Neutron activation analysis and related analytical techniques in environmental and life sciences

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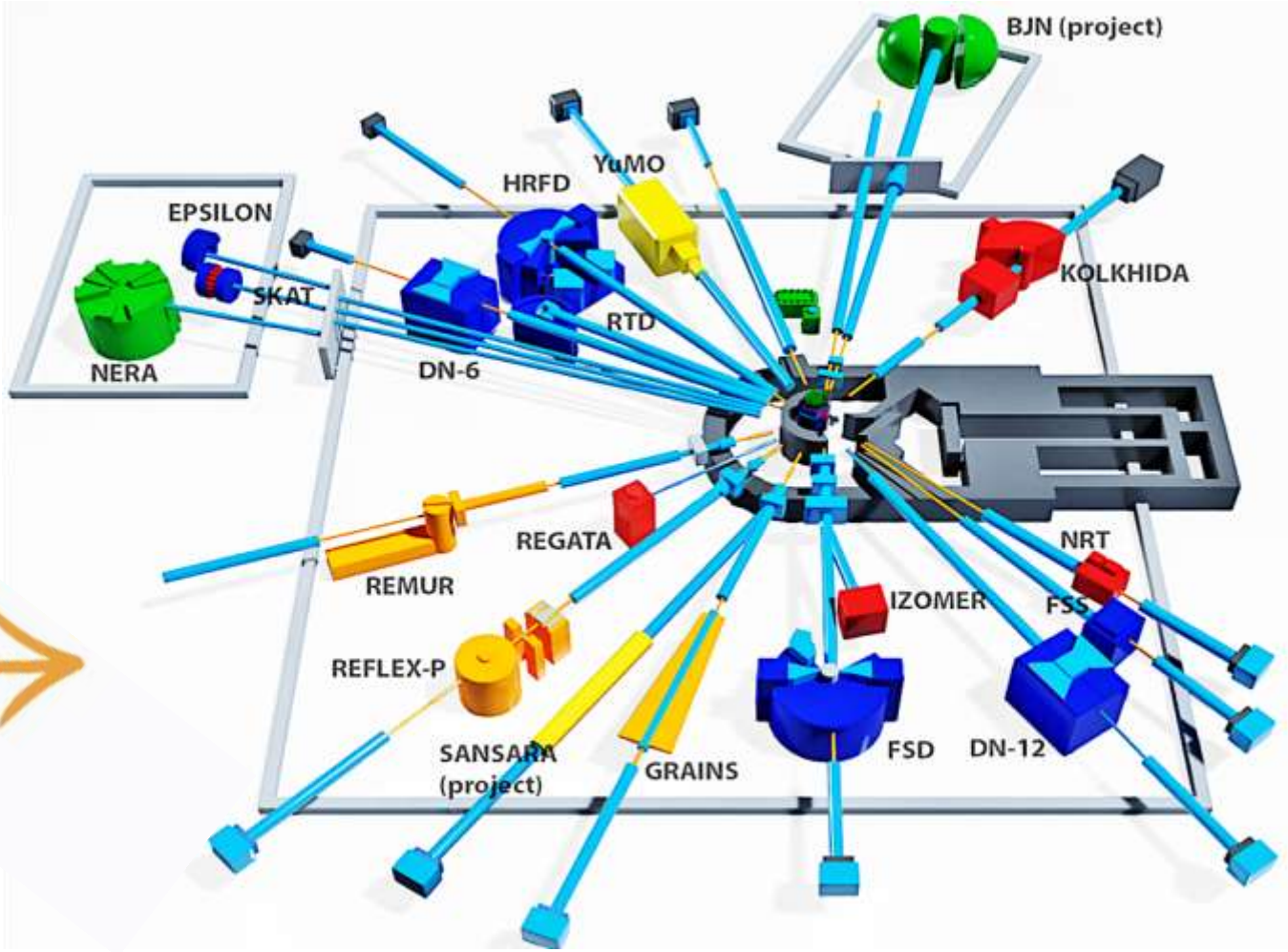
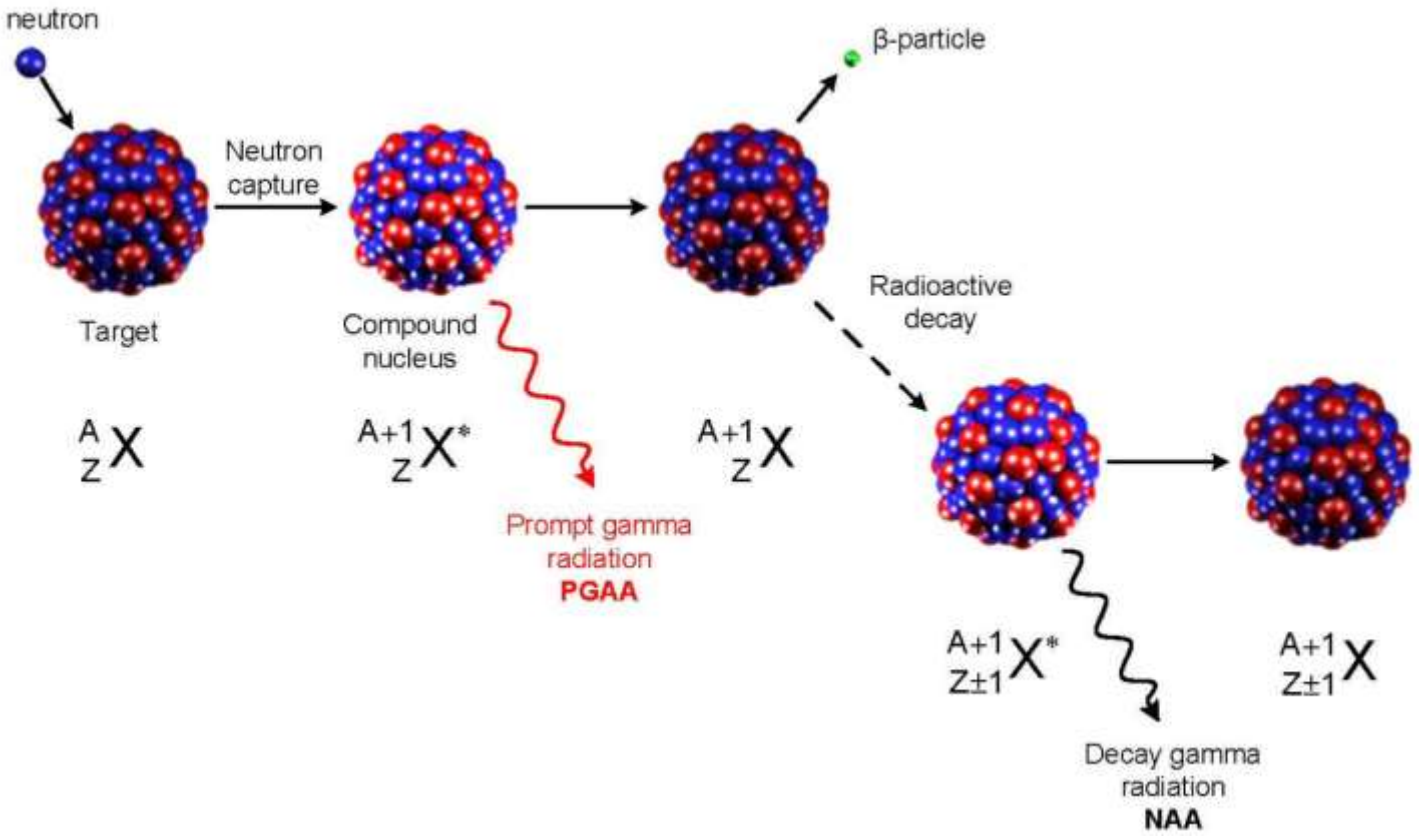
Major directions:

- ✔ Neutron-nuclear investigations
- ✔ Condensed matter physics
- ✔ Applied research

IBR-2 pulsed reactor



NAA: Principle



Advantages:

- ✔ High sensitivity and selectivity
- ✔ Multi element analysis
- ✔ Wide concentration range
- ✔ Easy sample preparation
- ✔ Best for rare earth elements

Disadvantages:

- ✔ Require nuclear reactors
- ✔ Storage and disposal of nuclear waste
- ✔ Analysis time

Methodology: NAA sample preparation

Moss

Weighing

Pelletization

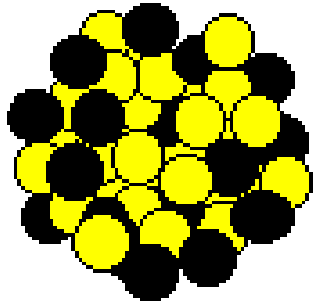
Sample packaging

NAA: Applications

Bio-monitoring

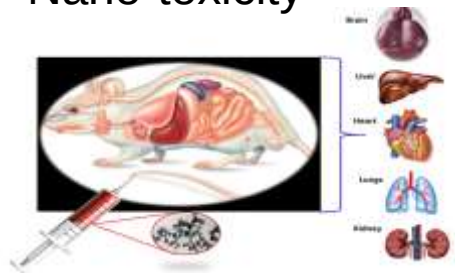
Geology

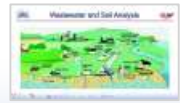
Food



Archeology

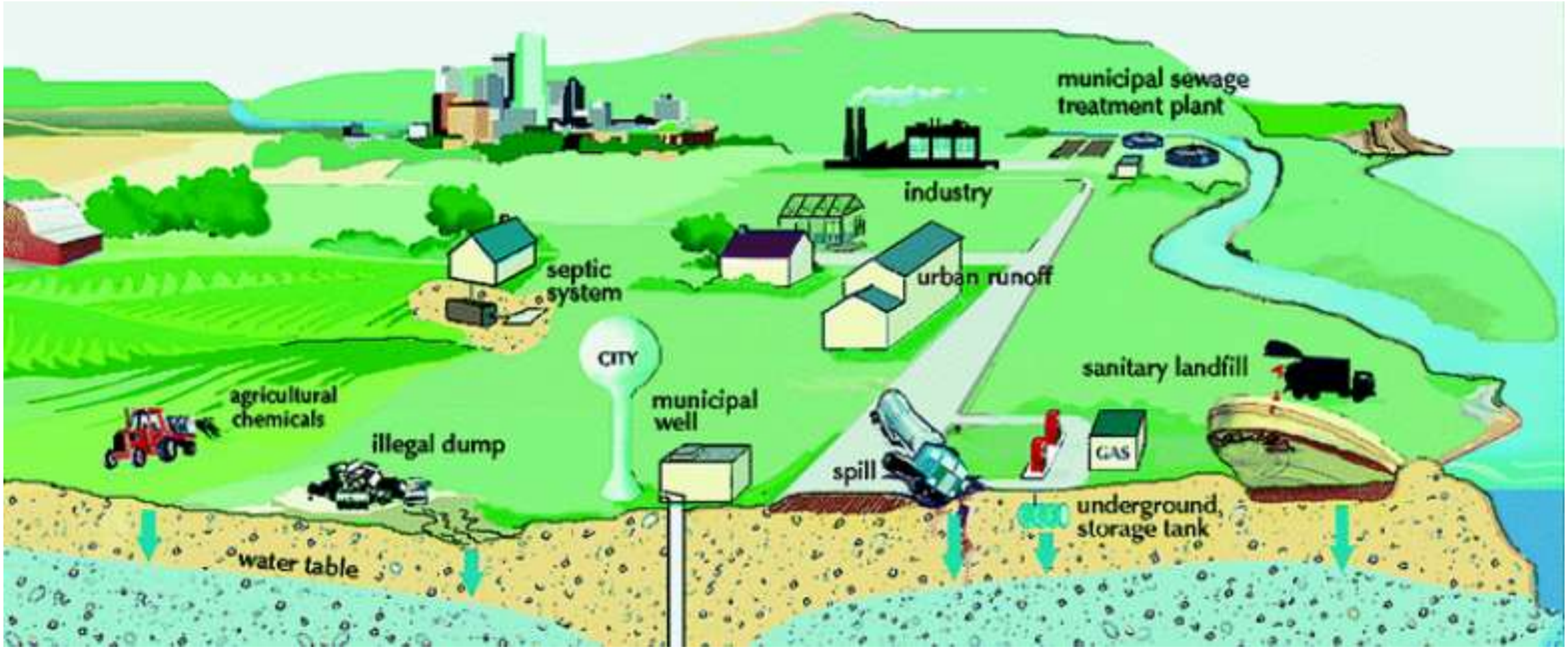
Nano-toxicity





Wastewater treatment

Wastewater and Soil Analysis



Aim

- Assess the adsorption efficacy of organic and inorganic sorbents for Gd(III) removal
- Measure the activity concentration of radionuclides in soil samples

Methodology: Wastewater treatment

Weighing

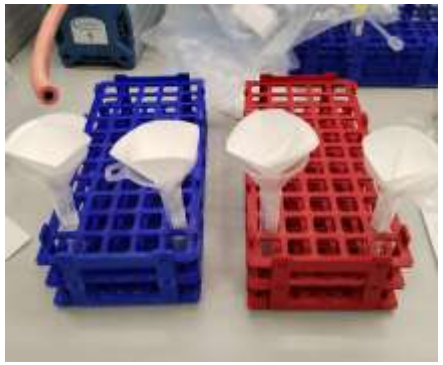
0.02g

Gd(III) solution

pH

Addition

shaking



Filtration

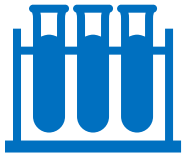
ICP-OES

Methodology: Adsorption studies

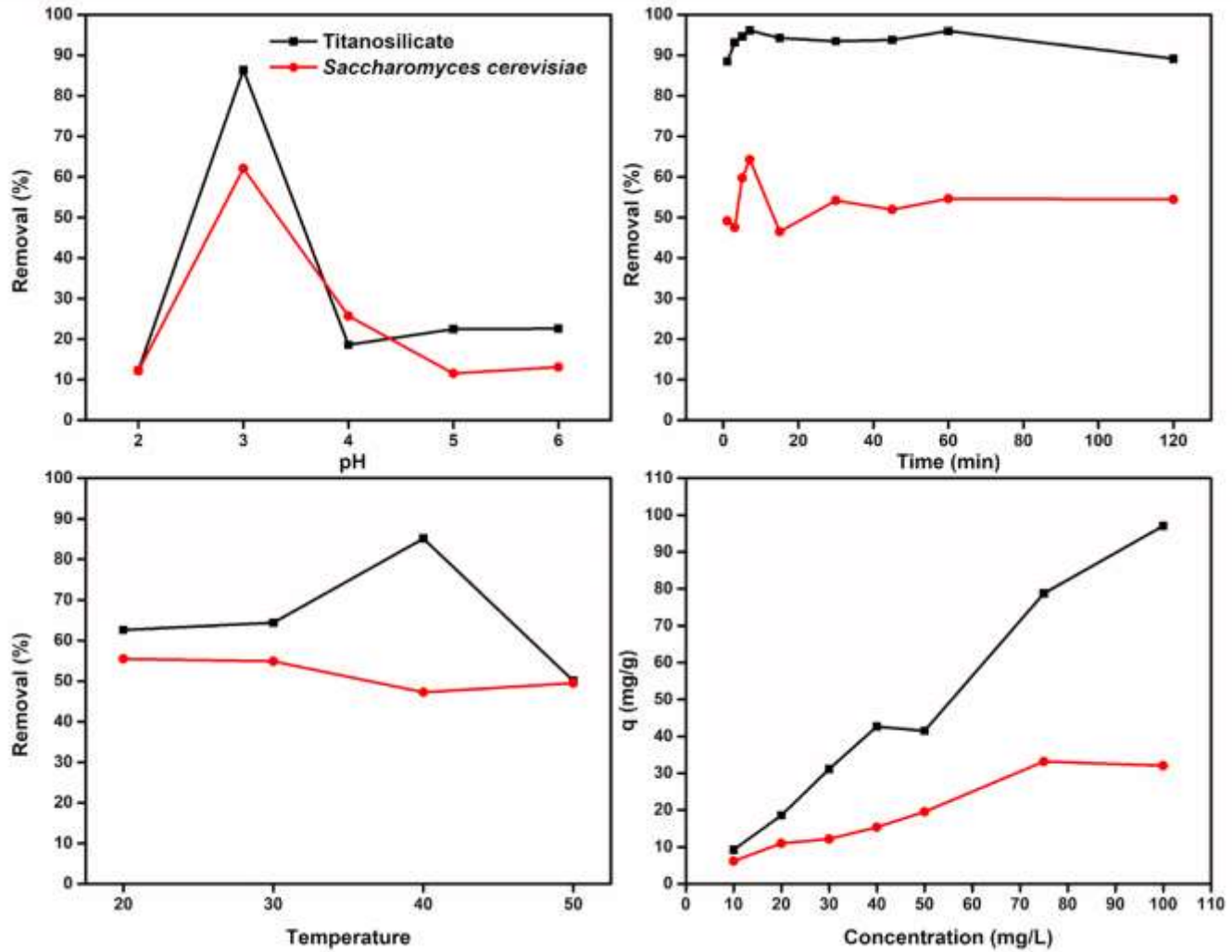
Parameters

pH	Time	Temperature	Concentration
2-6	1-120min	20-50^{o}C	10-100mg/L

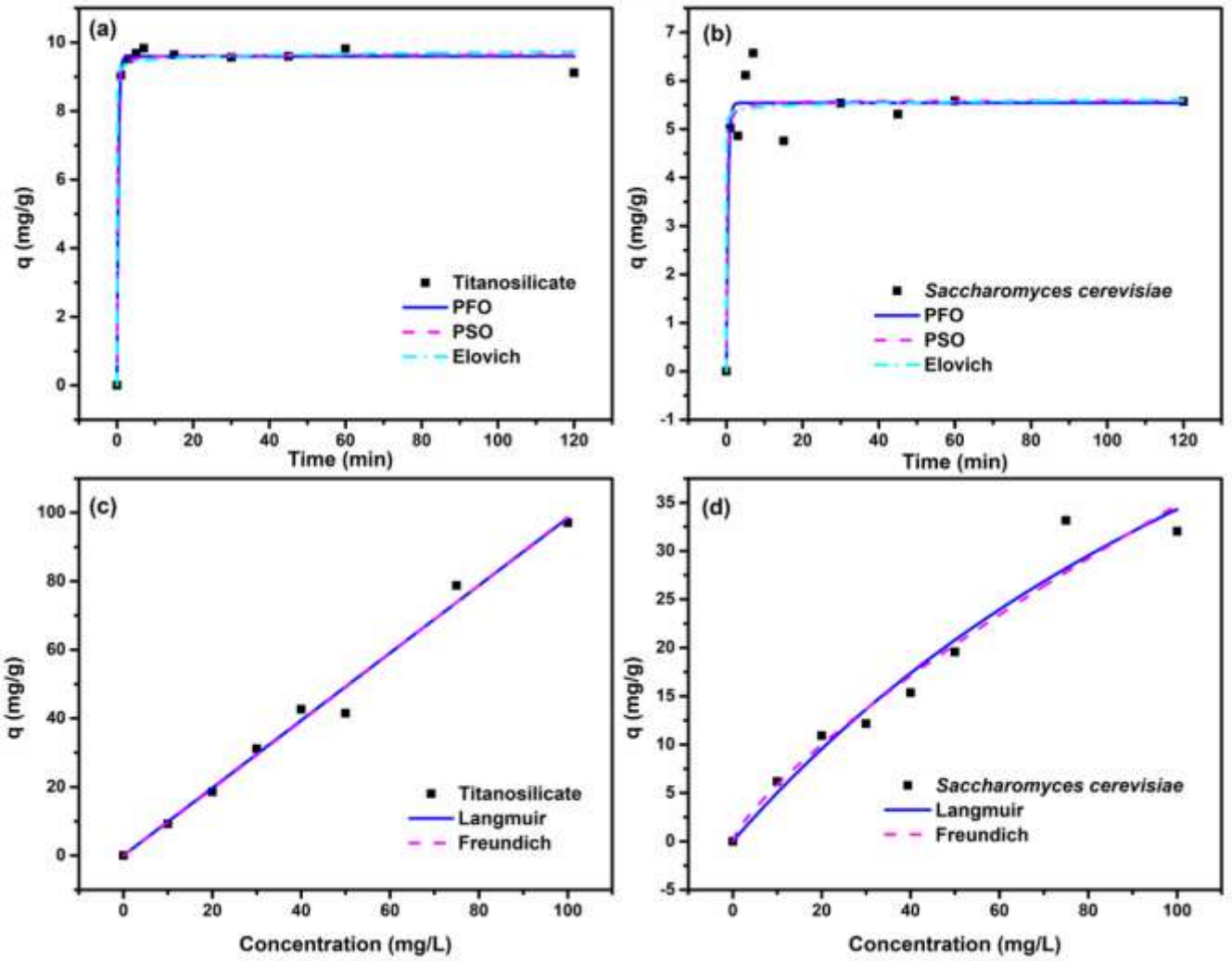


Results: Wastewater treatment



Results: Adsorption studies



Isotherms

	Langmuir			Freundlich		
Sorbent	q_m	b	R^2	K_F	n	R^2
ETS-10 Titanosilicate	1.352E5	7.285E-6	0.985	0.946	0.991	0.985
Saccharomyces cerevisiae	97.980	0.005	0.950	0.980	1.290	0.980

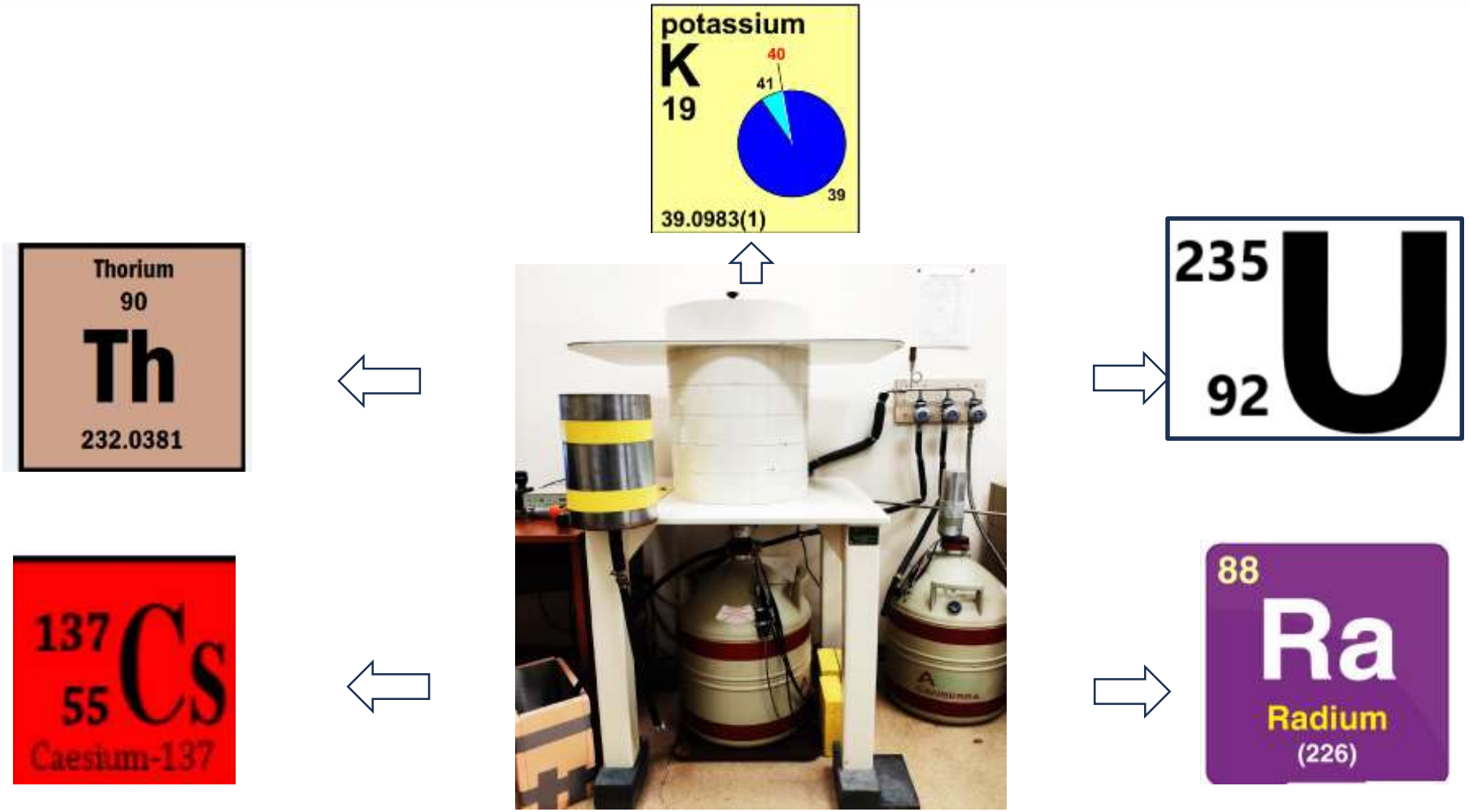
Kinetics

Sorbent	Pseudo-first order			Pseudo-second order			Elovich		
	q_e	k_1	R^2	q_e	k_2	R^2	α	β	R^2
ETS-10 Titanosilicate	9.595	2.862	0.995	9.630	1.910	0.994	1.463	10.950	0.991
Saccharomyces cerevisiae	5.542	2.336	0.905	5.591	1.752	0.904	9.647E41	18.644	0.897

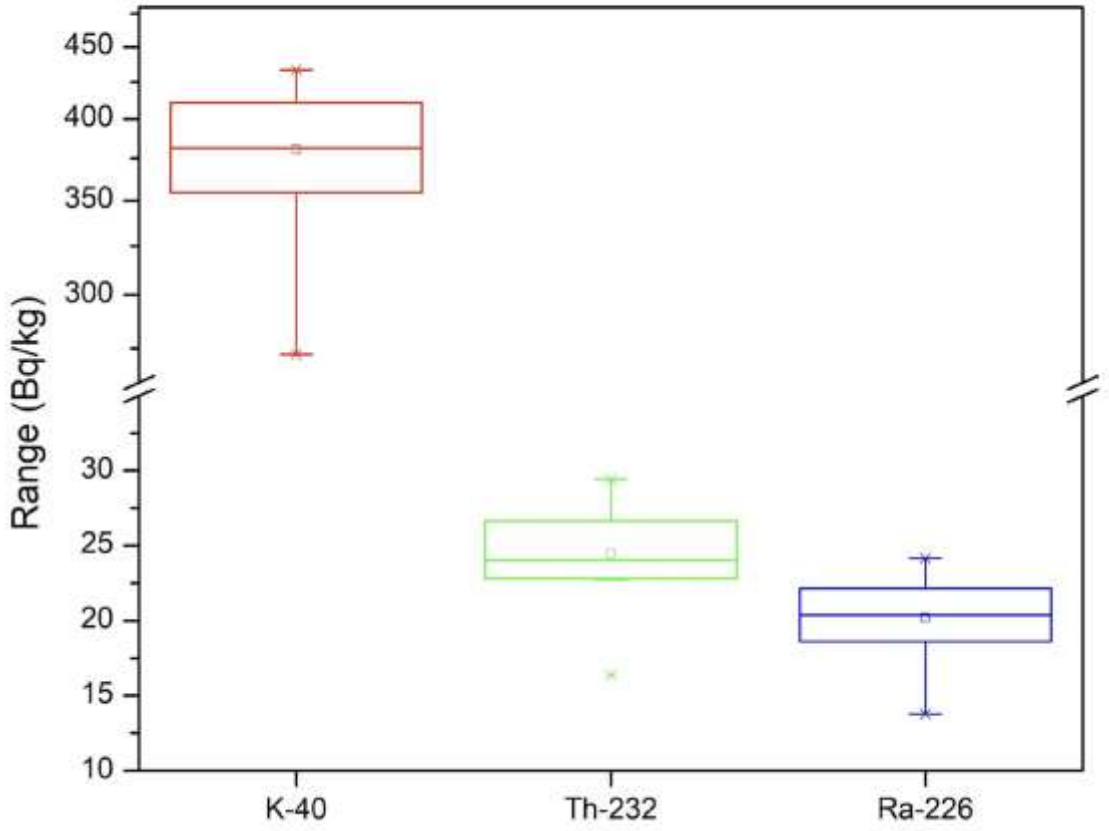
Thermodynamics

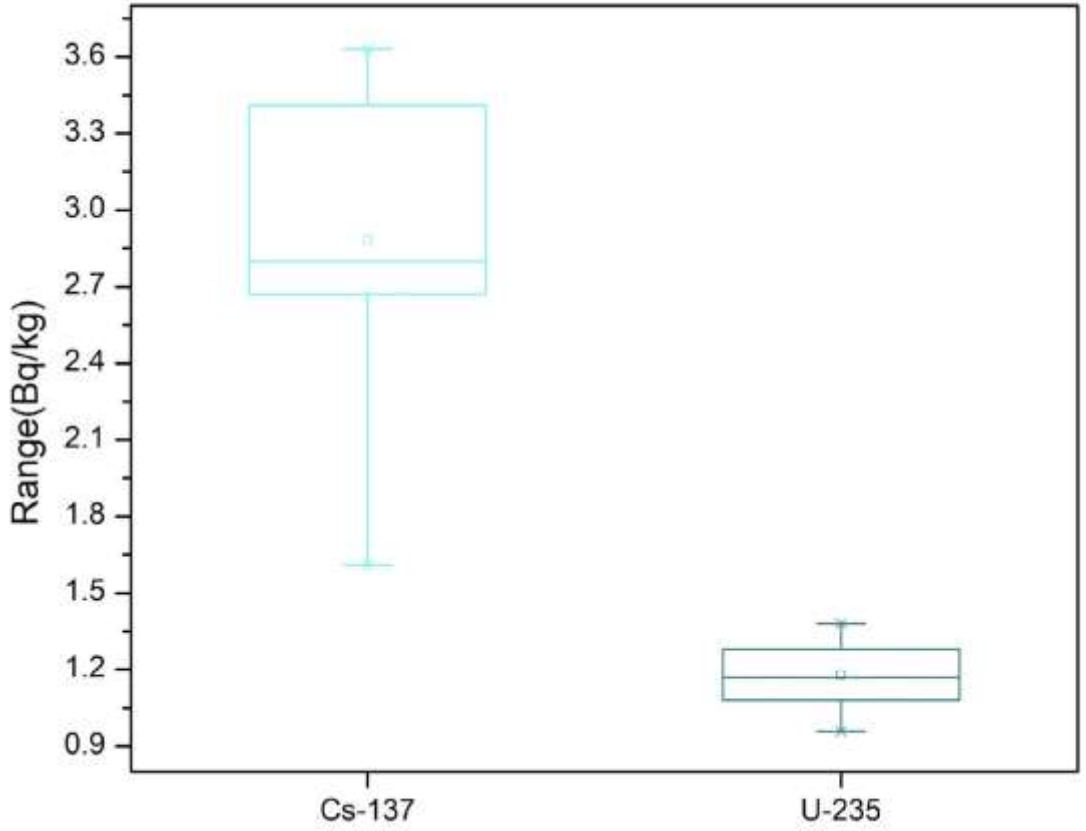
Sorbent	Temperature. K	ΔG0. kJ/mol	ΔH0. kJ/mol	ΔS0. J/mol·K
ETS-10 Titanosilicate	293.15	-1.835	-2.141	-1.044
	303.15	-1.825		
	313.15	-1.814		
	323.15	-1.804		
Saccharomyces cerevisiae	293.15	-0.560	-8.182	-26.000
	303.15	-0.300		
	313.15	-0.040		
	323.15	0.220		

Methodology: Gamma Spectrometry



Results: Activity concentration of radionuclides





Conclusion

- Training on NAA, ICP-OES and Gamma spectrometry
- Adsorption:
  - Optimal pH = 3 for both
  - Maximum removal around 7 min (for both), Titanosilicate with highest %R
  - Temperature had more effect on Titanosilicate than *Saccharomyces cerevisiae*
  - Concentration variation had more effect on Titanosilicate than *Saccharomyces cerevisiae*
- Langmuir model fitted better the data for both of sorbents
- The adsorption capacity of Titanosilicate was higher for *Saccharomyces cerevisiae*.
- Pseudo-First-Order model fitted well with Titanosilicate and Elovich model for *Saccharomyces cerevisiae* devoted to chemical sorption
- Thermodynamics indicated physisorption process

References

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Acknowledgements

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