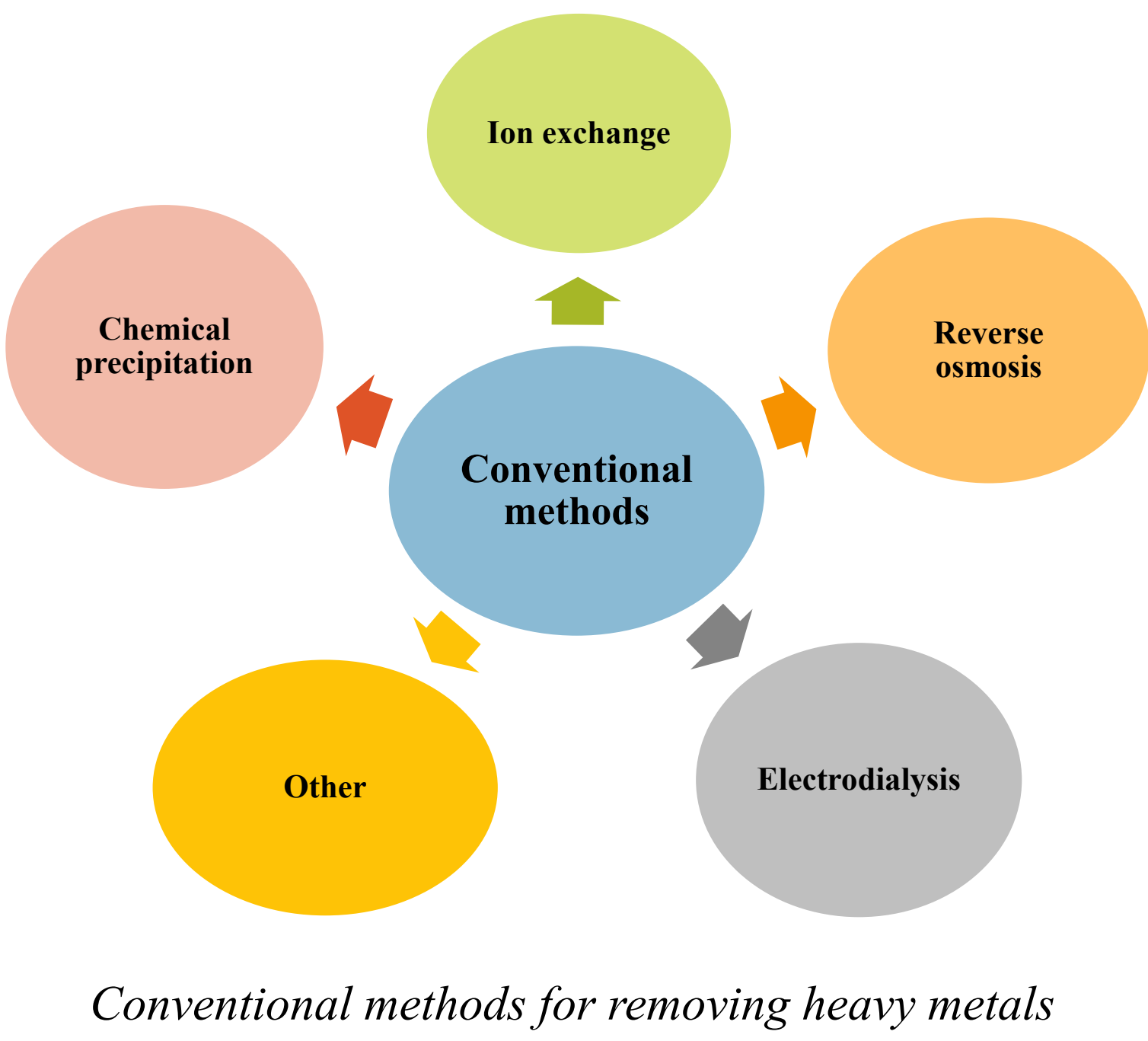


Introduction

Decontamination of heavy metals from industrial wastewater has posed significant challenges over the years. Conventional methods, while effective, often come with limitations due to high costs and complex operations.



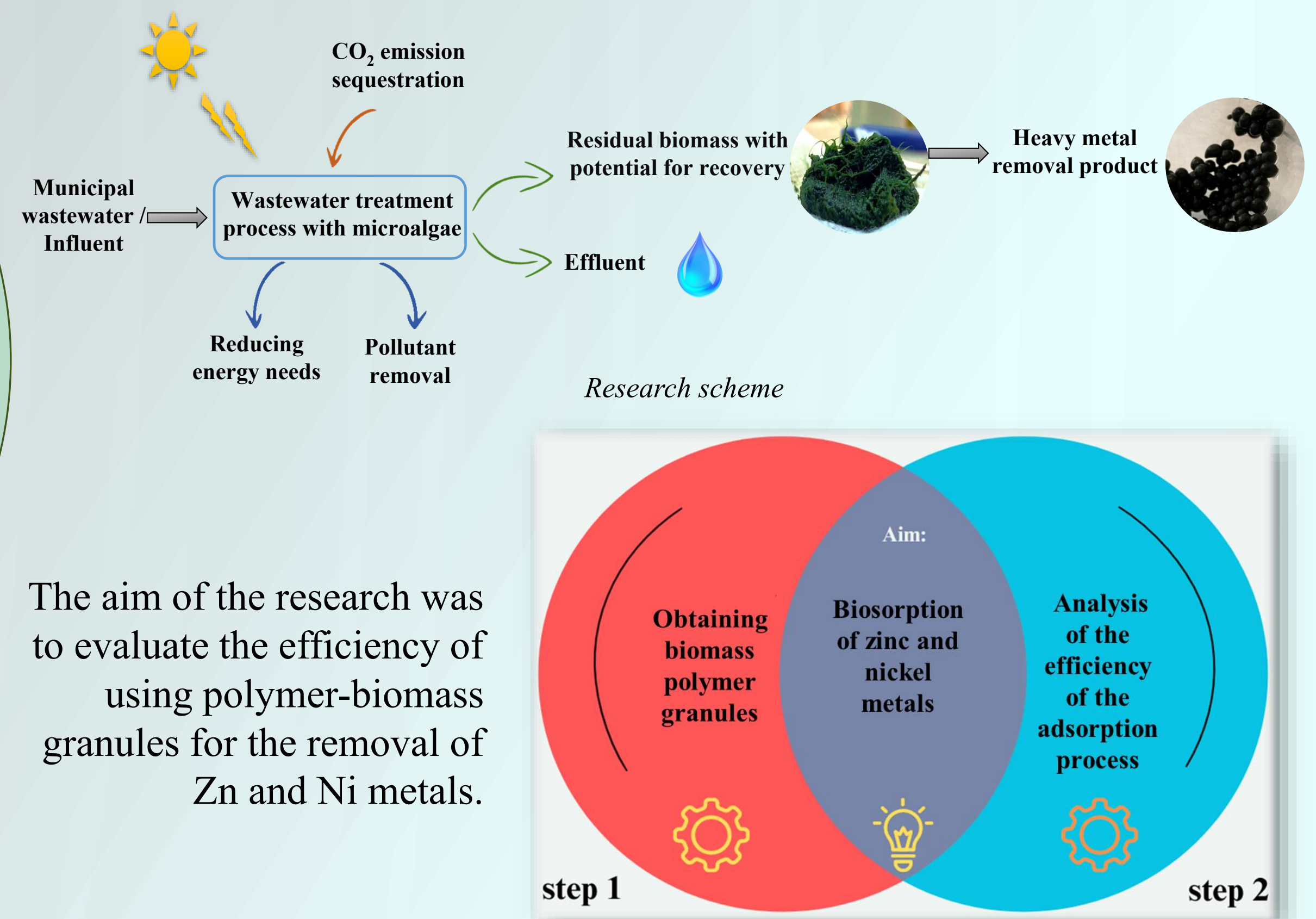
Consequently, **biosorption** has emerged as a promising alternative, utilizing microorganisms like *bacteria* and *microalgae* as biosorbents.

- Advantages:
- high surface-to-volume ratio
 - rapid adsorption and desorption kinetics
 - cost-effectiveness

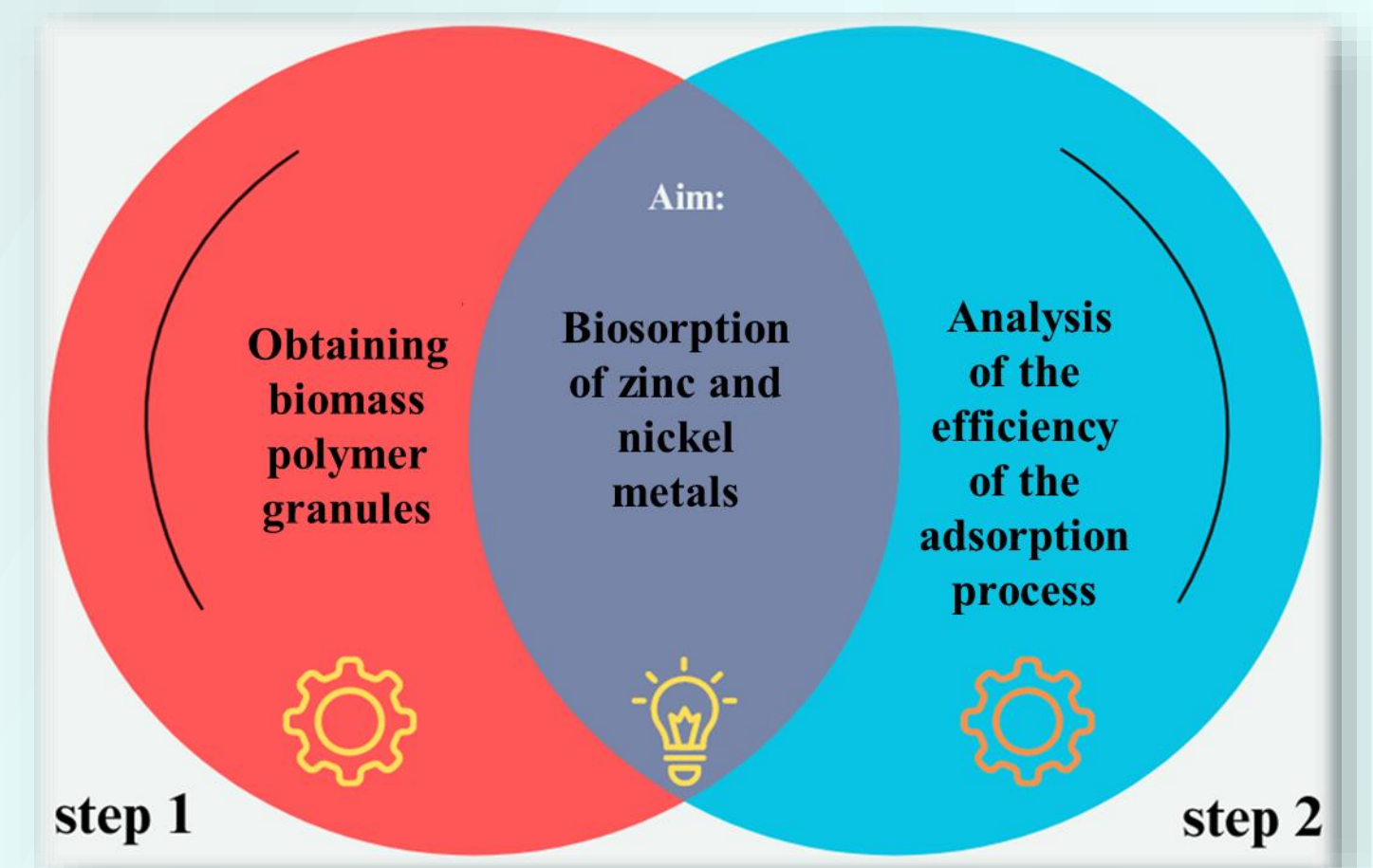


Aim

This research evaluated the efficiency of microalgae-bacteria biomass waste from municipal wastewater treatment, repurposed into polymer-based granular materials, as adsorbents.



The aim of the research was to evaluate the efficiency of using polymer-biomass granules for the removal of Zn and Ni metals.

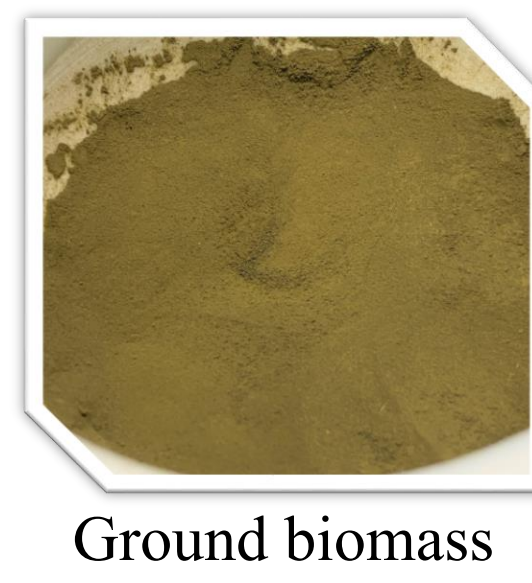


Materials and methods

step 1. Preliminary test

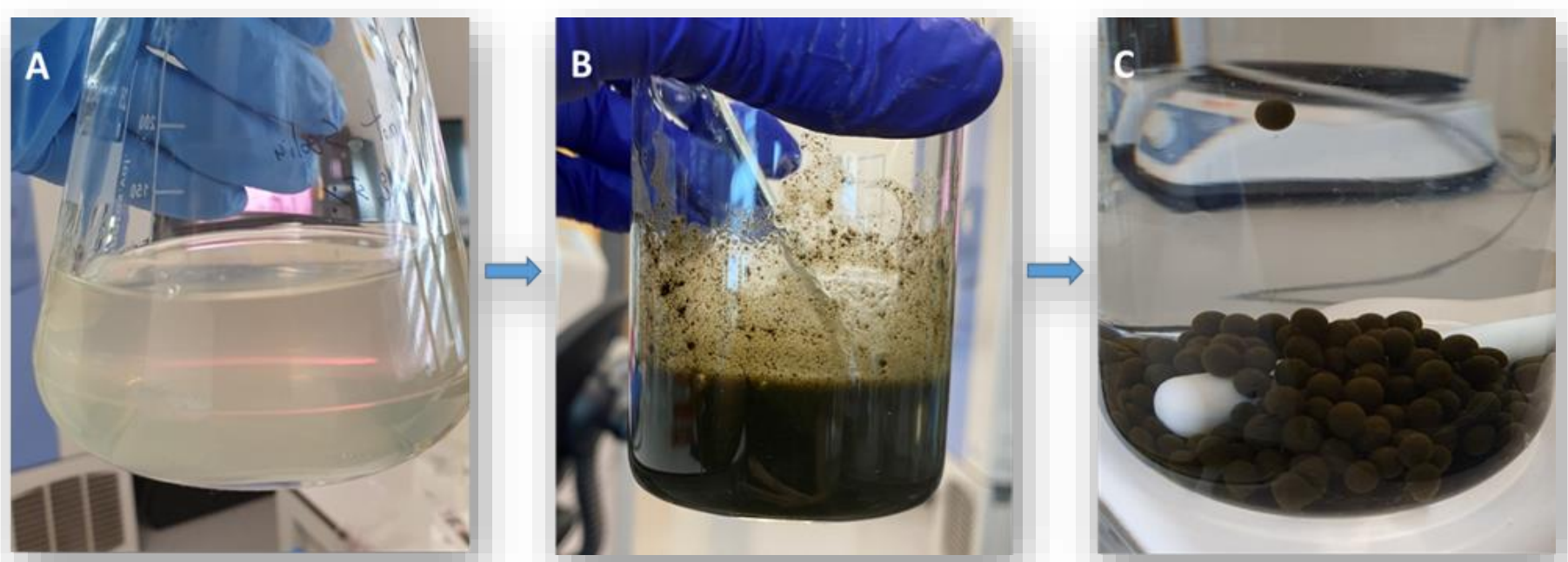
Biosorbent → mixed granular biomass microalgae-bacteria — used in municipal wastewater treatment processes.

The biomass was dried and ground, then used in the tests to identify the optimal pH and adsorption isotherm.



Ground biomass

Polymer-biomass granules: mixing sodium alginate with ground biomass (in a ratio of 9:1) and dropping the mixture into a 2% CaCl₂ solution.



Sodium alginate 2%

Alginat:bioss 9:1

Granules

The method was tested for both biomass polymer granules and suspended biomass.

Optimal pH and adsorption isotherm. step 2

The optimal pH was established by testing 8 pH values from 3 to 10, having the same amount of biomass and the same metal concentrations: 10 mg/l Ni and 20 mg/l Zn.

Biosorption experiments were performed using the Innova44 incubator.

Incubator Innova44



Operation conditions

Temperature: 25 °C

Agitation: 150 rpm

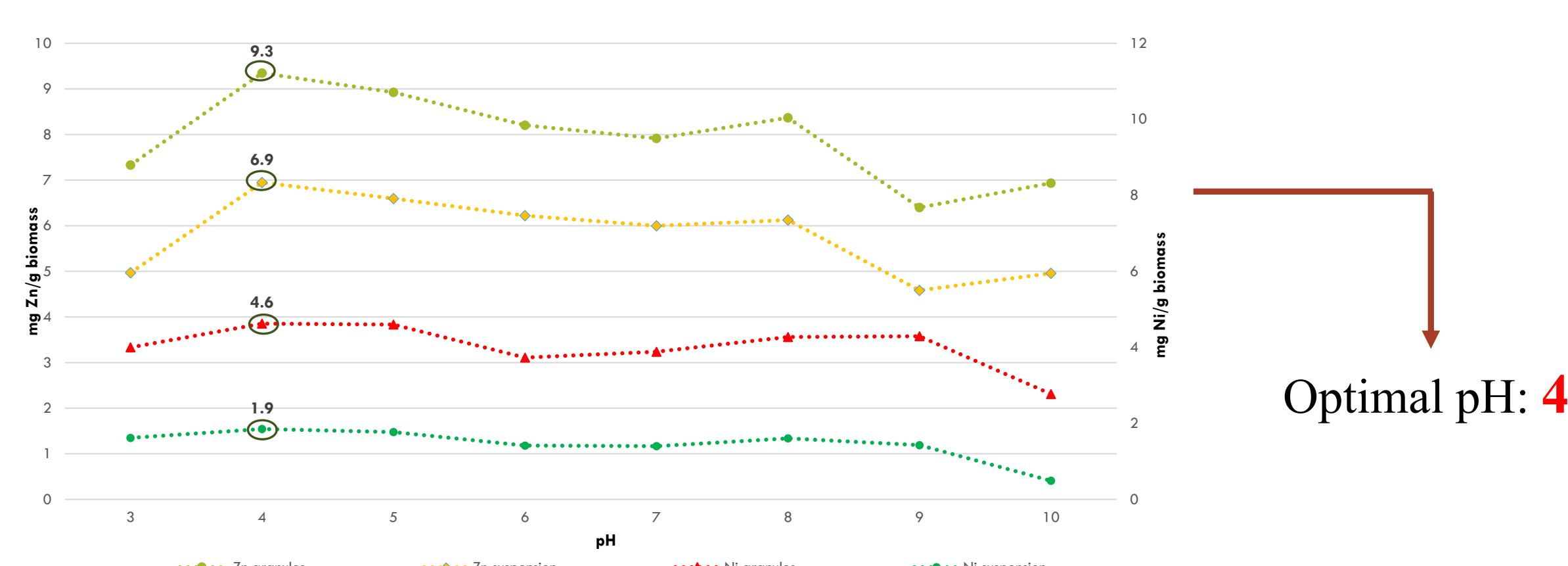
Retention time: 300 min

To evaluate the influence of metal concentrations on the adsorption process, different concentrations of Ni and Zn were analyzed: 5-30 mg/L, respectively 5-60 mg/L.

The analysis of metal concentration was performed based on the SR ISO 11047:1999 standard, using the Atomic Absorption Spectrophotometer.

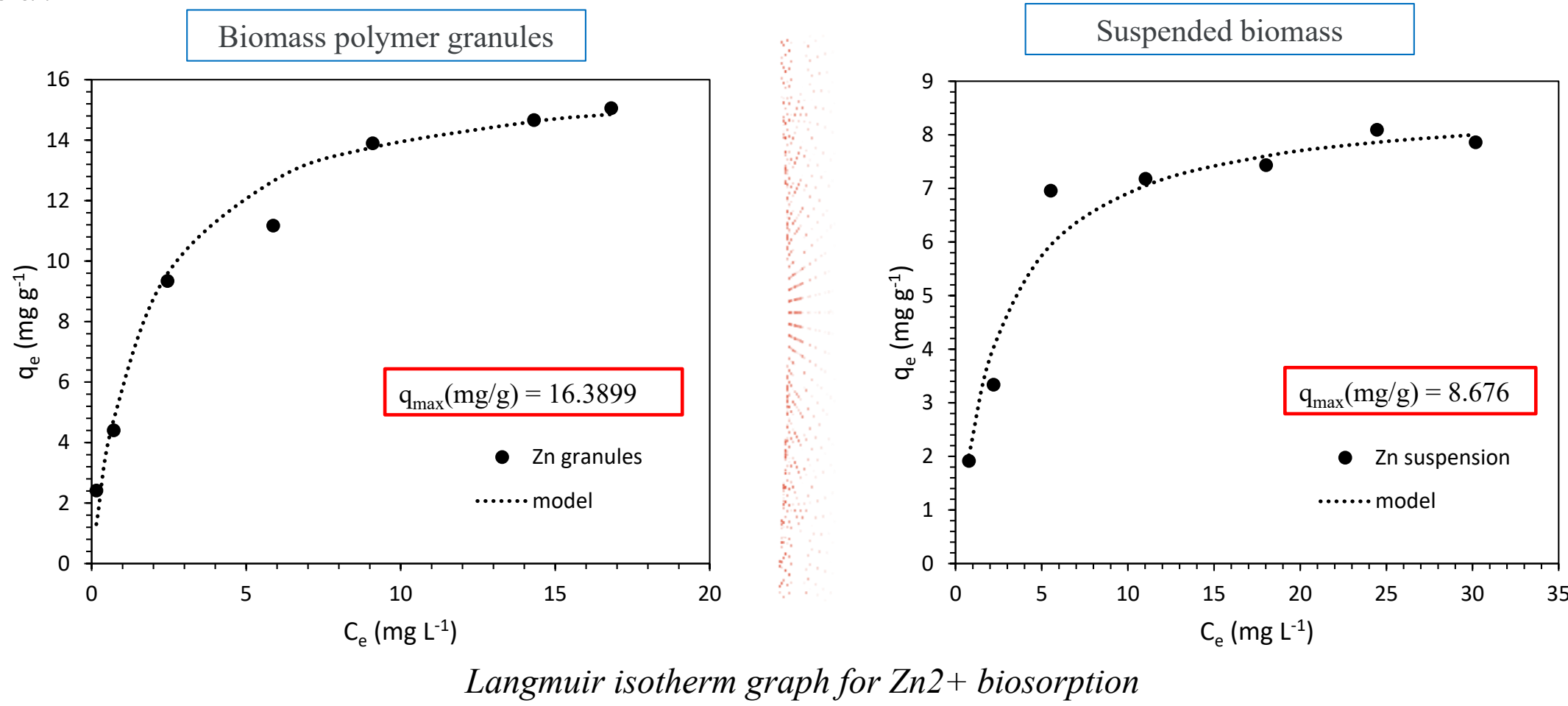
Results

Influence of pH on Ni and Zn adsorption



Removal efficiency by mixed granular biomass in the form of polymer-biomass granules and suspended biomass

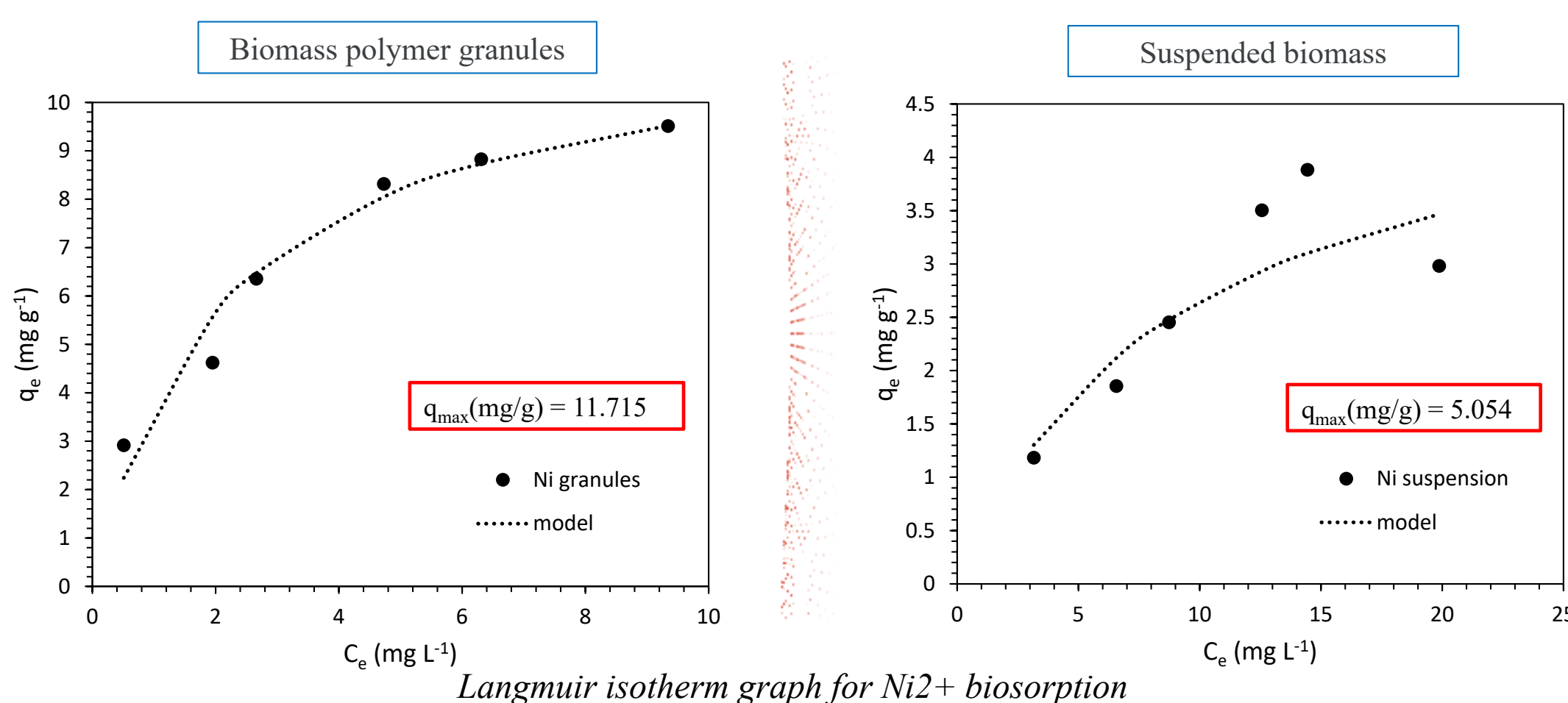
Langmuir adsorption isotherm → when the metal concentration increases, the adsorption capacity also increases until the saturation level is reached.



Langmuir isotherm graph for Zn²⁺ biosorption

The maximum absorption capacity for **zinc**:

- granules ~16.39 mg/g,
- suspended biomass ~8.68 mg/g.



Langmuir isotherm graph for Ni²⁺ biosorption

The maximum absorption capacity for **nickel**:

- granules ~11.71 mg/g,
- suspended biomass ~5.05 mg/g.

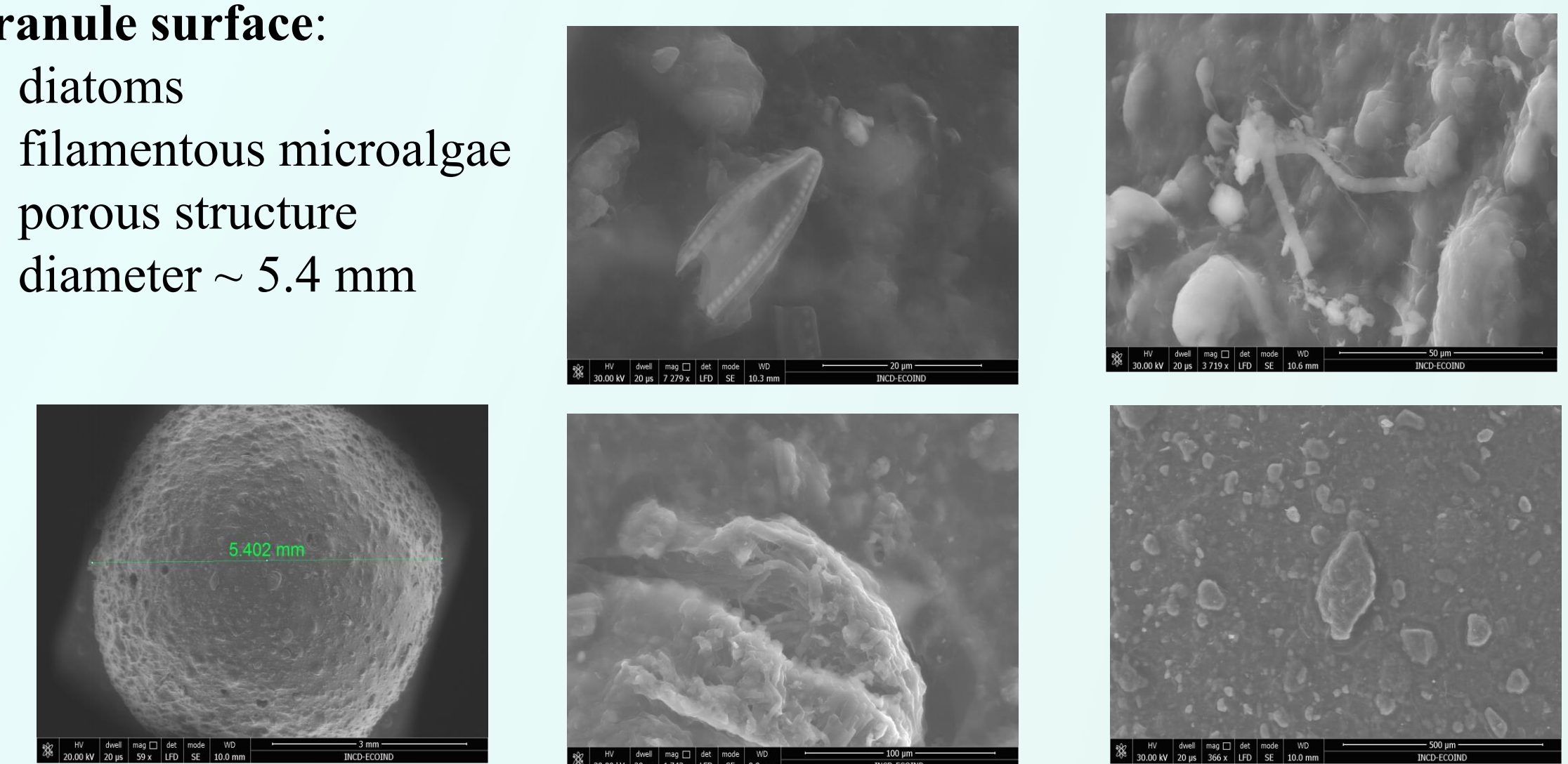
Balance parameter	Biomass polymer granules	Suspended biomass
	R_L	R_L
Zn	0.109	0.148
Ni	0.147	0.403

RL has been shown to be favorable for adsorption processes ($0 < RL < 1$)

Biomass characteristics

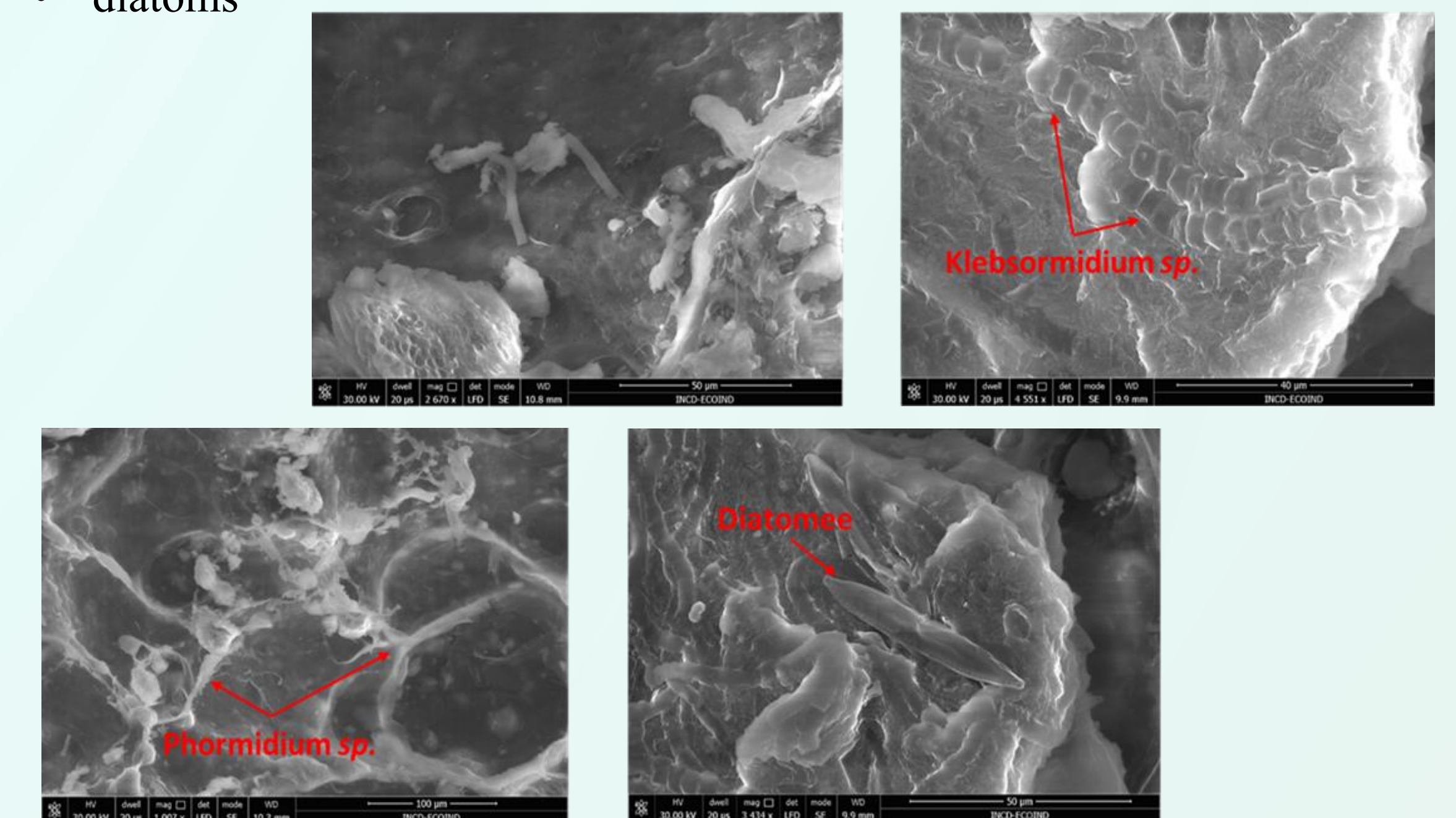
Granule surface:

- diatoms
- filamentous microalgae
- porous structure
- diameter ~ 5.4 mm



Sectioned granule:

- biomass distribution in polymer structure
- filamentous microalgae
- diatoms



Conclusions

➤ According to the results obtained, the polymer-biomass granules had the highest adsorption capacity for zinc metal, being 16.39 mg/g.

☐ Advantages of using granular biomass:

- Higher adsorption capacity
- No need for a biomass filtration step
- No additional costs

Therefore, it is highlighted that polymeric granules in biomass would improve the biosorption of metal ions compared to suspended biomass.