

Background: Heavy metals are persistent, toxic pollutants that threaten environmental and human health, often occurring at ppb levels that require pre-concentration for reliable analysis. Lignosulfonate, a natural polymeric by-product of the pulp, paper, and wood industries, offers promising chemical and mechanical properties for sorbent development. This study explores lignosulfonate-based nanocomposites for the pre-concentration of heavy metal ions from contaminated water and soils.

Aim: To synthesise lignosulfonate-based nanocomposites that can be used in effective removal of heavy metals (Pb, As, Cd etc.) and other contaminants from water and soils.

Synthesis of Lignosulfonate-based nanocomposites:

To water solution of lignosulfonate was added NaOH and APTES, mixed for 1h, afterwards added formalin and additionally mixed for 2h at 90°C, with added HCl at the end.

Overnight dried at 65°C, grinded, dried, decanted and dried 2h at 120°C at finale.

Silica-based composites:

To Aerosil solution in water was added AEAPTES, mixed for 1h at 50°C, afterwards water solution of lignosulfonate, mixed for 1h at 90°C.

Dried overnight at 80°C, grinded, dried, decanted and dried 2h at 120°C at finale.



Figure 1. Exampmple of samples

Conclusions & Future work: The results confirm the successful incorporation of lignosulfonate into a structurally stable silica-based composite, with functional groups potentially retaining their metal-binding ability. Further characterization of non-silica samples and evaluation of adsorption capacity and selectivity will establish its potential as an environmentally friendly sorbent for heavy-metal preconcentration from contaminated water and soil.

Characteristics and properties of some samples:

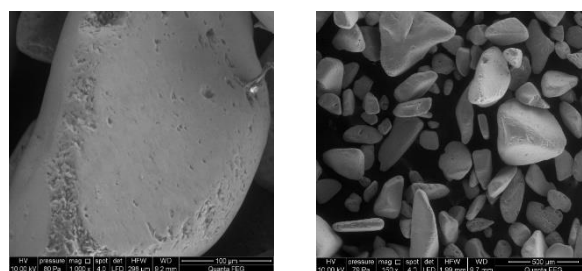


Figure 2. SEM electron micrograph with a 100 µm scale bar (left) and a 500 µm scale bar (right)

SEM showing an irregularly shaped particles (0.05 – 1 mm). No chipping and no powder fraction – signs of effective post-processing. The lignosulfonate is uniformly distributed on the silica particles; there are no distinct clusters of organic matter.

Elemental composition of the samples showed the Percentage of immobilized lignosulfonate in them 13 – 14 %.

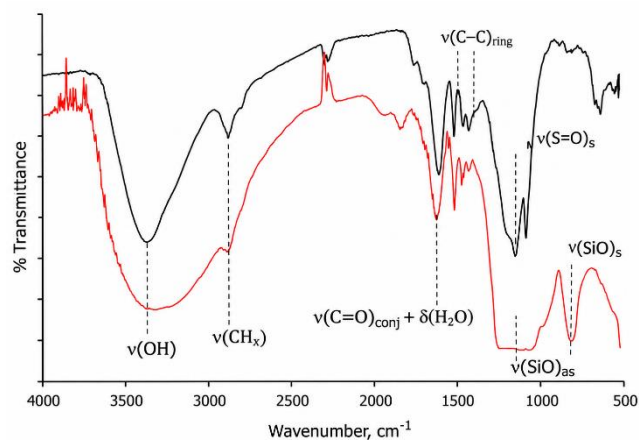


Figure 3. IR-spectrum of lignosulfonate and the nanocomposite

The IR-spectrum confirms the deposition of lignosulfonate in a silica structure for lignosulfonate-silica-based nanocomposites, which provides evidence for the immobilization of the lignosulfonate.

References

- Ge Y, Song Q, Li Z. A Mannich base biosorbent derived from alkaline lignin for lead removal from aqueous solution. *J Ind Eng Chem*.
- Budnyak, T. M., Aminzadeh, S., Pylypchuk, I., Riazanova, A. V., Tertykh, V. A., Lindström, M. E., & Sevastyanova, O. (2018). Peculiarities of synthesis and properties of lignin-silica nanocomposites prepared by sol-gel method. *Nanomaterials*.