



Removal of nickel and cadmium from aqueous solutions by sewage sludge ash: study in single and binary systems

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Outlines

I. Introduction

II. Material and methods

III. Results and discussion

IV. Conclusion

Overview of Heavy Metals

A metal having a density greater than 5 g/cm^3

Some notion of toxicity



Essential Elements (low [])

(Micronutrients) = Fe, Zn, Ni, Cu, Mn,....

- Essential for cellular functions



Toxic from a certain threshold

Non Essential Elements

= Cd, Pb, Hg, Sn,...

- Have not known biological function

- Toxic at lower[] than essential elements

Treatment process of heavy metals wastewater

In the case of wastewater, several treatments process :

- Membrane processes
- ion exchange
- précipitation and co-précipitation
- adsorption (sludge ash, phosphate rock, activated carbon, iron oxide,...)

Adsorption ?

Adsorption is a physicochemical phenomenon resulting in a change in concentration at the interface of two immiscible phases, namely solid / liquid.

Sorption is interesting:

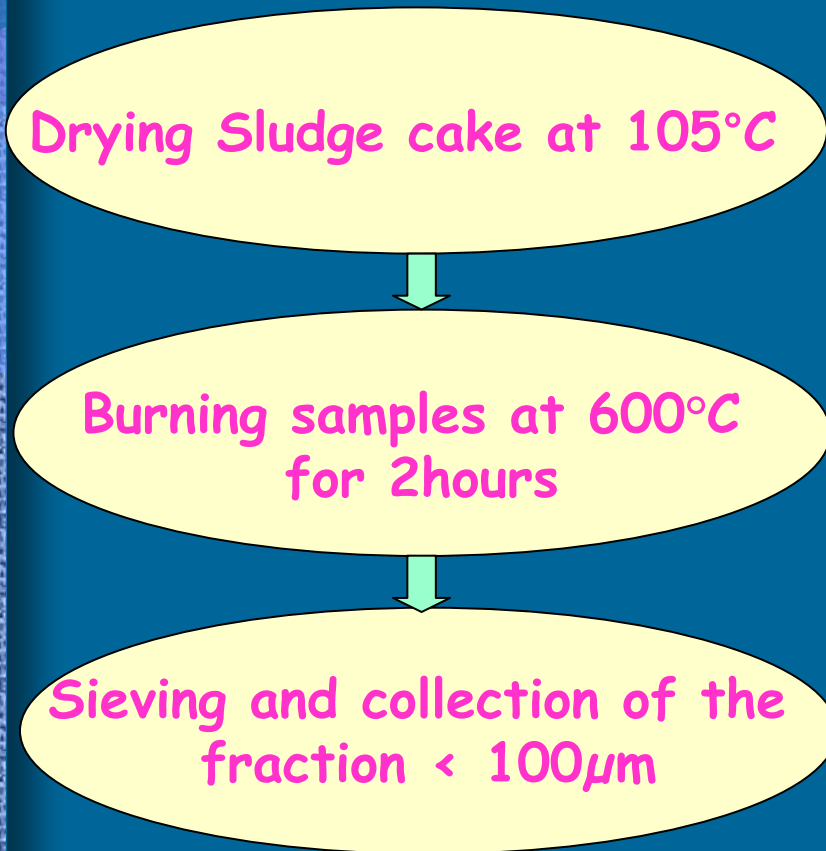
- Fixed systems
- simple technique
- Feasible regeneration
- Stable waste

Sorbent

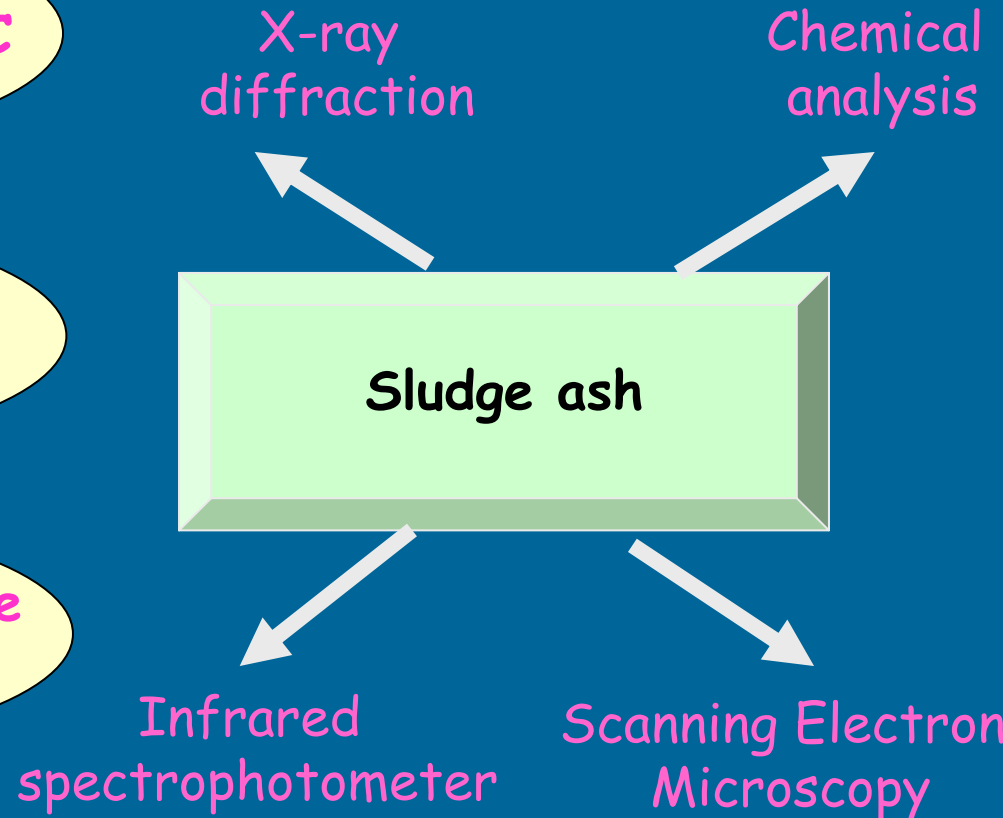
- Porous materials
- A high specific surface area
- Regenerable

Material and methods

Preparation



Characterization



Material and methods

The methodology of batch study:

- ✓ Contact time necessary to get equilibrium
- ✓ The influence of pH on the sorption of Cd and Ni
- ✓ Effect of temperature on the sorption
- ✓ Establishment of sorption isotherms
- ✓ Effect of competition between different pollutants

Results and discussion

Characterizations of the sorbent

Chemical composition

Rich in silica (20%) and in alumina (10%) (sorption function) and in Ca oxide (20%) and K (4-23%)

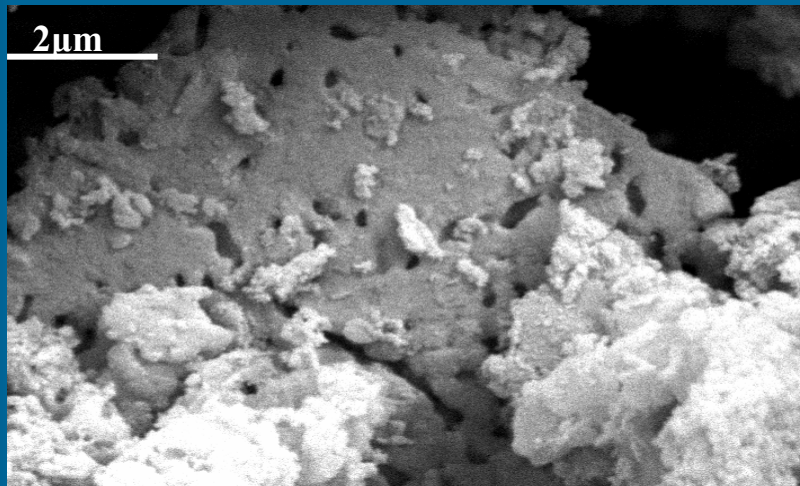


Figure. Scanning electron micrograph of sewage sludge ash.

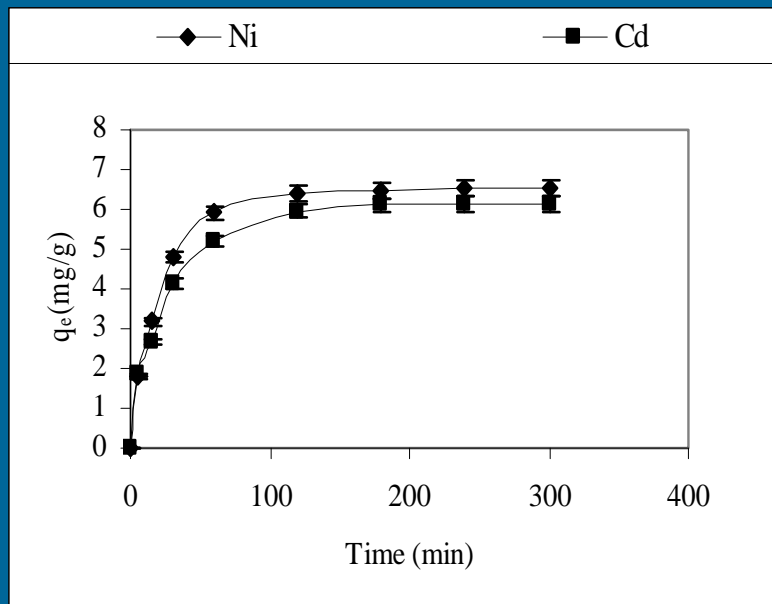
SS: 51 m²/g



Porous structure

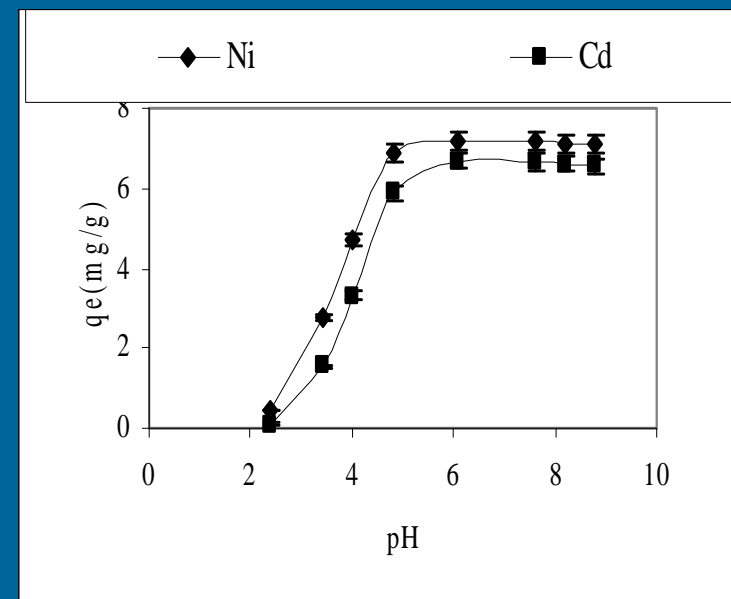
Results and discussion

Kinetic study



The optimum time for both Cd and Ni removal was 120 min

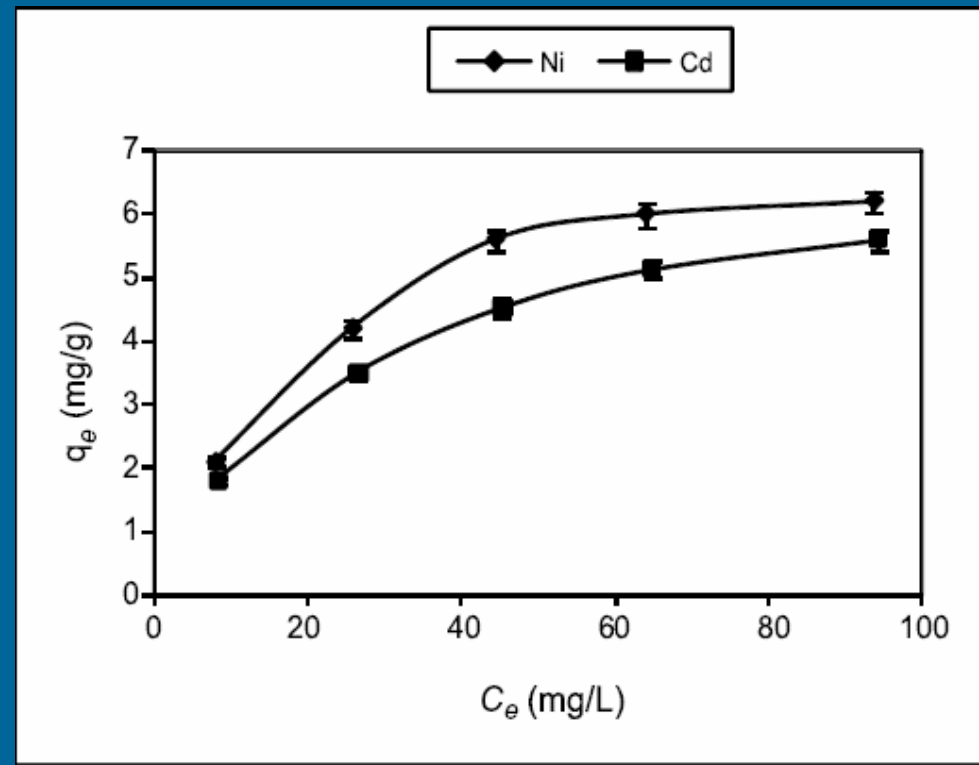
pH effect



The maximum sorption of Ni and Cd was found to occur at pH 6

Results and discussion

Sorption isotherms



Ni(II) and Cd(II) sorption isotherm on sewage sludge ash at 20°C

Results and discussion

Langmuir and Freundlich constant for Ni(II) and Cd(II) sorption in single system

| | Langmuir model | | | Freundlich model | | |
|-------------------|----------------------|-------------|-------|------------------|------|-------|
| | q_{\max} (mg/g) | b (L/mg) | R^2 | K_f | 1/n | R^2 |
| Ni (single-metal) | 7.65 | 0.051 | 0.99 | 0.87 | 0.45 | 0.95 |
| Cd (single-metal) | 7.1 | 0.039 | 0.98 | 0.69 | 0.47 | 0.93 |

Conclusion

The results obtained in this study clearly demonstrated the potential use of sewage sludge ash for the removal of Ni(II) and Cd(II) from aqueous solutions.

- The kinetic studies indicated that equilibrium was reached in 2 h
- The optimum pH corresponding to the maximum adsorption was found to be 6
- The enhanced sorption at higher temperature indicates endothermic sorption process
- The affinity of the sewage sludge ash for Ni(II) ions was greater than that for Cd(II), from both single-component and the binary solutions

*Thank you for
your
attention*