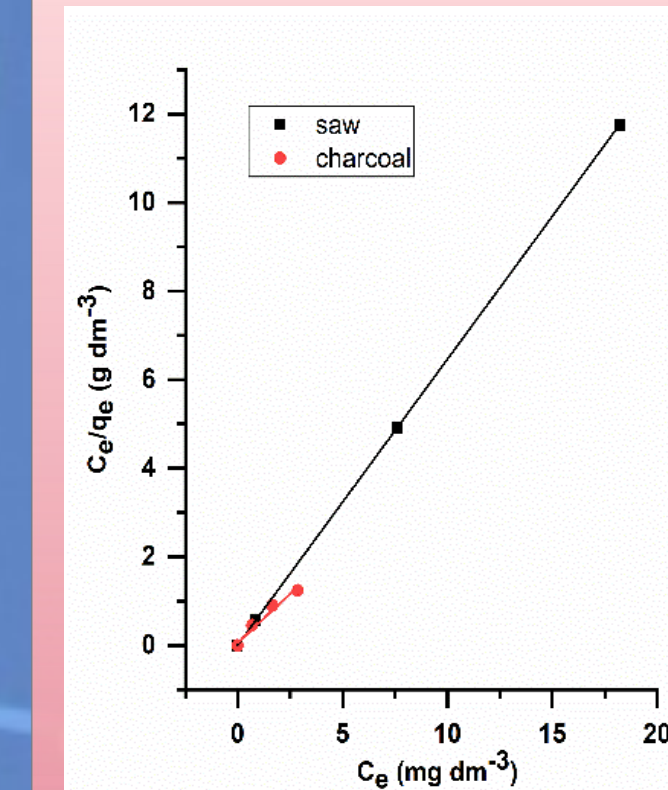


unmodified jack sawdust samples after the adsorption of Pb(II)

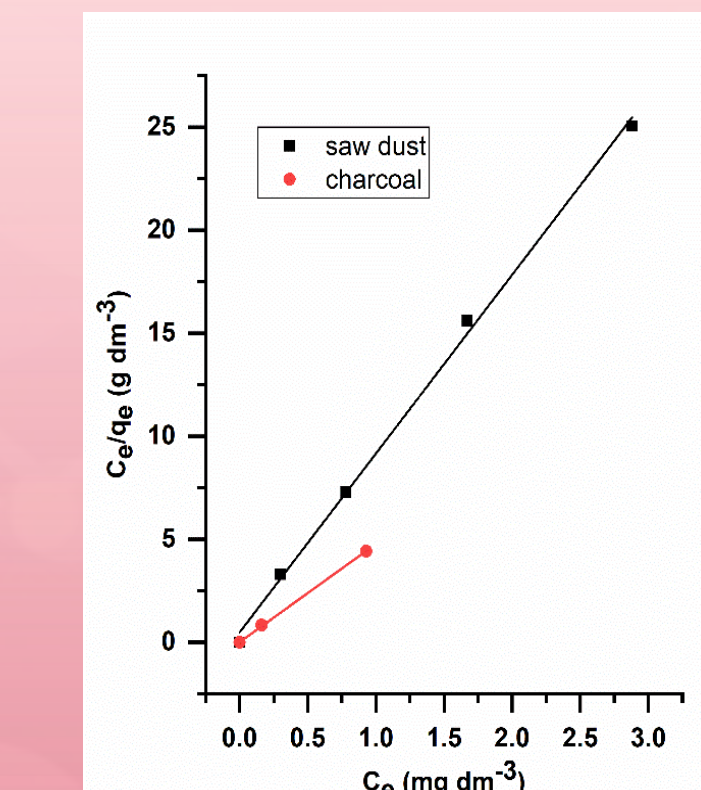


unmodified jack sawdust samples after the adsorption of Cd(II)

- The equilibrium data were studied with Langmuir, Freundlich and Temkin isotherms and Langmuir isotherm best fit with the experimental data.
- The adsorption kinetics were studied with pseudo first order, pseudo second order and intra particle diffusion models and Pb(II) followed pseudo second order model and Cd(II) followed pseudo first order model.
- The thermodynamic parameters were found out that adsorption processes for both ions are non-spontaneous and exothermic.



Langmuir adsorption isotherm for Pb(II) adsorption



Langmuir adsorption isotherm for Cd(II) adsorption

Metal Ion	Adsorbent	Langmuir Isotherm		
		q _m (mg/g)	k (dm ³ /mg)	R ²
Pb(II)	Saw dust	1.55	70.82	0.999
	Charcoal	2.26	7.57	0.961
Cd(II)	Saw dust	0.12	17.08	0.997
	Charcoal	0.21	270.71	0.999

EDAX

	C %	O %	Pb% / Cd %
Unmodified sawdust	52.25	47.75	
Pb adsorbed sawdust	52.17	47.38	0.25
Cd adsorbed sawdust	51.96	47.84	0.20

Conclusion

- Study demonstrates that the jack sawdust can be used as an alternative for heavy metal adsorption.
- Jack saw dust has several desorption cycles and hence it is an eco-friendly adsorbent.
- Pb(II) is showing better adsorption results with jack saw dust than Cd(II).

References

- Owalude, S. O.; Tella, A. C. Removal of Hexavalent Chromium from Aqueous Solutions by Adsorption on Modified Groundnut Hull. Beni-Suef Univ. J. Basic Appl. Sci. 2016, 5 (4), 377–388. <https://doi.org/10.1016/j.bjbas.2016.11.005>.
- (2) Abia, A. A.; Asuquo, E. D. Lead (II) and Nickel (II) Adsorption Kinetics from Aqueous Metal Solutions Using Chemically Modified and Unmodified Agricultural Adsorbents. African J. Biotechnol. 2006, 5 (16), 1475–1482.
- (3) Ali, A.; Saeed, K.; Mabood, F. Removal of Chromium (VI) from Aqueous Medium Using Chemically Modified Banana Peels as Efficient Low-Cost Adsorbent. Alexandria Eng. J. 2016, 55 (3), 2933–2942. <https://doi.org/10.1016/j.aej.2016.05.011>

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