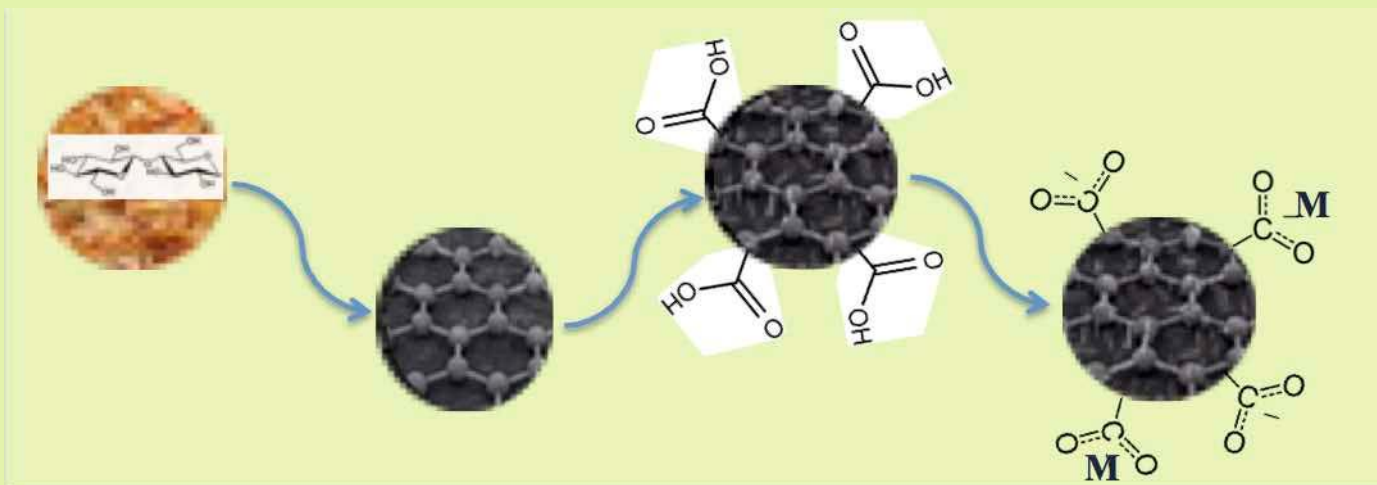




University of Cyprus
Department of Chemistry

**Thorium removal from acidic aqueous solutions
by activated biochar derived from cactus fibres**



Loukia Hadjittofi & Ioannis Pashalidis

Outline

Background Information

Materials and Methods

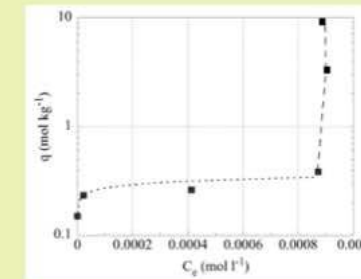
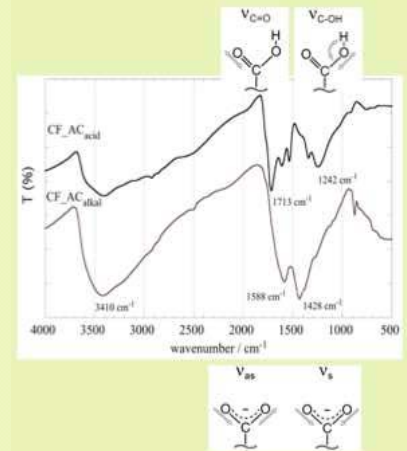
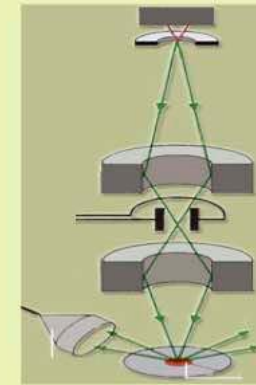
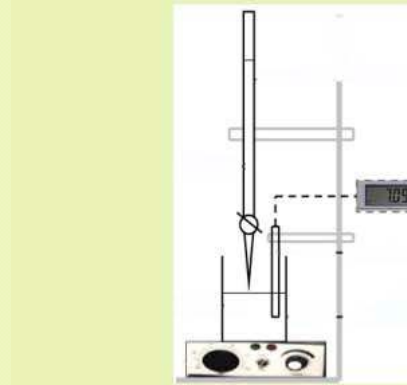
Preparation & characterization

Sorption experiments

Data Presentation/Discussion

- FTIR spectra
- pH titration curve
- Sorption data
- Comparison of sorption data

Outlook



Materials and Methods

Activated Biochar Fibres

Cladodes (*Opuntia Ficus-indica*) →

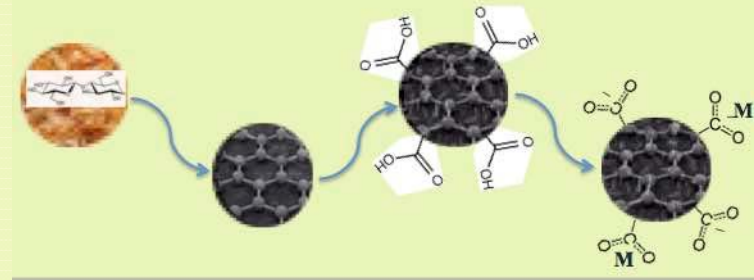
Cactus Fibres



Carbonisation and Activation of the Fibres

- 650 °C under O₂-restricted conditions

- boiling in 12 M HNO₃ for 3 h



Characterisation

- pH titration
- FTIR spectroscopy
- SEM analysis

Sorption Experiments

Batch experiment

30 ml test solution

0.01 g biochar

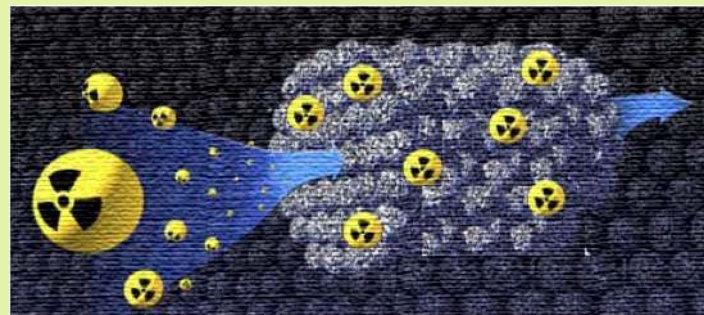
$5 \times 10^{-6} \text{ M} < [\text{Th(IV)}] < 5 \times 10^{-3} \text{ M}$



Removal of Actinides from Aqueous Solutions

Effective collection of actinides from water systems is advantageous for

- **recovery and recycling of valuable resources,**
- **environmental remediation,**
- **chemical separations, and**
- **in situ monitoring**

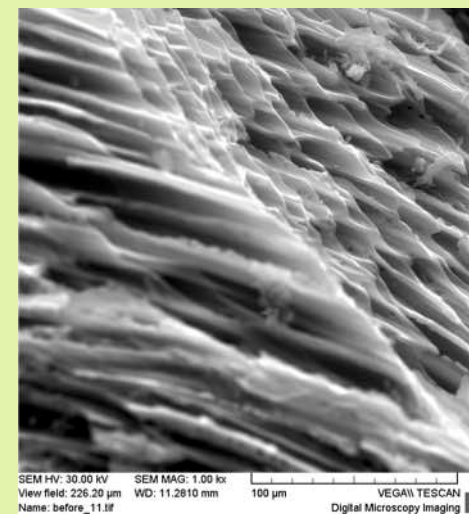


Addleman et al. (2012) Environ Sci Technol 46, 11251

Biochar fibres:

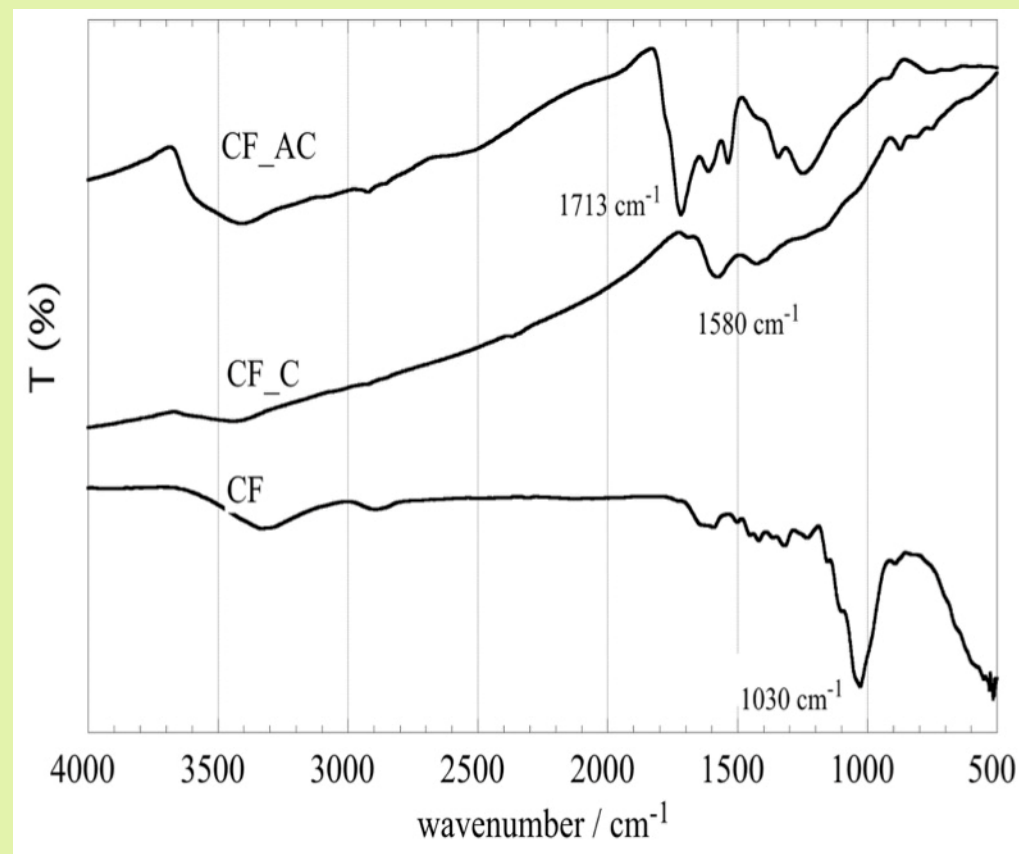
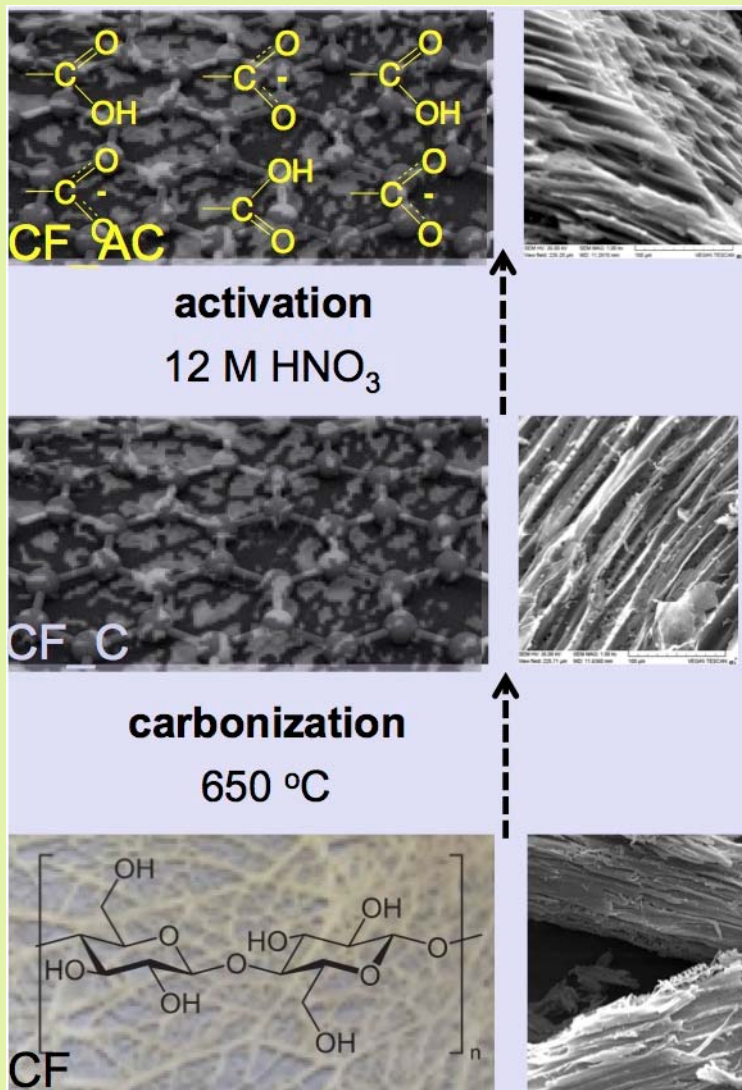
Sorbent Characteristics Affecting $M(z)$ Sorption:

- Compatibility (*Mechanical, Thermal, Chemical*)
- Regenerability / Reusability (*Cyclic Adsorption Applications*)
- Cost
- Kinetics (*Porosity - Intraparticle Mass Transfer*)
- Adsorption Capacity (*Texture - Surface Coverage*)
- Selectivity (*Chemical Surface Modification*)



Interaction and Sorption of Metal-ions by Activated Biochar Fibres

Preparation and characterization of the biosorbent

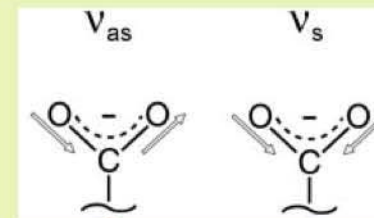
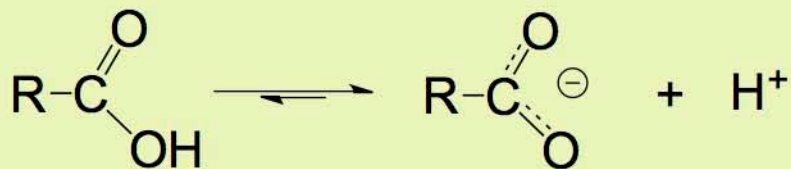
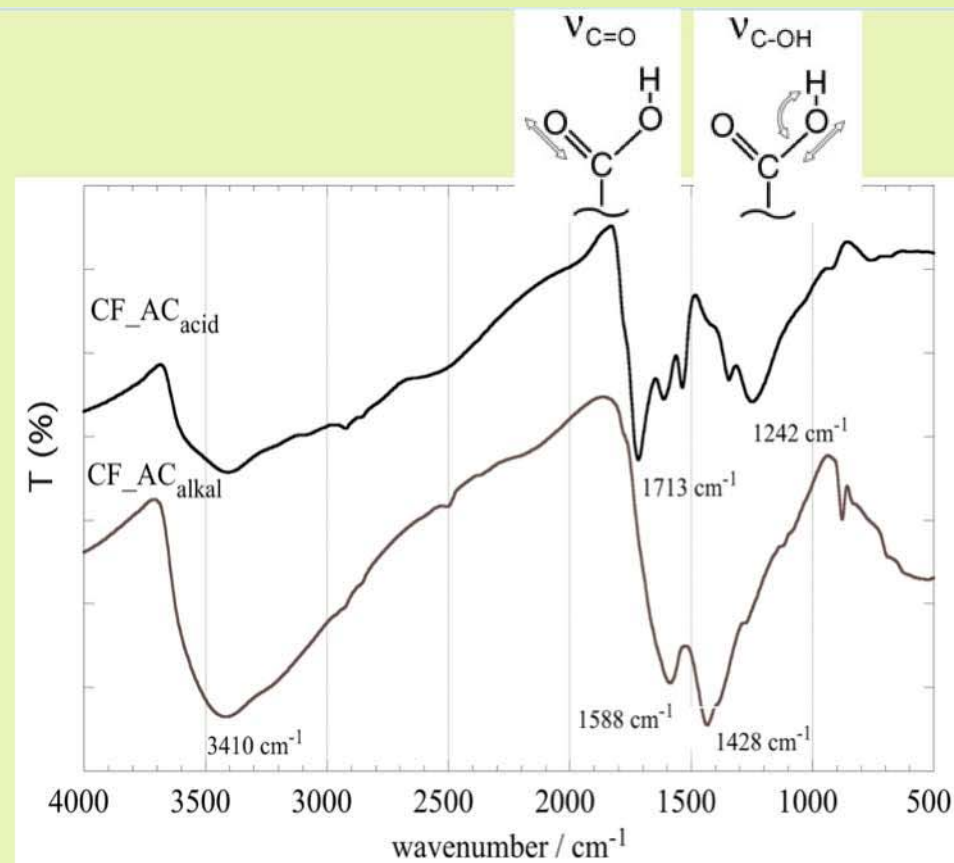
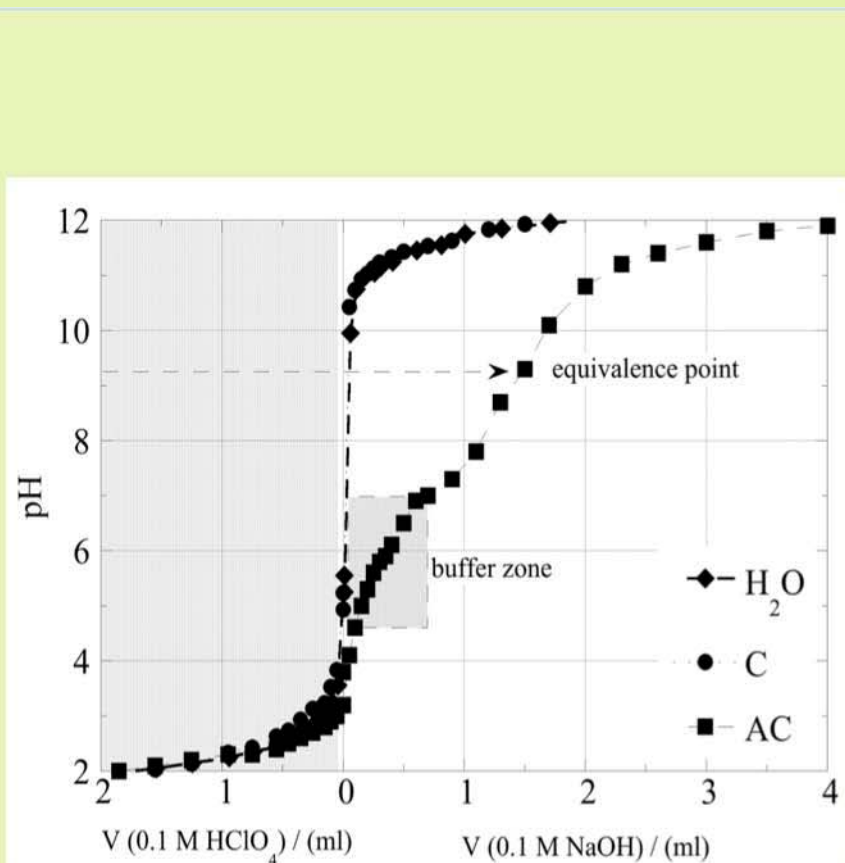


Bioresource Technol 159 (2014) 460

J Radioanal Nucl Chem 304 (2015) 897

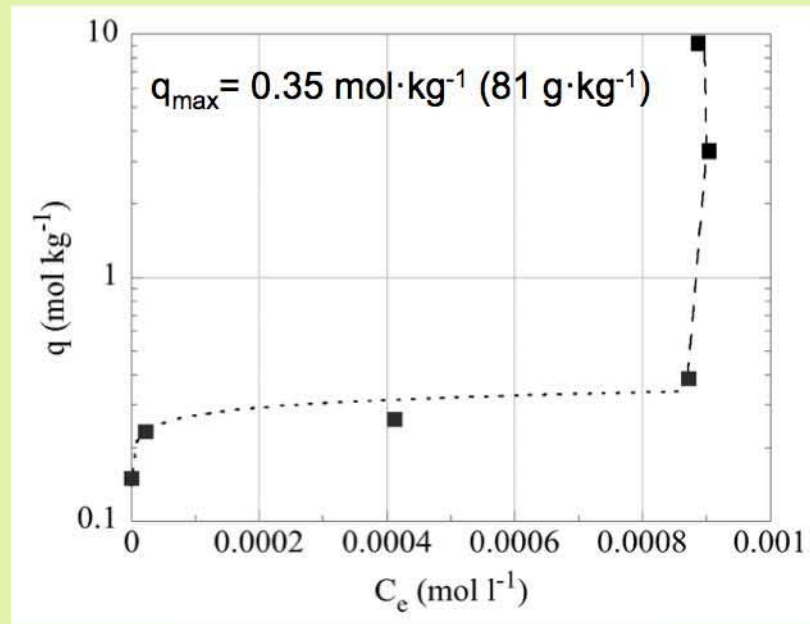
Interaction and Sorption of Metal-ions by Activated Biochar Fibres

Preparation and characterization of the biomass sorbent

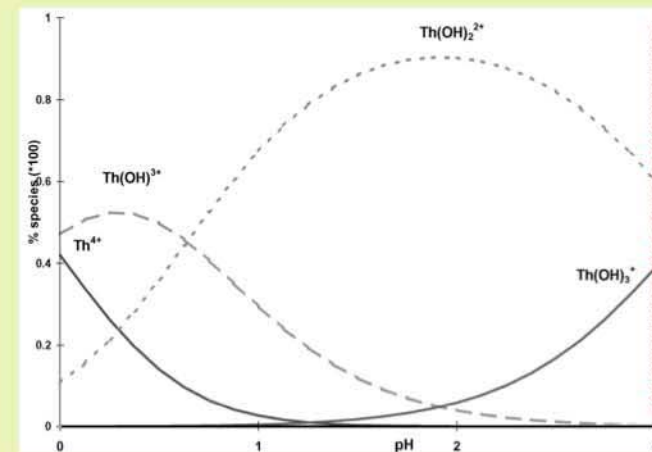
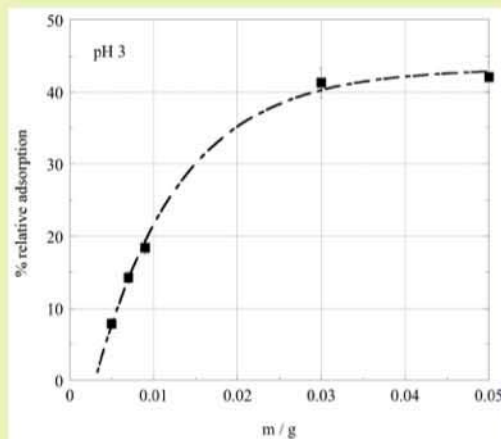
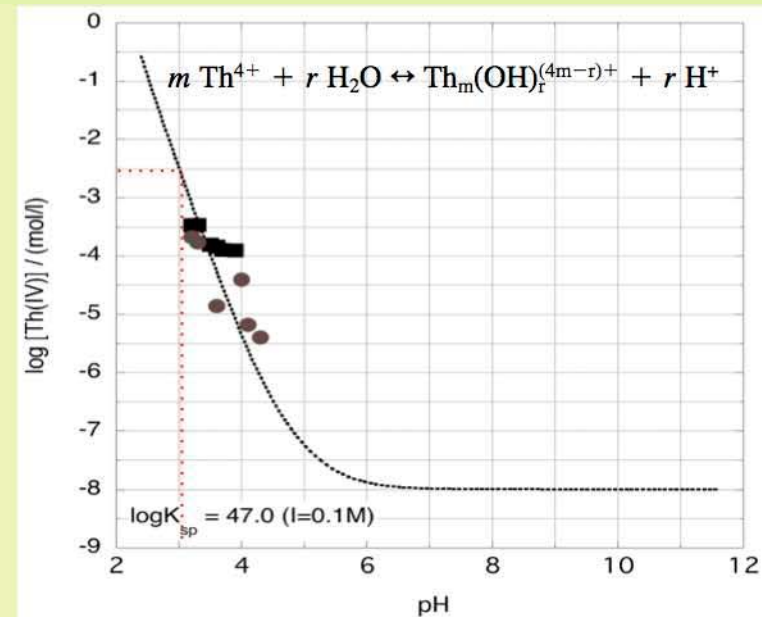


Interaction and Sorption of Th(IV)-ions by Activated Biochar Fibres

Sorption experiments at pH 3



Solubility curve of $\text{Th}(\text{OH})_4$

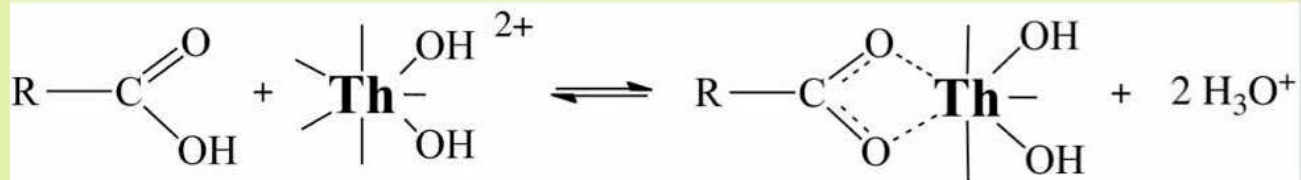
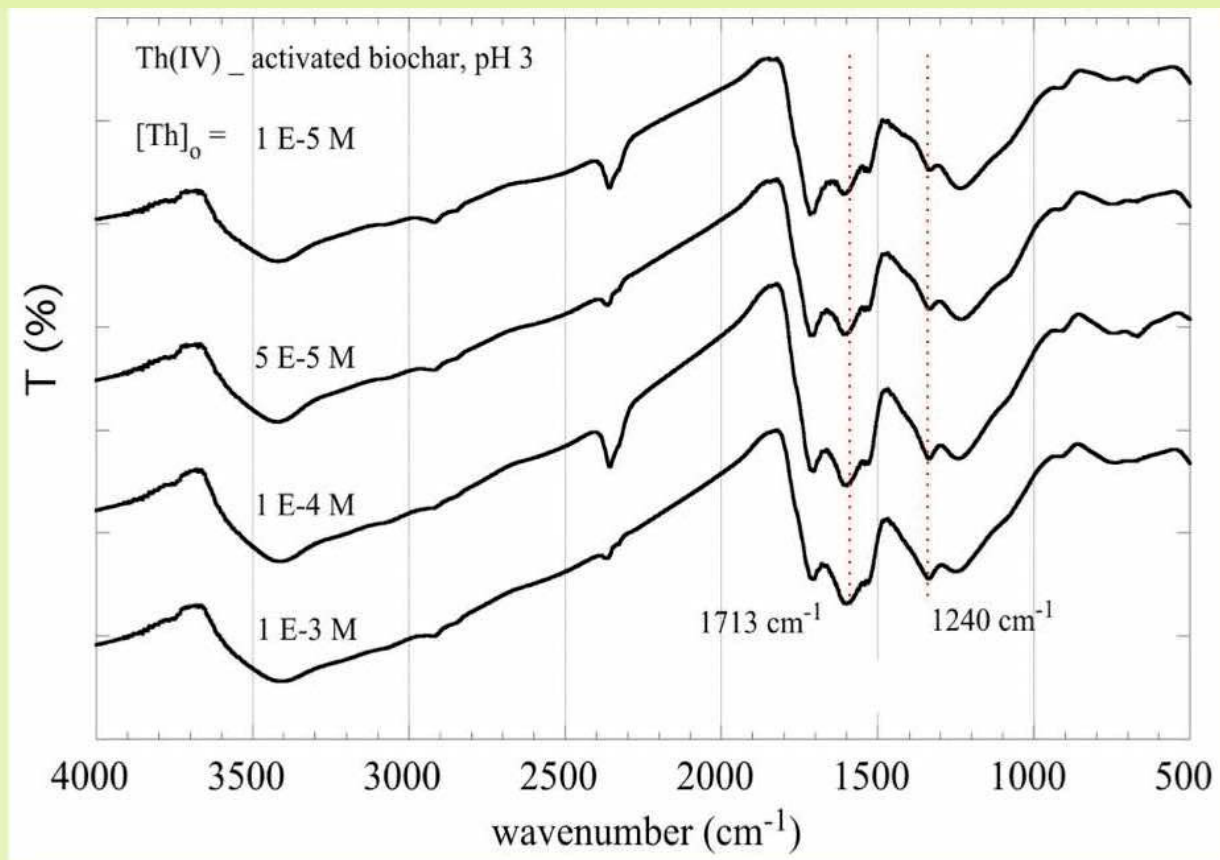


hydrolysis → restricted adsorption

C Moulin et al (2001) *Anal Chim Acta* 441, 26

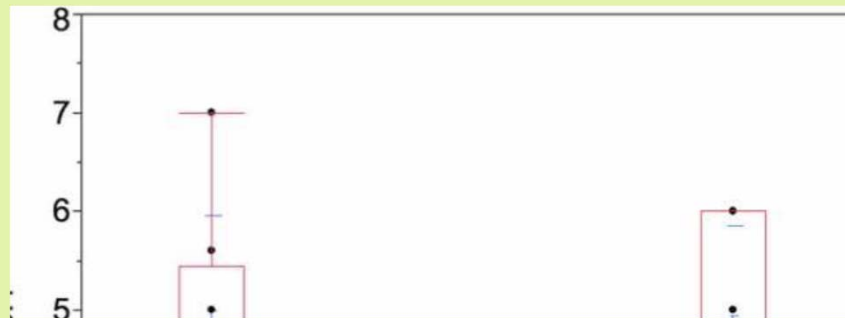
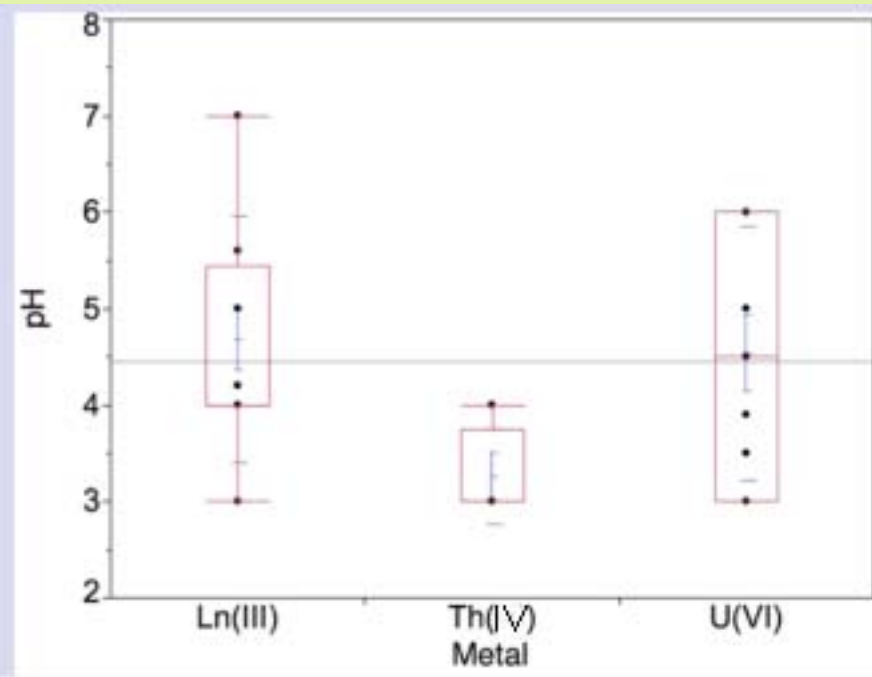
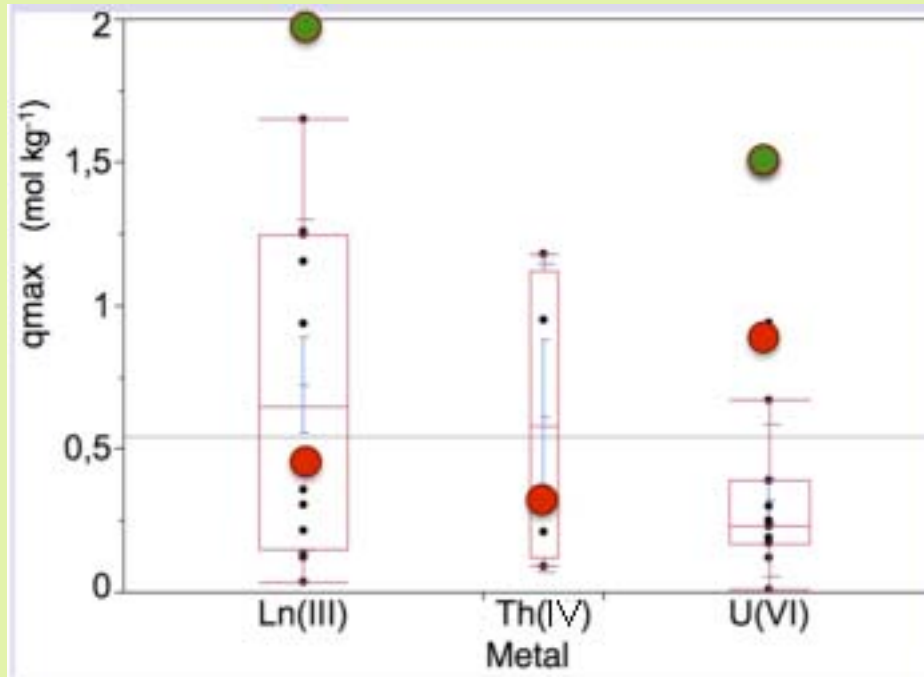
Interaction and Sorption of Th(IV)-ions by Activated Biochar Fibres

FTIR spectra → *inner-sphere complexes*



Interaction and Sorption of M(z) by Activated Biochar Fibres

Comparison of adsorption data



Gad and Awwad (2007) *Separ Sci Technol* 42, 3657

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Zhang et al. (2013) *J Radioanal Nucl Chem* 295, 1201

Acknowledgements

Thank you for your attention