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As^{V} and As^{III} removal from water with different iron oxyhydroxides nanosorbents

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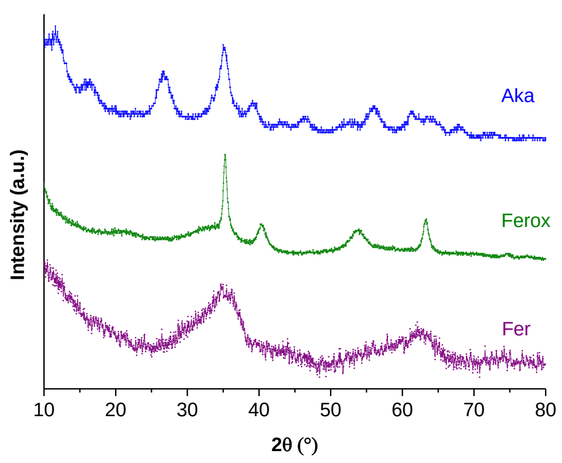
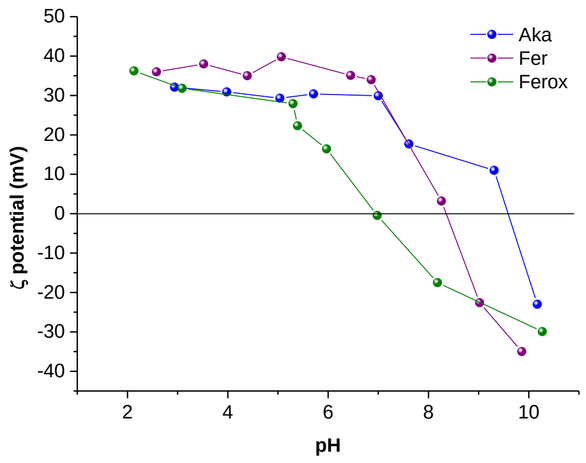
INTRODUCTION & AIM

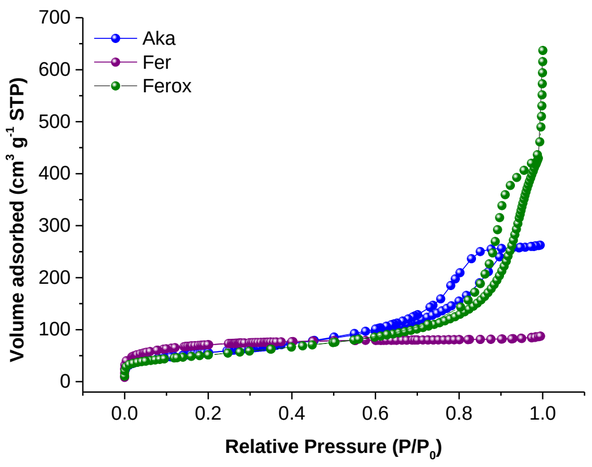
Arsenic pollution in surface water and groundwater is a worldwide problem originated by dissolution of arsenic from soil, mainly due to anthropogenic activities. Due to the possibility to form inner-sphere complexes, the high surface-to-volume ratio and, therefore, the high density of active sites (-OH groups), nanopowders of iron oxides and oxyhydroxides show a high affinity for arsenate and arsenite species in wide pH ranges and pollutant concentrations, which is particularly promising also due to their low production costs and low toxicity.

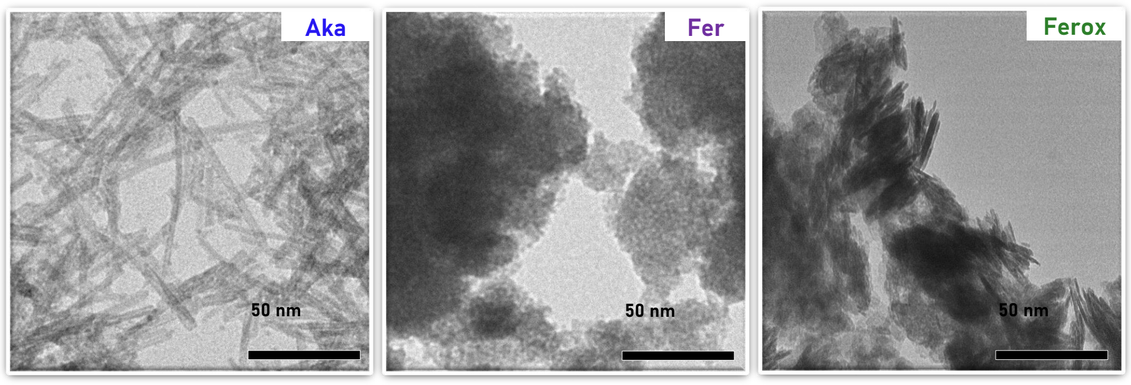
METHOD

Sorbent	Solvent	Precursor	Precipitating agent	pH adjusting	Thermal treatments
Aka	Water	$FeCl_3$ $6H_2O$	NaOH solution (pH = 10)	pH = 2 with HCl 37%	98 °C for 4 h
Fer	Water	$Fe(NO_3)_3$ $4H_2O$	KOH solution (pH = 8)	-	-
Ferox	Water	$FeCl_2$ $4H_2O$	NaOH solution (pH = 8)	pH = 2 with H_2O_2 30%	-



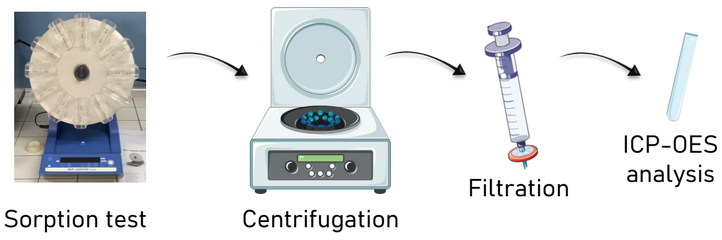


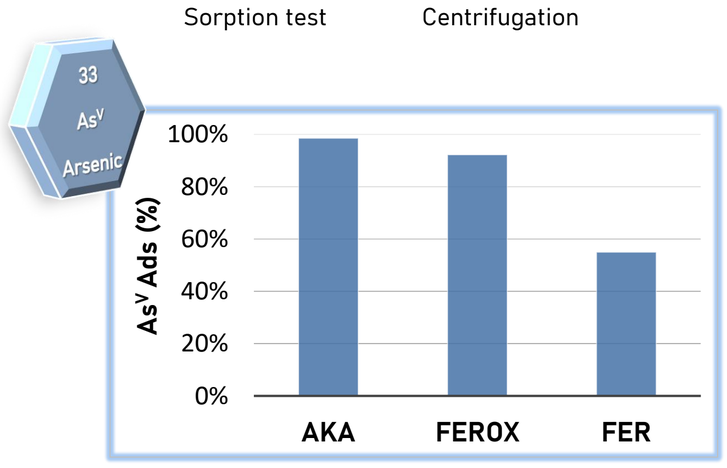




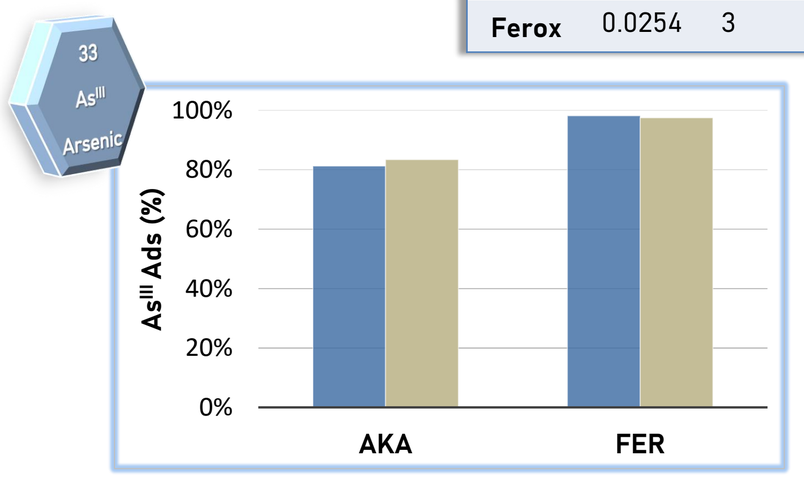
RESULTS & DISCUSSION

Sorbent	pH	C_0 As^{V} (mg L^{-1})	C_0 As^{III} (mg L^{-1})	T (min)
Aka	2, **3**, 4, 6, **8**	100	100	960
Fer	2, **3**, 4, 6, **8**	100	100	960
Ferox	2, **3**, 4, 6, **8**	100	100	960





Sorbent	m (mg)	pH_0	C_0 As^{V} (mg L^{-1})	Adsorption capacity (%)	q_e (mg_{inq}/g_{sorb})
Aka	0.0258	3	100	99	41.7
Fer	0.0256	3	100	55	20.6
Ferox	0.0254	3	100	92	39.1



Sorbent	m (mg)	pH_0	C_0 As^{III} (mg L^{-1})	Adsorption capacity (%)	q_e (mg_{inq}/g_{sorb})
Aka	0.0254	3	100	81	33.2
Aka	0.0254	8	100	83	33.8
Fer	0.0254	3	100	98	39.2
Fer	0.0251	8	100	97	38.3

CONCLUSION

Akaganeite is the most promising sorbent in the whole pH range for As(V), while ferrihydrite is the best sorbent for As(III). Results on feroxyhyte proved its suitability as a sorbent for As(V) as a promising alternative to akageneite, due to its straightforward and quick synthesis process.

FUTURE WORK / REFERENCES

HRTEM is in progress for feroxyhyte, together with further removal tests for both feroxyhyte and ferrihydrite to investigate the effect of the initial As concentration, contact time, ionic strength, and the presence of competitors.

1) M. Sanna Angotzi, V. Mameli, A. Fantasia, C. Cara, F. Secci, S. Enzo, M. Gerina, C. Cannas. As [(III, V)] Uptake from Nanostructured Iron Oxides and Oxyhydroxides: The Complex Interplay between Sorbent Surface Chemistry and Arsenic Equilibria. Nanomaterials 2022, 12, 326.*

2) Cornell, R.M.; Schwertmann, U. The Iron Oxides; Wiley: New York, NY, USA, 2003; Volume 39, ISBN 9783527302741.