Adsorptive Removal of Chromium (VI) Using Cu/Fe Impregnated Activated Carbon Prepared from Solid Sludge

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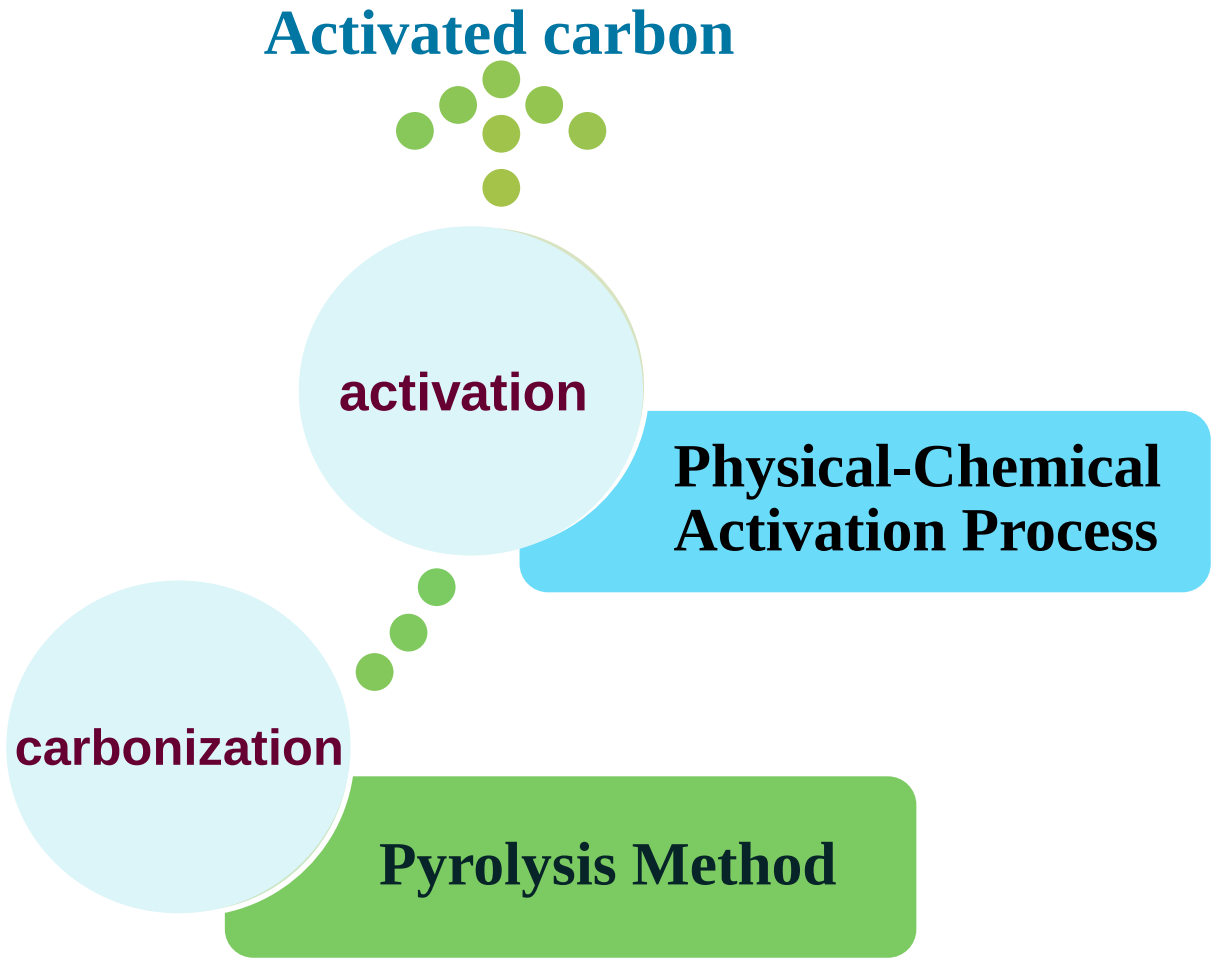
Overview

- Introduction
- Methodology
- Results
- Conclusion
- Future Plan
- Acknowledgment

Introduction

- Wastewater
- Heavy Metal Removal Methods
- Activated Carbon
- Preparation of Activated Carbon
- The of Methods of Recycle Activated Carbon



Introduction

Sludge

COMPONENT

Sludge

Activated Carbon
from Sewage Sludge

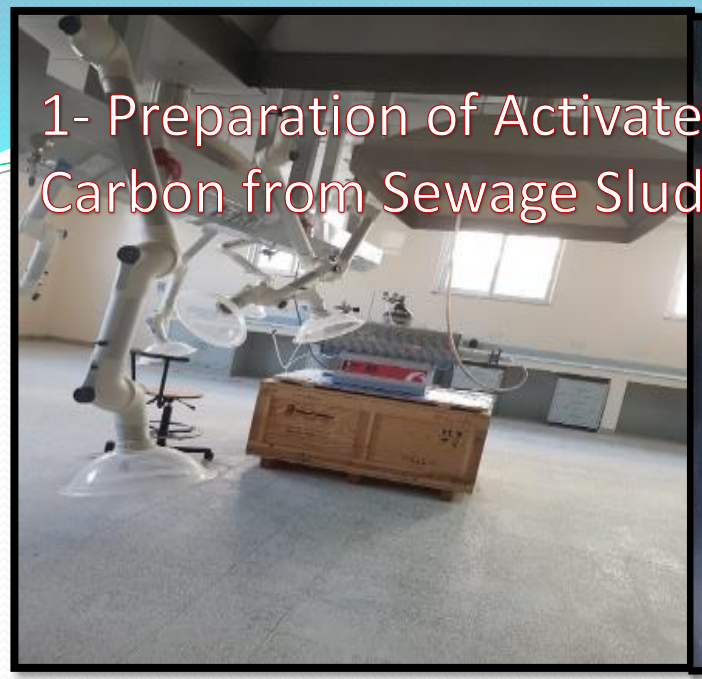
Methodology

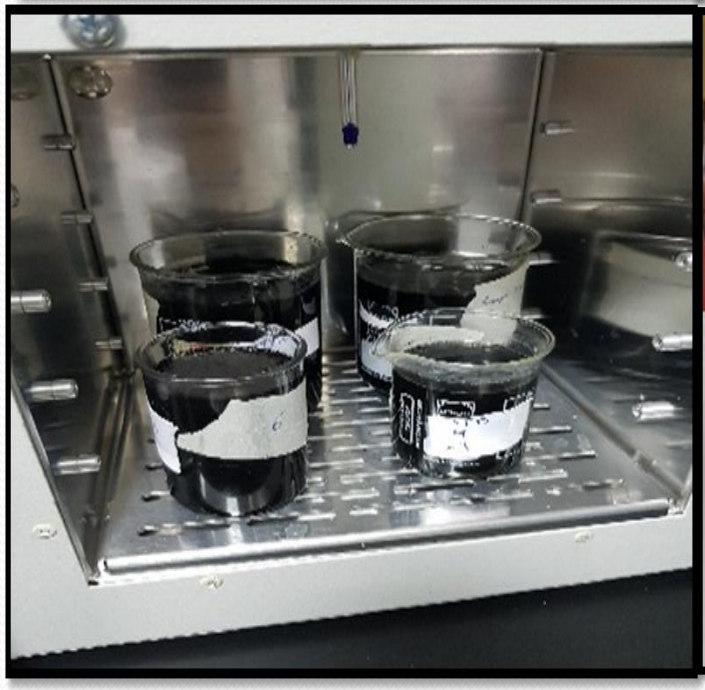
- Preparation of activated carbon (AC) using physiochemical activation.

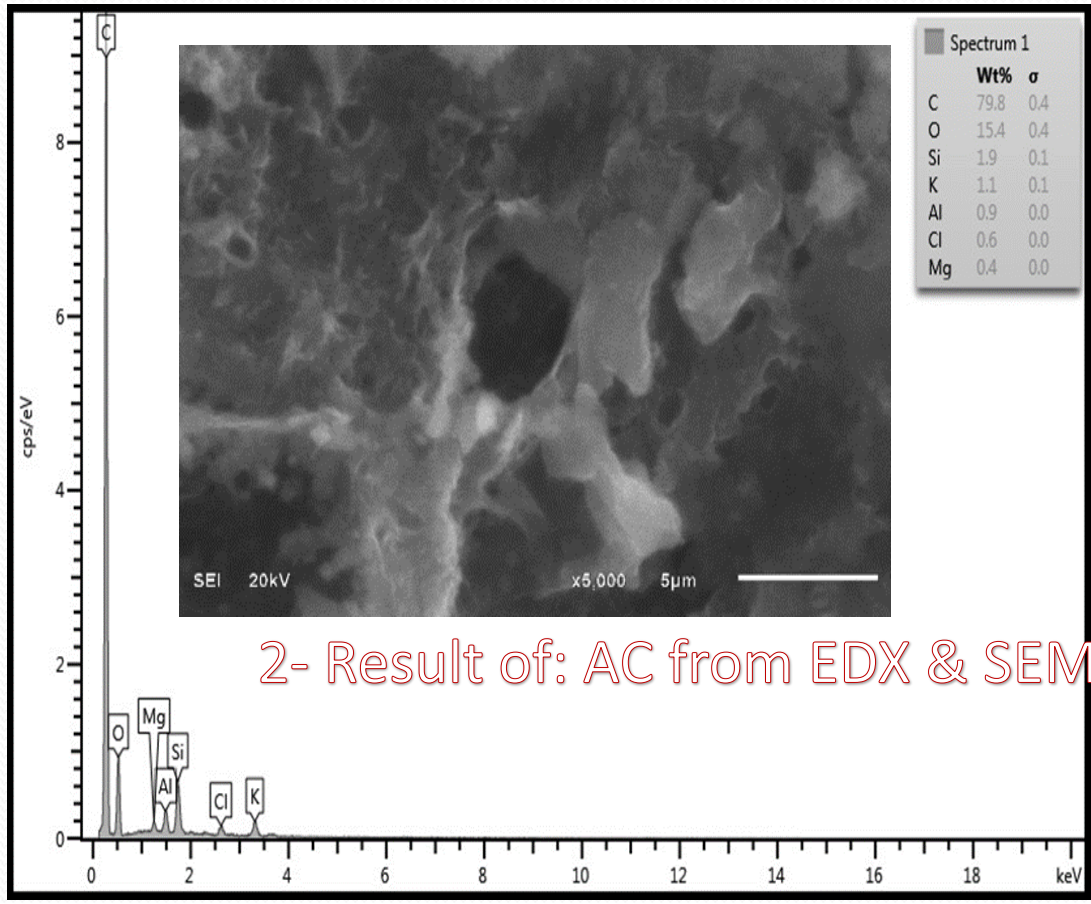
- Removal of Chromium (VI) using the prepared sludge
  - Different Dose
  - Different Concentration
  - Different pH

- Removal of Chromium (VI) Using Sludge S-AC/Fe and S-AC/Cu
- Leaching of Fe and Cu after Adsorption Process

1- Preparation of Activated Carbon from Sewage Sludge

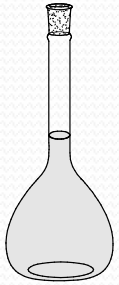




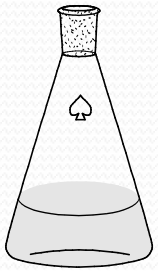


2- Result of: AC from EDX & SEM

Effect of Dosage in AC Adsorbent of Cr (VI)



1000 ppm of $K_2Cr_2O_7$ was prepared then diluted to 10 ppm at pH=3.



Different masses of AC were weighted, then transferred into conical flasks and poured 50 ml of 10 ppm in it.

All conical flasks were put in shaking incubator at conditions: shaking speed= 170 rpm, T= 30˚C, t= 6 hrs.

Standards and samples were measured by AAS.

After six hours the solutions were filtered.

Effect of Dosage in AC adsorbent of Cr (VI) by AAS

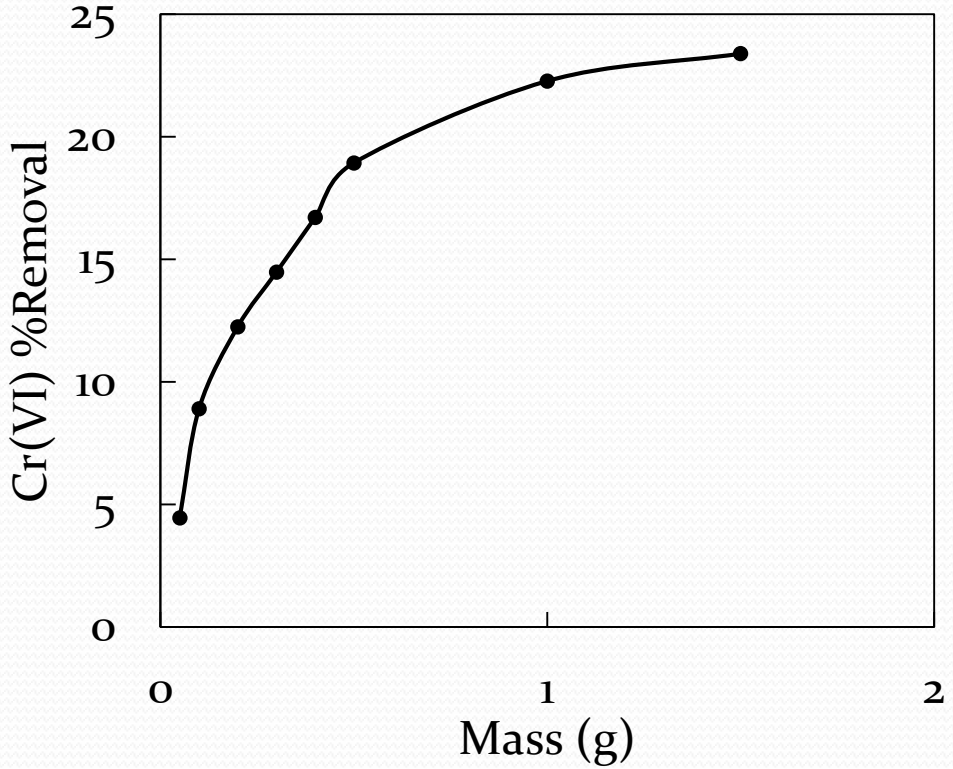


Figure 1: Effect of Dosage on the Percentage of Cr (VI) Removal. At Conditions (shaking speed= 170 rpm, T= 30˚C, pH= 3, C= 10 mg/L and t= 6 hrs).

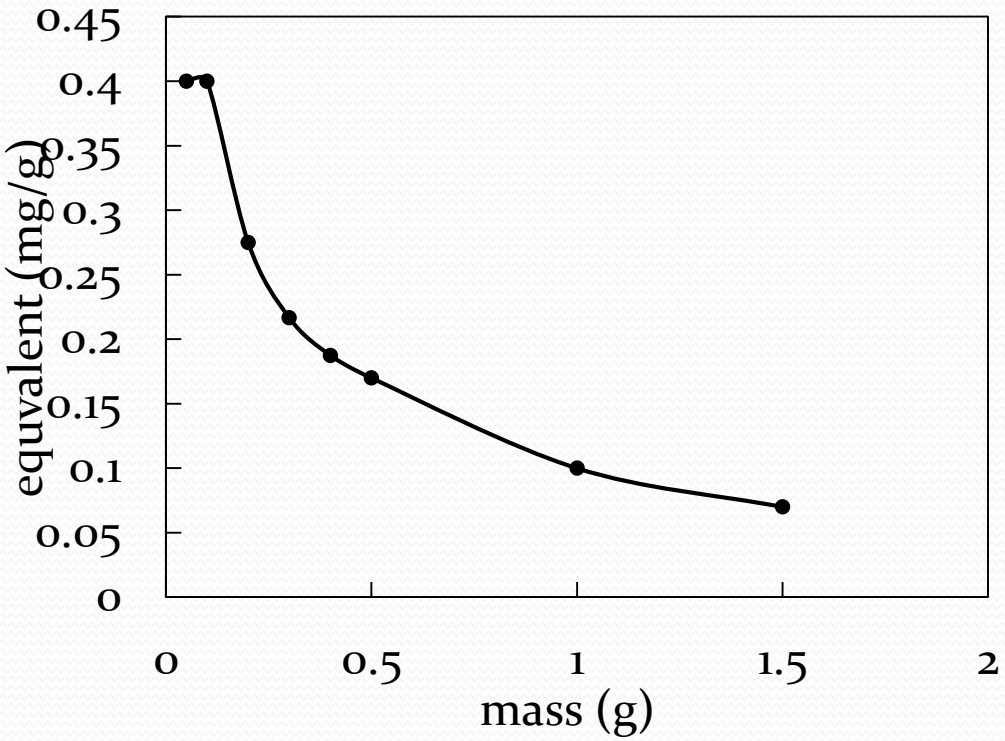


Figure 2: Effect of Dosage on the Equivalent (q_e) of Cr (VI). At Conditions (shaking speed= 170 rpm, T= 30˚C, pH= 3, C= 10 mg/L and t= 6 hrs).

Effect of Concentration in AC adsorbent of Cr (VI) by AAS

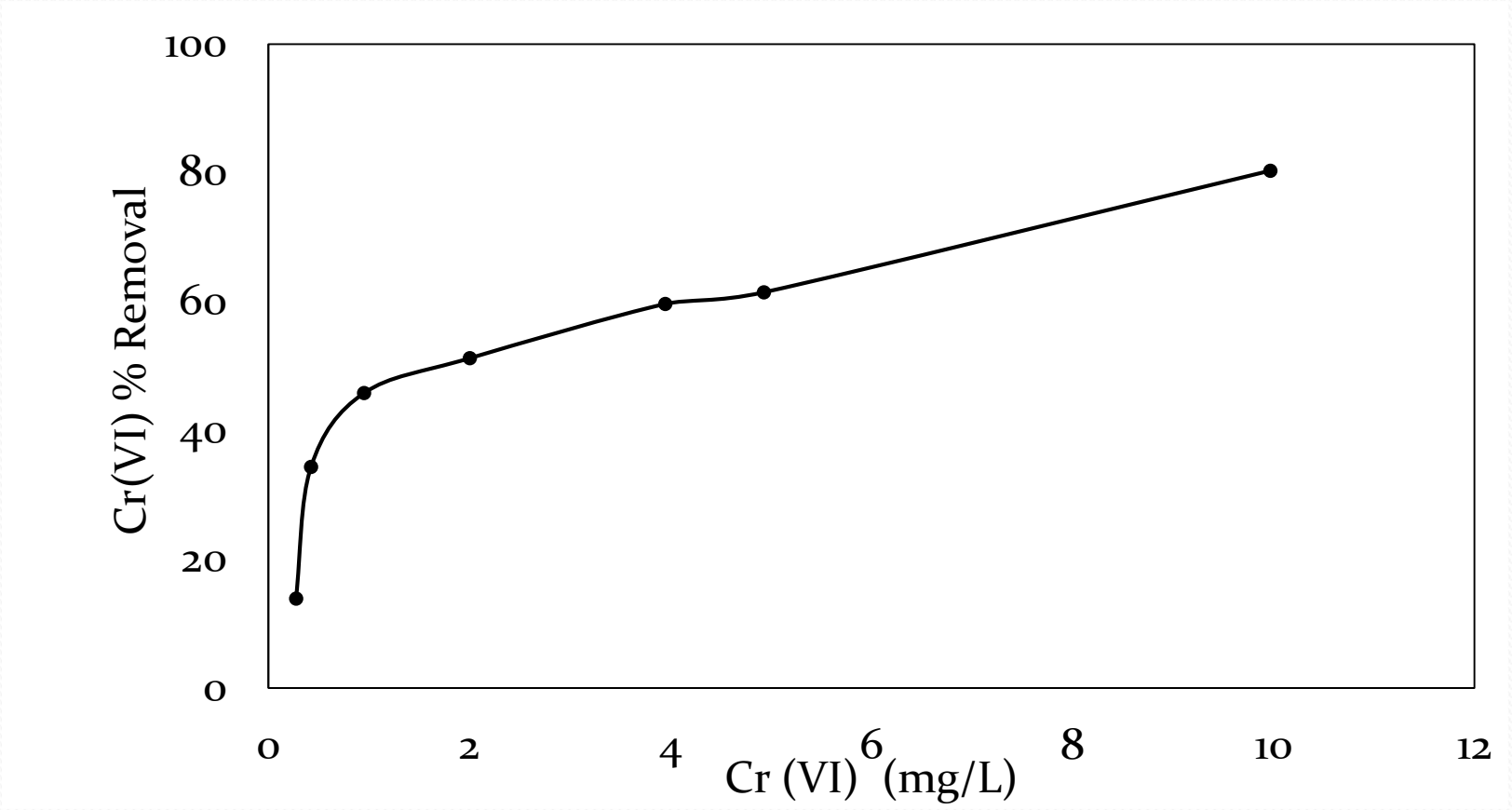
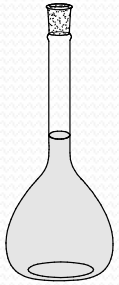
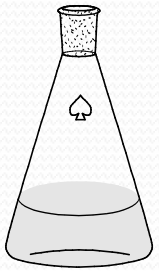


Figure 3 : Figure 4: Effect of Concentration on the Percentage of Removal of Cr (VI). At Conditions (shaking speed= 170 rpm, T= 30˚C, pH= 3, m= 1.5 g and t= 6 hrs).

Effect of pH in AC Adsorbent of Cr (VI)





1000 ppm of $K_2Cr_2O_7$ was prepared then diluted to 10 ppm.

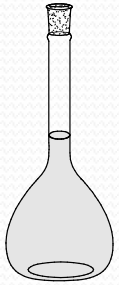
Condition	value
Dosage	0.5 g
Conc.	10 ppm
pH	2, 3, 4, 5, 6 &7

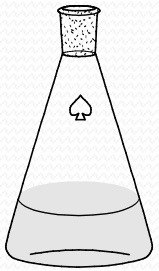
All conical flasks were put in shaking water bath at conditions: shaking speed= 170 rpm, T= 30˚C, t= 6 hrs.

Standards and samples were measured by AAS.

After six hours the solutions were filtered.

Effect of pH in AC Adsorbent of Cr (VI)





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Standards and samples were measured by AAS.

After six hours the solutions were filtered.

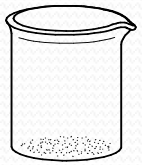
Table 1: Comparing Removal % with Different Types of AC.

Raw material of AC	equivalent (mg/g)	C_0 (mg/L)	pH	Removal %	References
Solid Sludge	0.79	10	3	78.89	This project
Shaddock Peels	9.95	50	2	99.2	(Tao et al., 2019)
Longan Seed	35.02	100	3	62.5	(Yang et al., 2014)

Synthesis of AC/Fe (1st Method) (Danmaliki & Saleh, 2016)

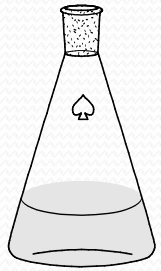
7 g AC + 150 ml DDW
+ 100 ml ethanol
(sonication for 5 hrs.)

20 ml ethylene
glycol
(shaking for 2 hrs.)

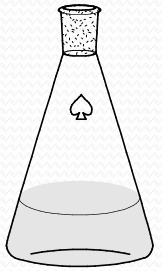


5.06 g ferric nitrate
+ 12.5 ml DDW

dropwise



Controlled pH
(8-9)



Stirring & heating
for 6 hrs. at 80˚C

Filtered + washed
and dried at 110˚C
overnight

Synthesis of AC/Cu (Jegadeesan et al., 2015).

4 g AC + 50 ml of CuCl2 (0.5 M)
(sonication for 6 hours)

Filtered & dried at 90˚C for 48 hrs.

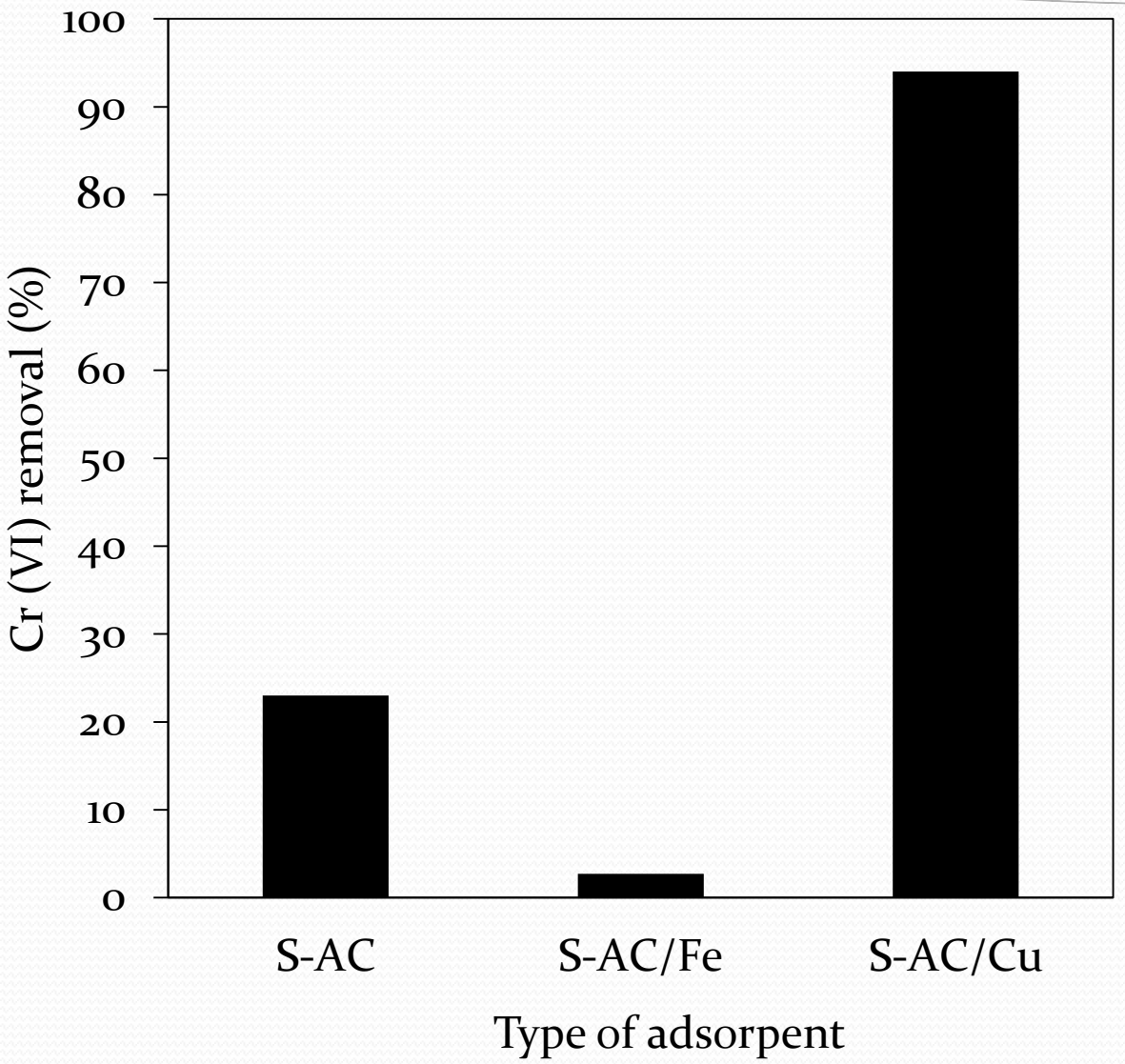


Figure 5: Percentage removal of Cr (VI) using the modified activated carbons

Table 2: Comparing Cr (VI) removal % with different types of Activated carbon.

Raw material of activated carbon	Heavy metal	Catalyst	C_0 (mg/L)	pH	Removal %	References
Solid Sludge	Cr (VI)	Cu (II)	10	3	94.57	This project
Leucaena leucocephala	Cr (VI)	-	100	4	54	(Lataye & Kurwadkar, 2016)
Cassava Sludge	Cr (VI)	-	10	4	60	(Yang et al., 2018)

Conclusion and Recommendations

- A direct relation between AC dosage and percentage of removal of chromium.
- The % removal was high at pH 3. The removal of Cr is always greater at high dosage of AC and high concentration of Cr.

- The optimum condition for removing Cr from wastewater ; shaking speed= 170 rpm, T= 30˚C, pH= 3, m= 0.5 g and t= 6 hrs.

- To increase the metal removal efficiency of sludge AC adsorbent, Fe (III) and Cu (II) were added. Cu (II) metal was added at the same conditions, chromium (VI) removal increased to 94.57 %. Thus, it was suitable for sludge AC to enhance the removal of Chromium (VI). Therefore, sludge AC impregnated with Cu(II) is an efficient adsorbent for chromium (VI) removal.

Future Plan

- Study the removal of other metals from wastewater by AC adsorbent.
- Try to synthesis large quantities of sludge AC without and with different metal impregnation.
- Use another type of AC from another sources.
- Making pellets out of the prepared AC

Credits and Acknowledgements

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