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BCR sequential extraction procedure and its application to mine tailings and fly ashes

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Sequential extraction

- offers a potential to gain a better understanding of the composition of solid wastes;
- is a valuable procedure used to estimate the mobility of elements under different conditions;
- a wide range of sequential extraction procedures have been developed.

BCR sequential extraction procedure...

Step 1

Acid- soluble

Step 2

Reducible

Step 3

Oxidizable

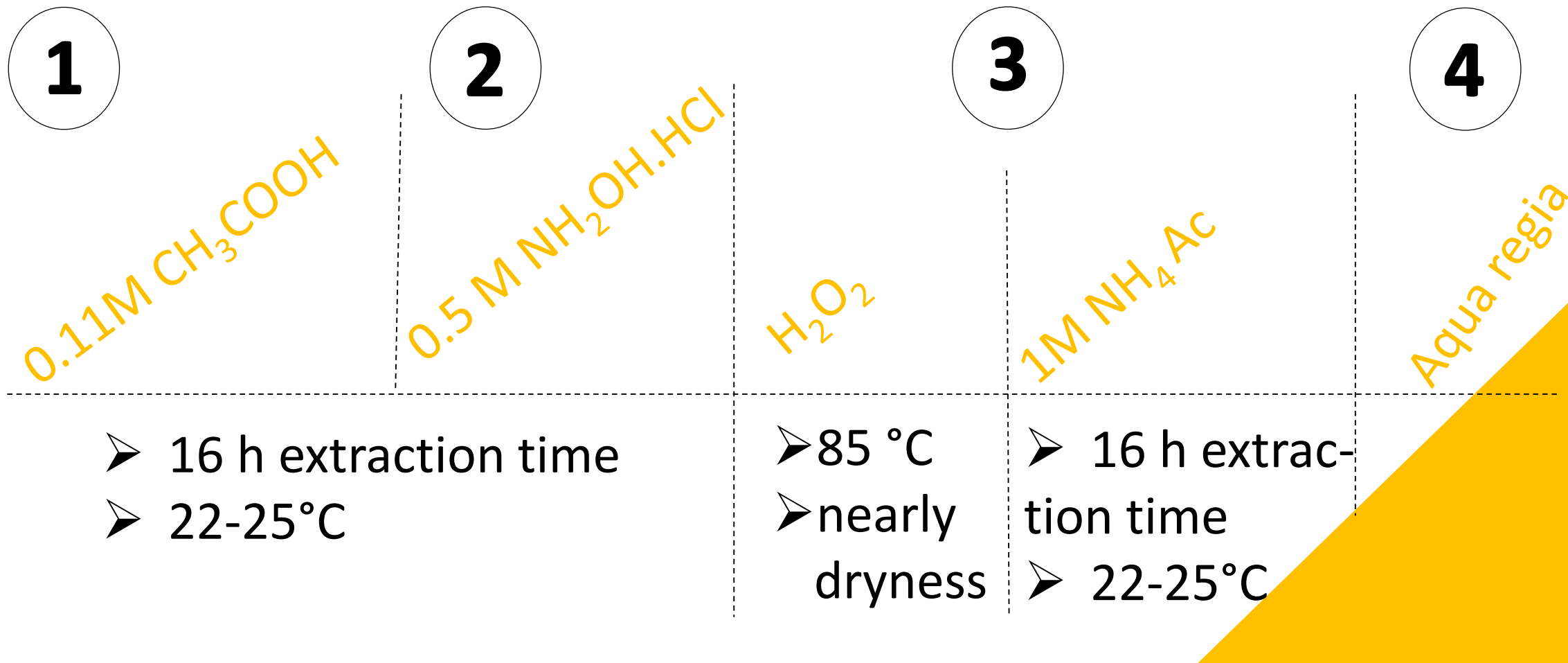
Step 4

Residual

Certified elements

Cd Cr Cu Ni Zn Pb

...BCR sequential extraction procedure

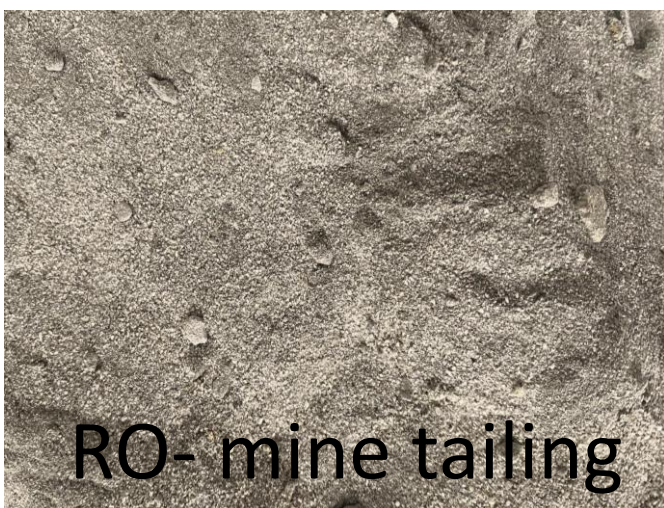
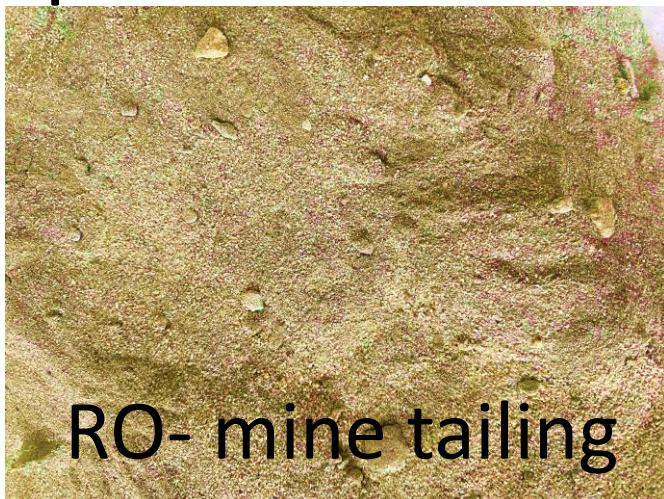


CRM BCR[®] – 701

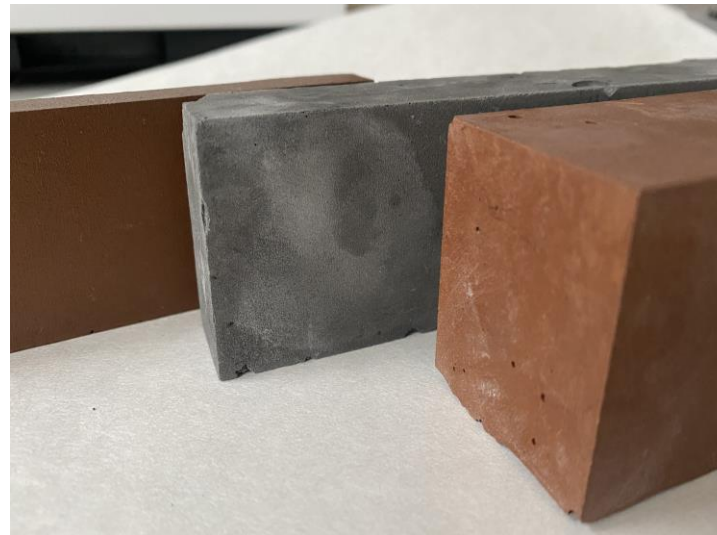
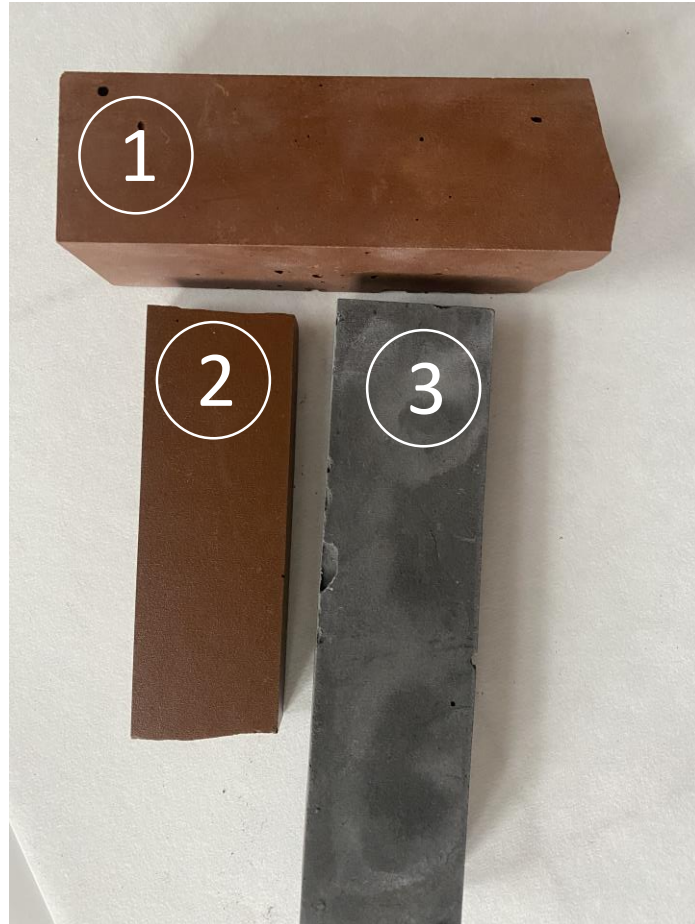
Extractable element	Certified value [mg/kg]		
	Step 1:	Step 2:	Step 3:
Cd	7.3 ±0.4	3.77±0.28	0.27±0.06
Cr	2.26 ±0.16	45.7±2.0	143±7
Cu	49.3±1.7	124±3	55±4
Ni	15.4 ±0.9	26.6±1.3	15.3±0.9
Pb	3.18 ±0.21	126±3	9.3±2.0
Zn	205 ±6	114±5	46 ±4

(Joint Research Centre, Certified reference material BCR[®] – 701, Certificate of analysis)

Samples: Mine tailings and Fly ash



Samples: Mine tailing and Fly ash



- ① 25% Fly ash+75% Mine tailing
- ② 50% Fly ash+50% Mine tailing
- ③ 100% Fly ash

Analyzing CRM BCR[®]– 701

Step 1



Step 2



Step 3



Step 4

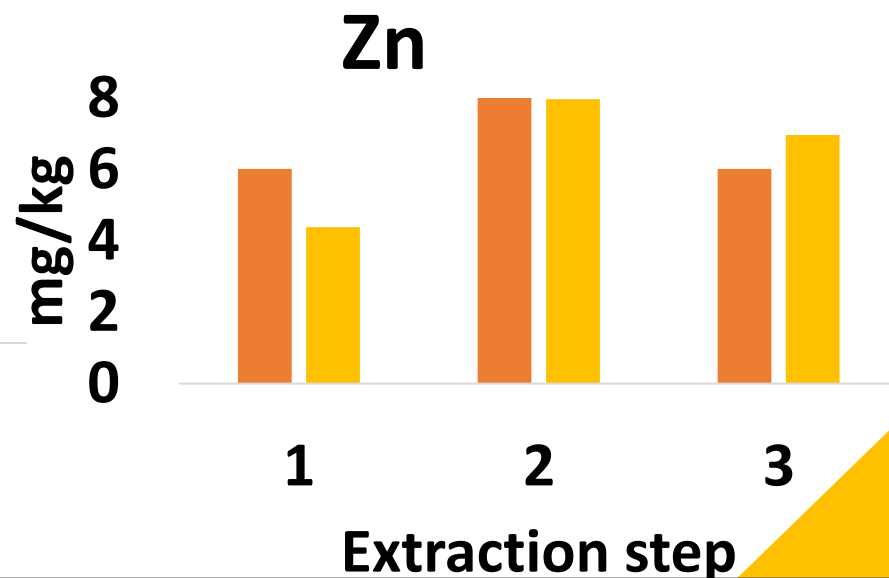
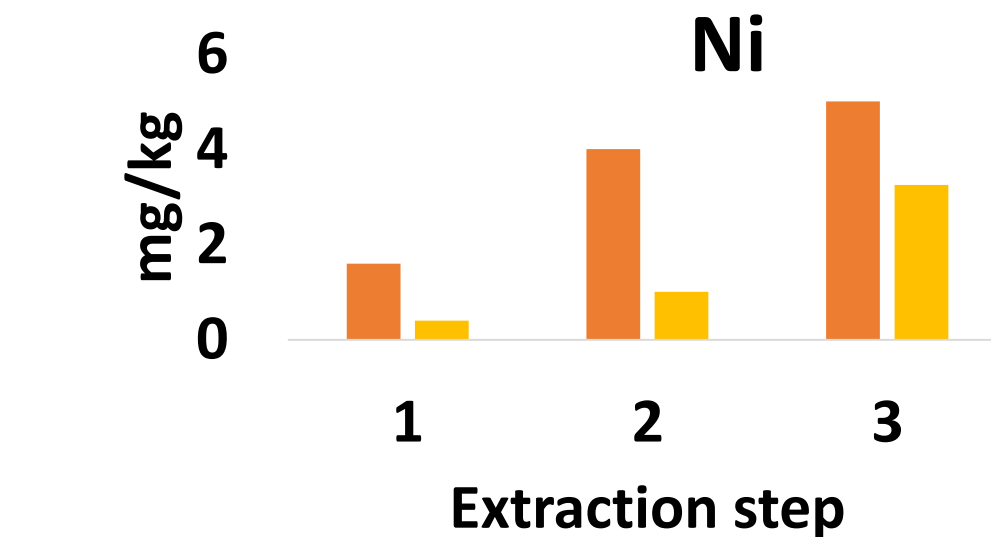
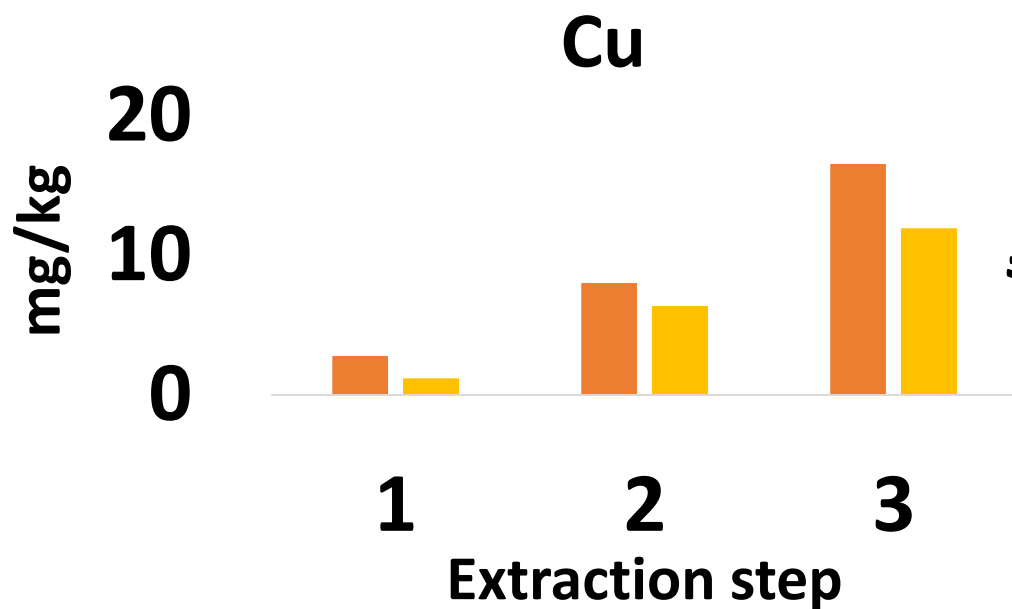


Agreement between triplicates was in the frame of 10%.

Step 1+Step 2+Step 3+residual agreed with the certified values.

Some results

Raw material
Geopolymer



Some practical aspects of BCR procedure

- application of BCR procedure on different sample types- soil, sediment, fly ash, etc.;
- different: chemical composition, particle size, mass/volume ratio, buffer capacity, extracting conditions;
- method validation;
- research laboratory.

Another sequential extraction procedure(SEP)?

5- step SEP

1M $\text{Mg}(\text{NO}_3)_2$



0.1M $\text{NH}_2\text{OH}\cdot\text{HCl}$



0.2M $(\text{NH}_4)_2\text{C}_2\text{O}_4$
0.1M $\text{H}_2\text{C}_2\text{O}_4$
0.1M $\text{C}_6\text{H}_8\text{O}_7\cdot\text{H}_2\text{O}$



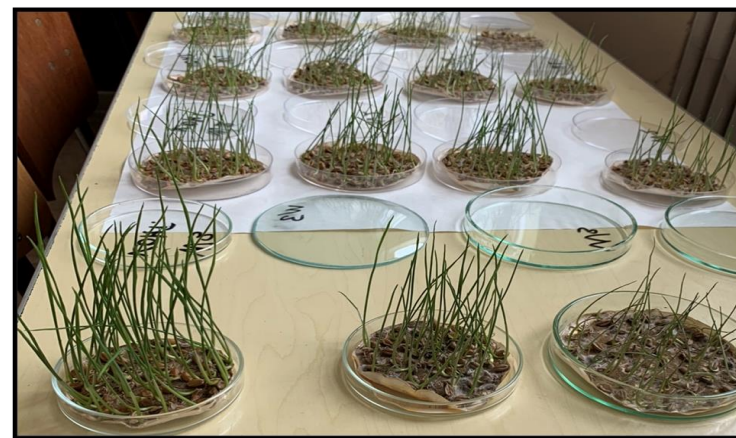
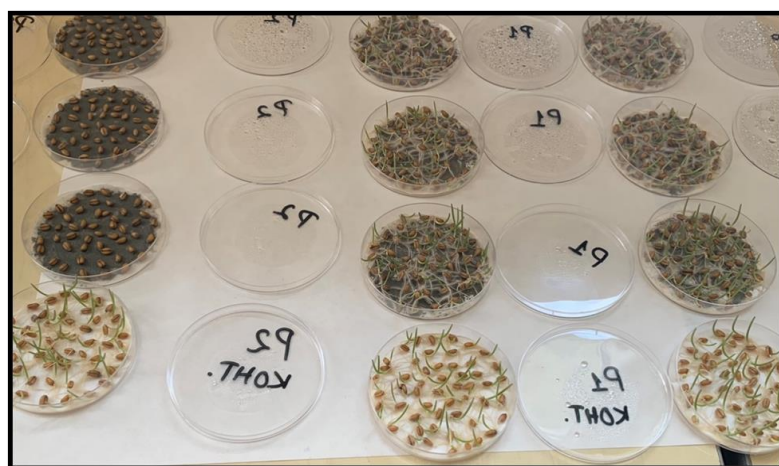
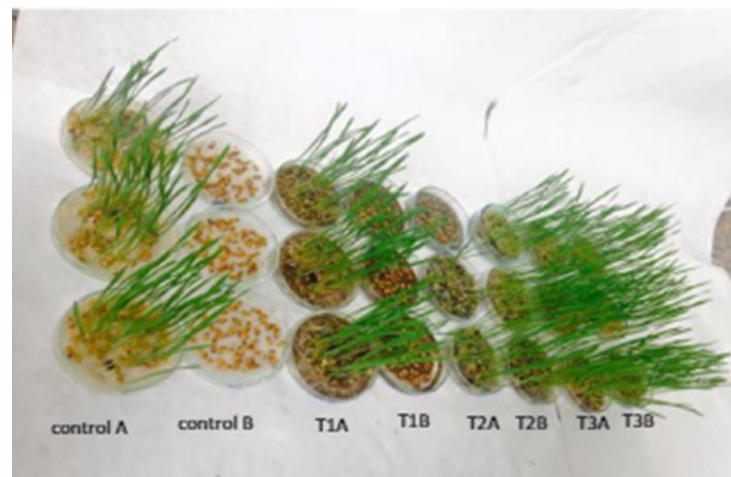
0.1M $\text{NH}_2\text{OH}\cdot\text{HCl}$
0.25M HCl



Aqua regia

Mine tailing+ heavy metal accumulation by plants:

Tarnița case



(Ilieva *et al.*,
2018,
Ilieva *et al.*,
2019)

To be continued...

- BCR SEP- validation
- BCR- spiked samples
- samples from Portugal, Spain and Turkey

Our team



Acknowledgements:

This study is supported by the Bulgarian National Science Fund under the contract KP-06-DO02/5 "RecMine – Environmental footprint reduction through eco-friendly technologies of mine tailings recycling".



RecMine
Environmental footprint reduction through eco-friendly technologies of mine tailings recycling

Coordinator


Partners

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RAW MATERIALS FOR THE SUSTAINABLE DEVELOPMENT AND THE CIRCULAR ECONOMY



E R A • M I N