ECO-Recycling s.r.l.

Preliminary characterization of Romanian tailings storage basins

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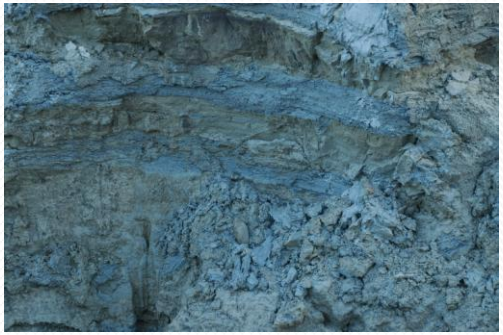
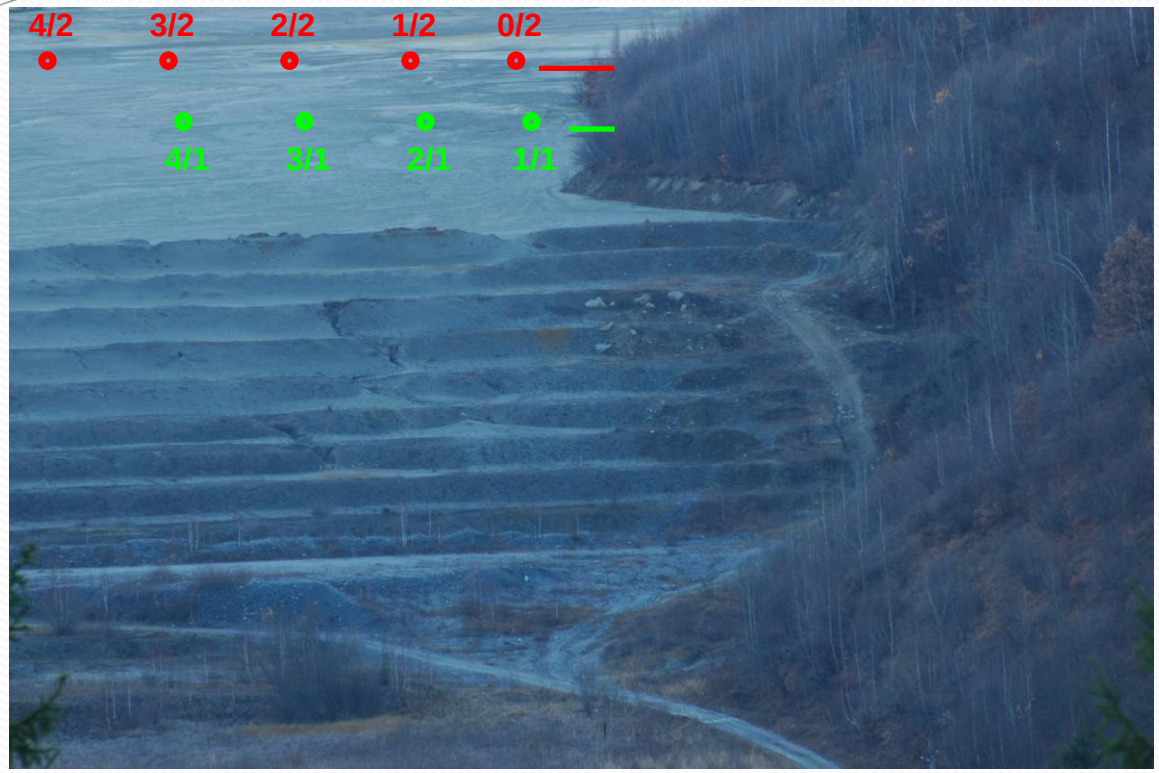
Contaminated basins

- **Balan** **(24 million tonnes)**
- **Deva deposit 1**
- **Deva deposit 2** **(10 million m^3)**
- **Brad Ribita**
- **Brad Criscior**

Balan basin



Samples



- **Balan**

- **DEVA 1° basin** **(1/1 1/2)**
- **DEVA 2° basin** **(2/1 2/2 2/3)**
- **BRAD RIBITA** **(1/1 1/2 1/3)**
- **BRAD CRISCIOR** **(1/1 1/2 1/3)**

Total number of samples = 20

Balan basin

XRF first pipeline

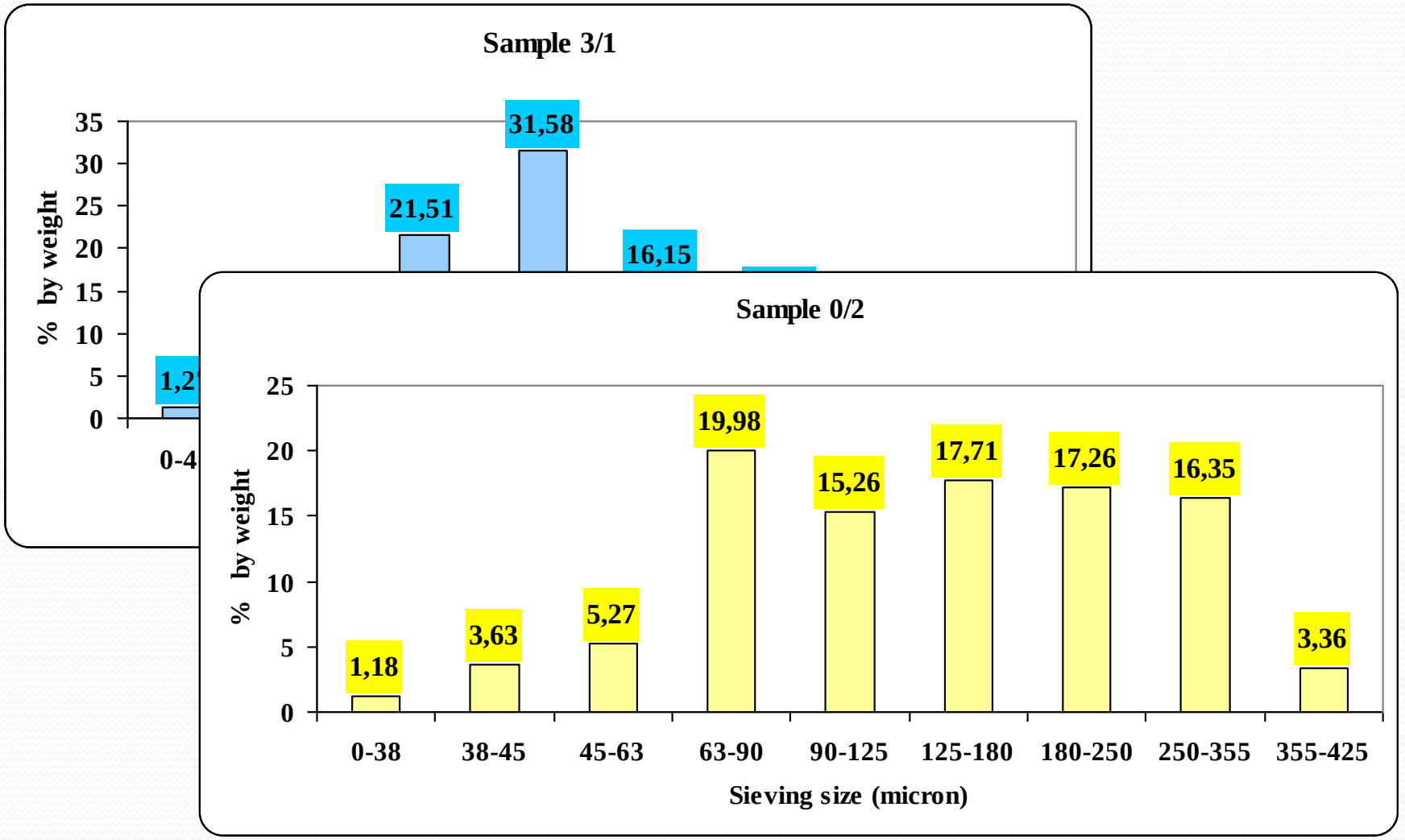
1/1 - 4/1	% w/w
Magnesium	1,3 – 2,5
Aluminum	2,8 – 4,8
Silicon	14,5 – 24,8
Sulfur	1,5 – 4,7
Potassium	0,7 – 0,9
Calcium	0,2 – 1,1
Titanium	0,21 – 0,3
Chromium	0,1 – 0,5
Iron	10,3 – 14,6
Copper	0,1 – 0,3
Zinc	0,10 – 0,14
Arsenic	–
Lead	–

XRF second pipeline

0/2 - 4/2	% w/w
Magnesium	0,8 – 2,7
Aluminum	1,8 – 7,6
Silicon	16,3 – 30,1
Sulfur	0,7 – 1,7
Potassium	0,4 – 1,2
Calcium	0,1 – 0,6
Titanium	0,1 – 0,3
Chromium	0,01 – 0,1
Iron	6,5 – 12,1
Copper	0,10 – 0,25
Zinc	0,11 – 0,20
Arsenic	–
Lead	–

Balan basin

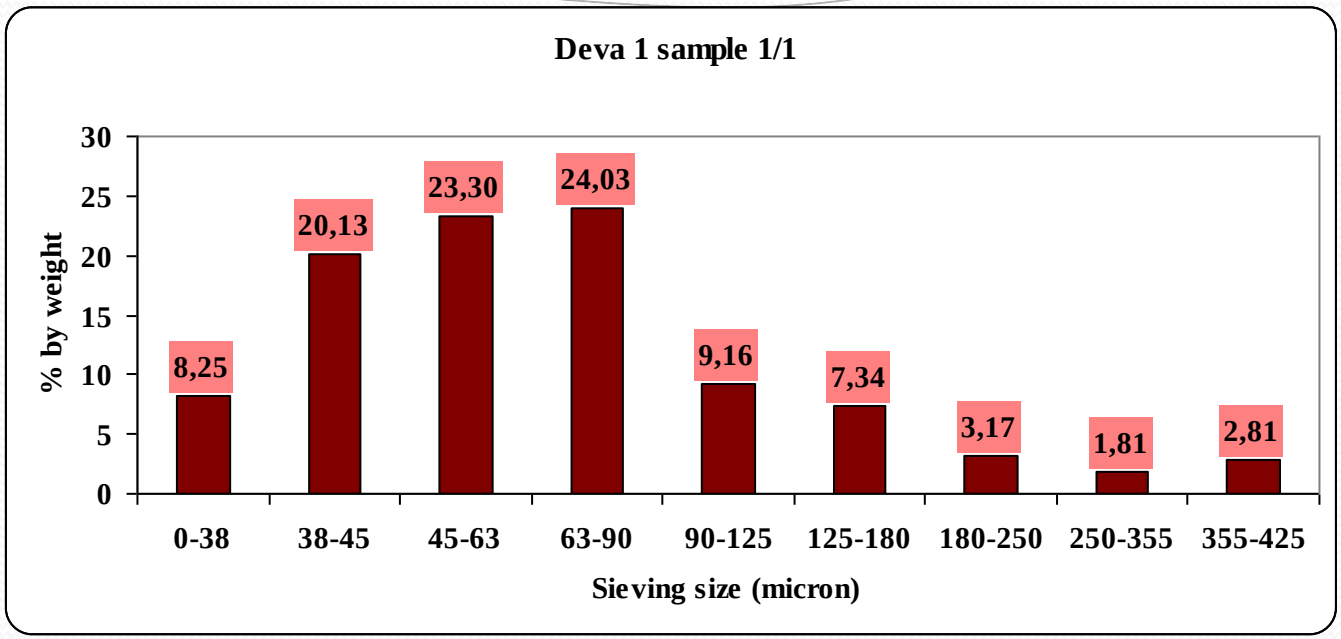
Grain size characterization

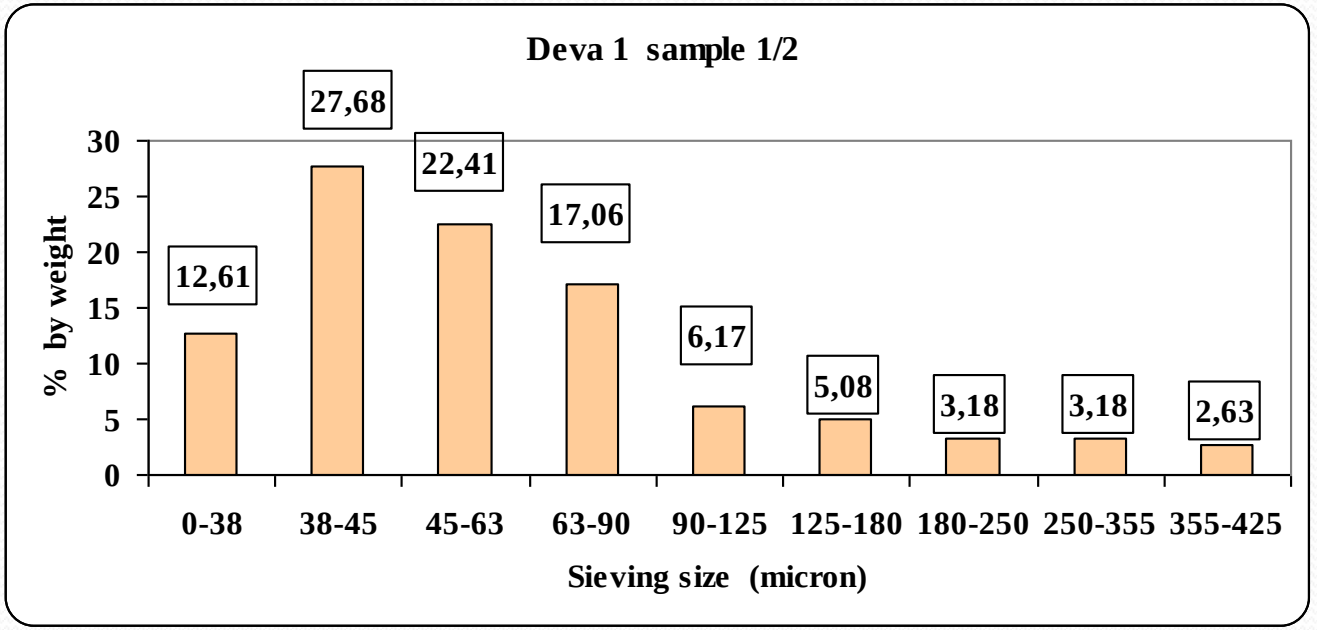


Deva basin – 1° deposit

XRF

1/1 - 1/2	% w/w
Magnesium	0,6 – 1
Aluminum	3,3 – 4,3
Silicon	20,8 – 23,2
Sulfur	–
Potassium	1,3
Calcium	1,3 – 1,6
Titanium	0,12 – 0,14
Chromium	–
Iron	2,6 – 2,7
Copper	–
Zinc	–
Arsenic	–
Lead	–

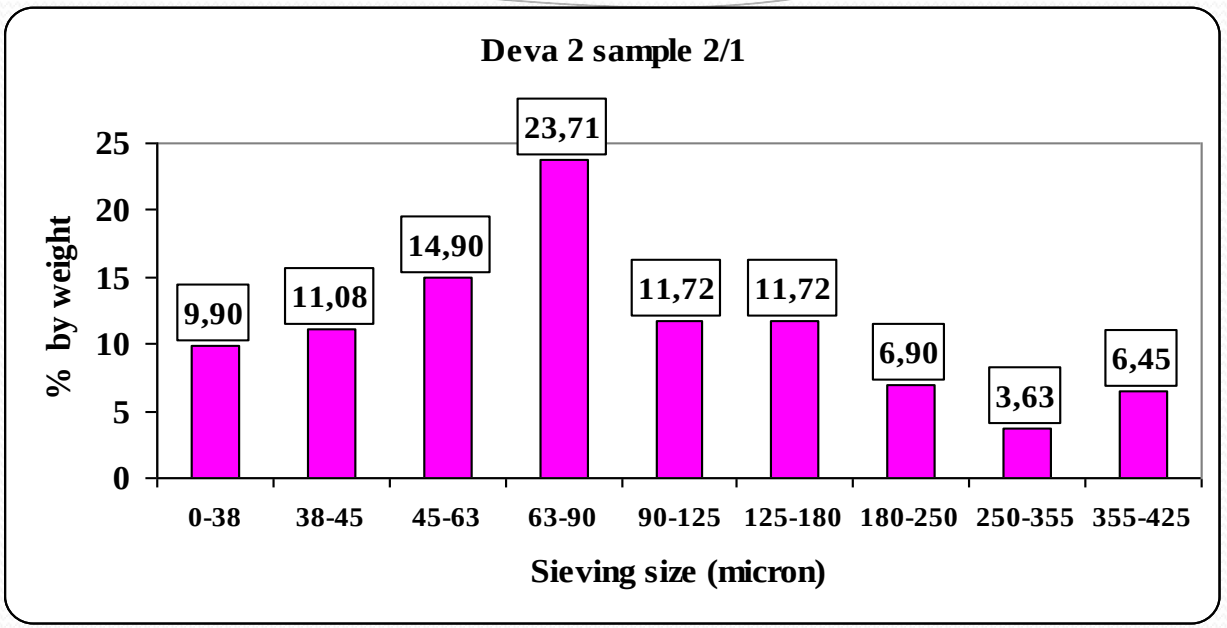


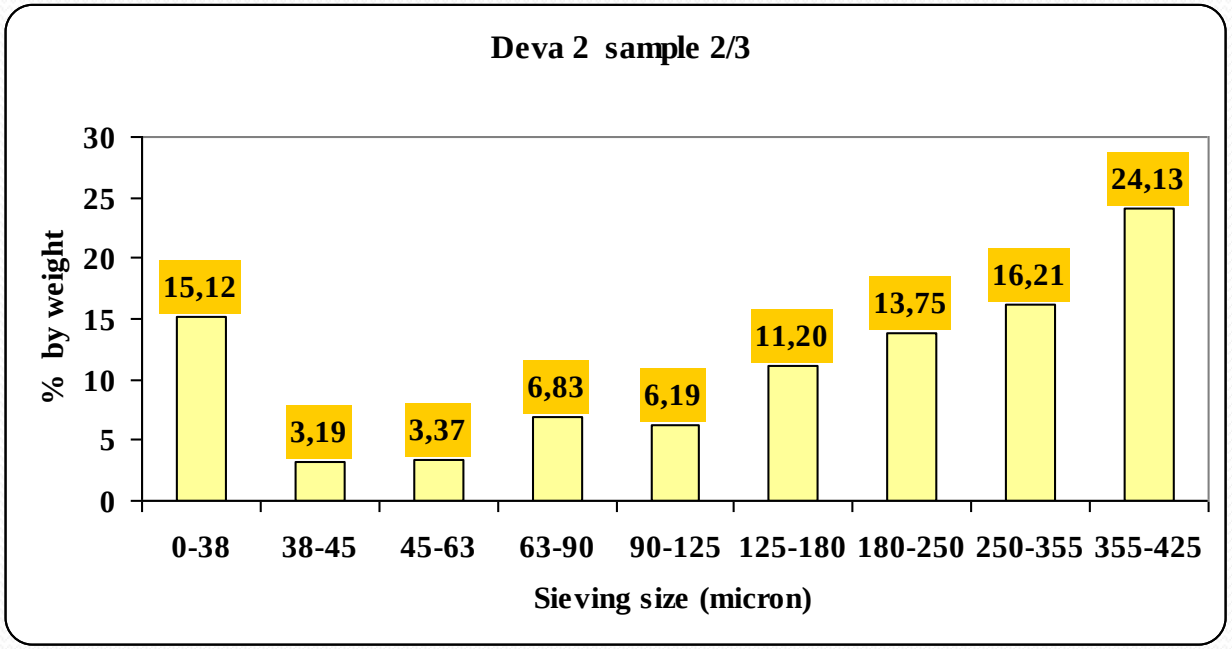


Deva basin – 2° deposit

XRF

2/1 - 2/3	% w/w
Magnesium	0,5 – 1
Aluminum	4,9 – 6,1
Silicon	21,4 – 22,5
Sulfur	0,2 – 0,9
Potassium	0,9 – 1,3
Calcium	1,0 – 1,9
Titanium	0,17 – 0,21
Chromium	0,15 – 0,17
Iron	4,6 – 11,4
Copper	0,16 – 0,25
Zinc	0,11 – 0,44
Arsenic	–
Lead	–

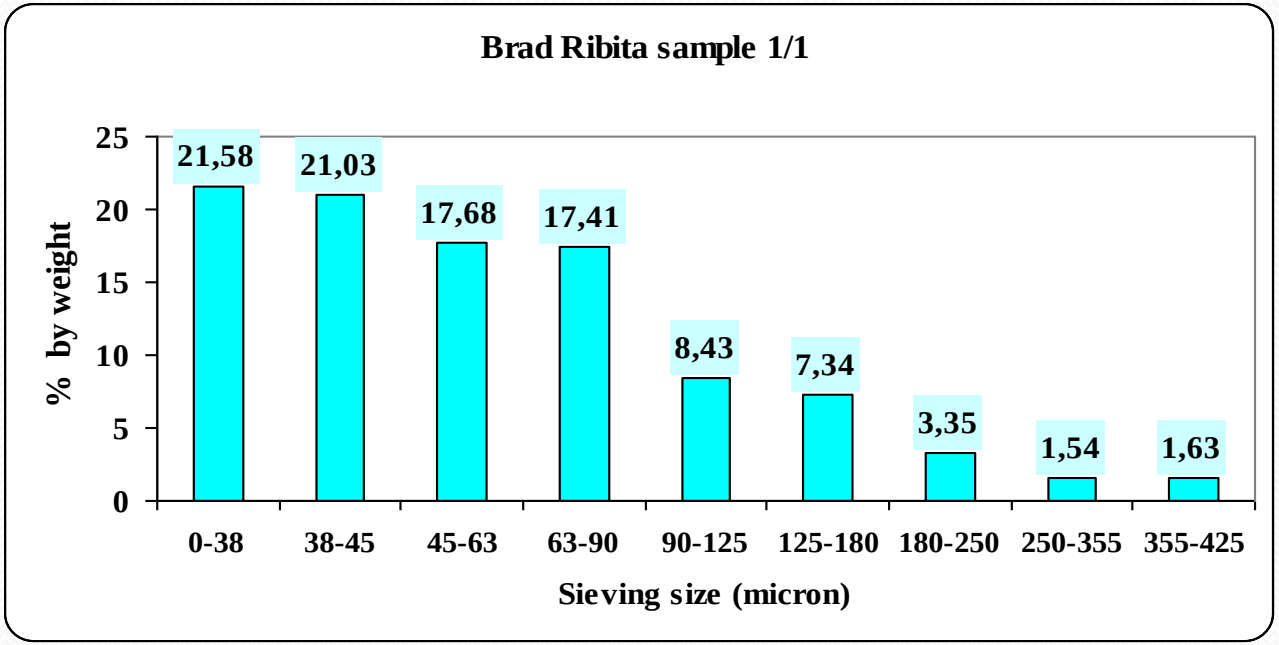


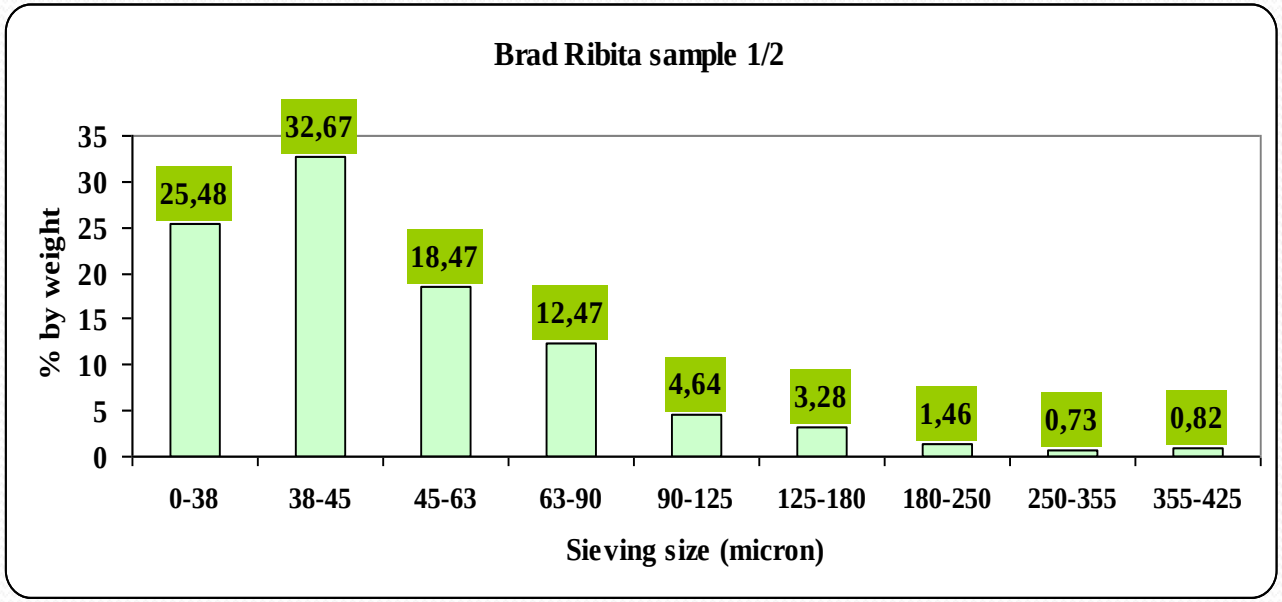


Brad Ribita

XRF

1/1 - 1/3	% w/w
Magnesium	0,60 – 0,96
Aluminum	2,5 – 4,7
Silicon	10,9 – 19,5
Sulfur	0,24 – 0,69
Potassium	1,26 – 1,81
Calcium	1,54 – 2,36
Titanium	0,17 – 0,23
Chromium	0,10 – 0,16
Iron	2,1 – 3,5
Copper	–
Manganese	0,11 – 0,15
Arsenic	–
Zinc	–

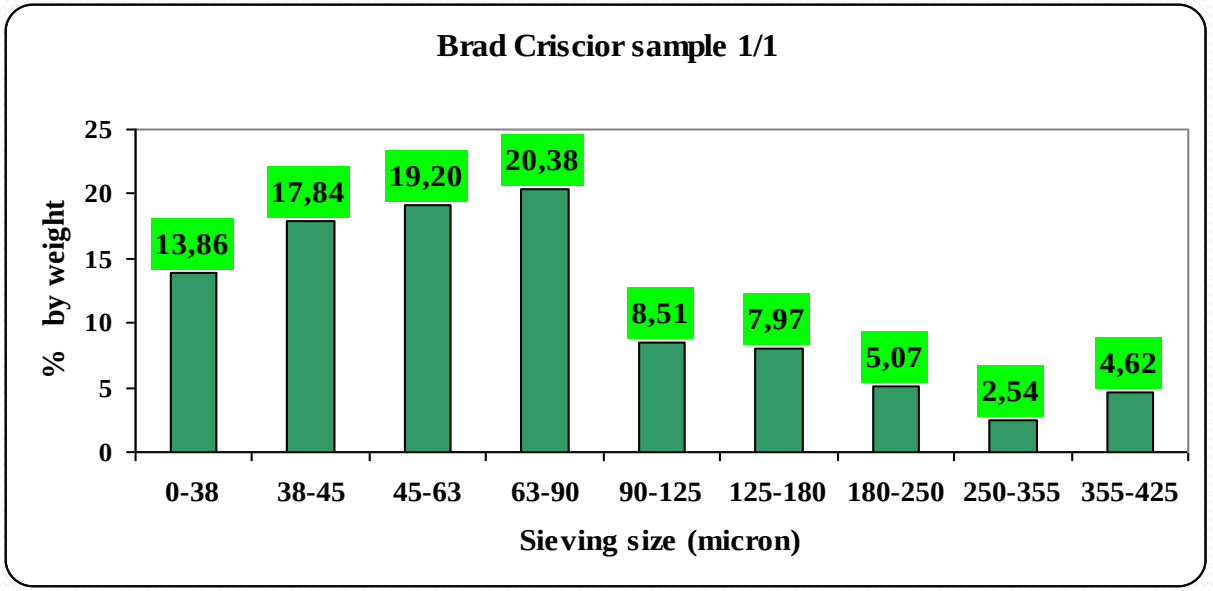


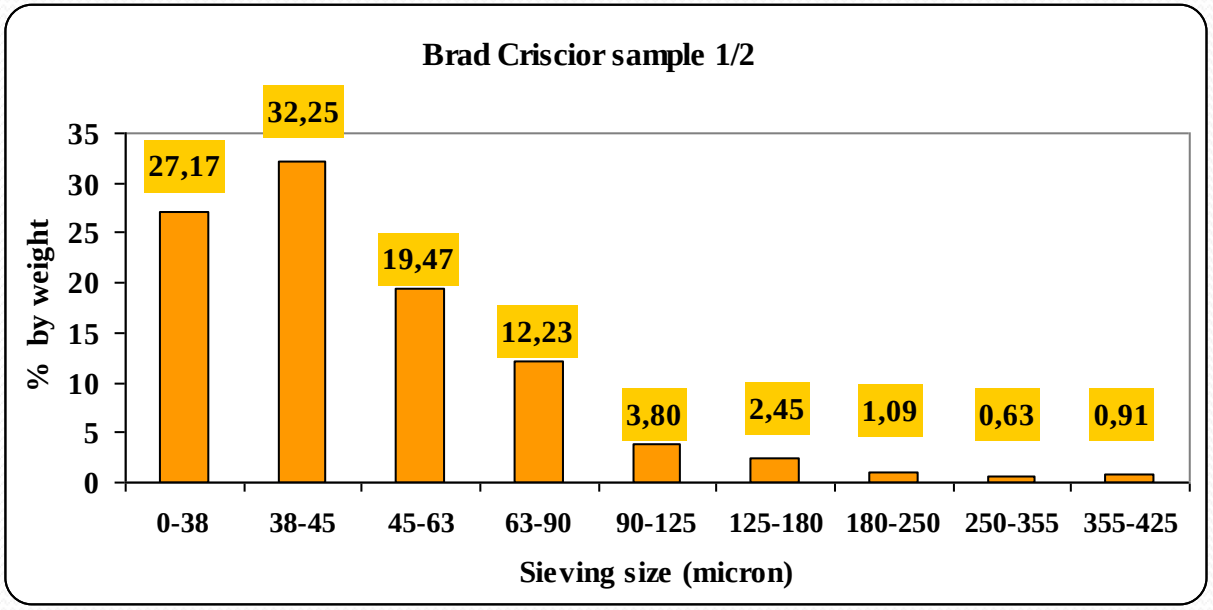


Brad Criscior

XRF

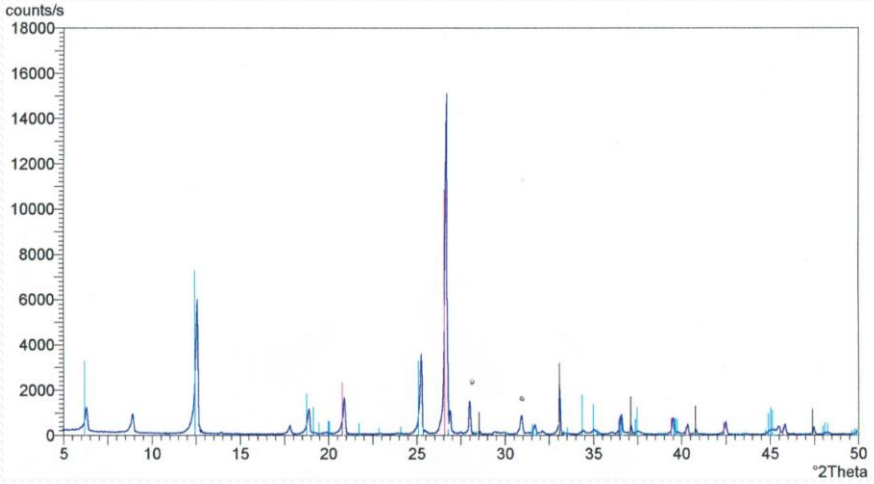
1/1 - 1/3	% w/w
Magnesium	0,8 – 1
Aluminum	1,7 – 3,2
Silicon	9,8 – 18,9
Sulfur	0,32 – 0,54
Potassium	1,1 – 1,8
Calcium	2,1 – 2,4
Titanium	0,1 – 0,2
Chromium	0,1
Iron	2,3 – 3
Copper	–
Manganese	0,1 – 0,2
Arsenic	0,01 – 0,1
Zinc	–





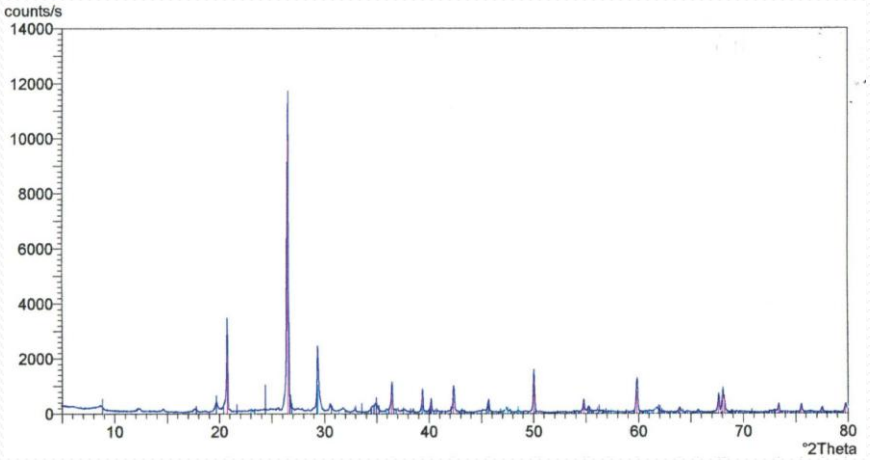
XRD analyses

Balan



- Quartz - SiO_2 >50% w/w
- Chamosite - $Mg_xFe_yAl_zSi_w$
- Pyrite - FeS_2
- Pyroxenes

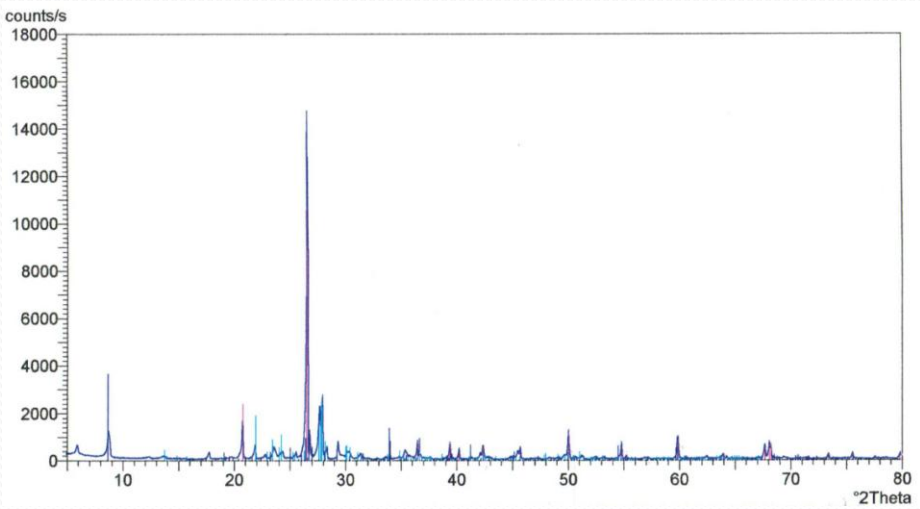
Bad Criscior



- Quartz - SiO_2
- Calcium carbonate - $CaCO_3$
- Pyrite - FeS_2
- Mica

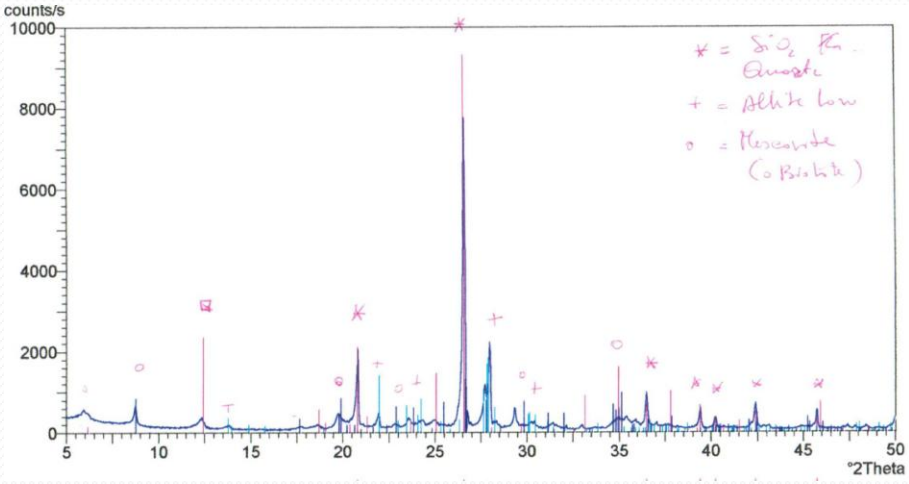
XRD analyses

Deva 1



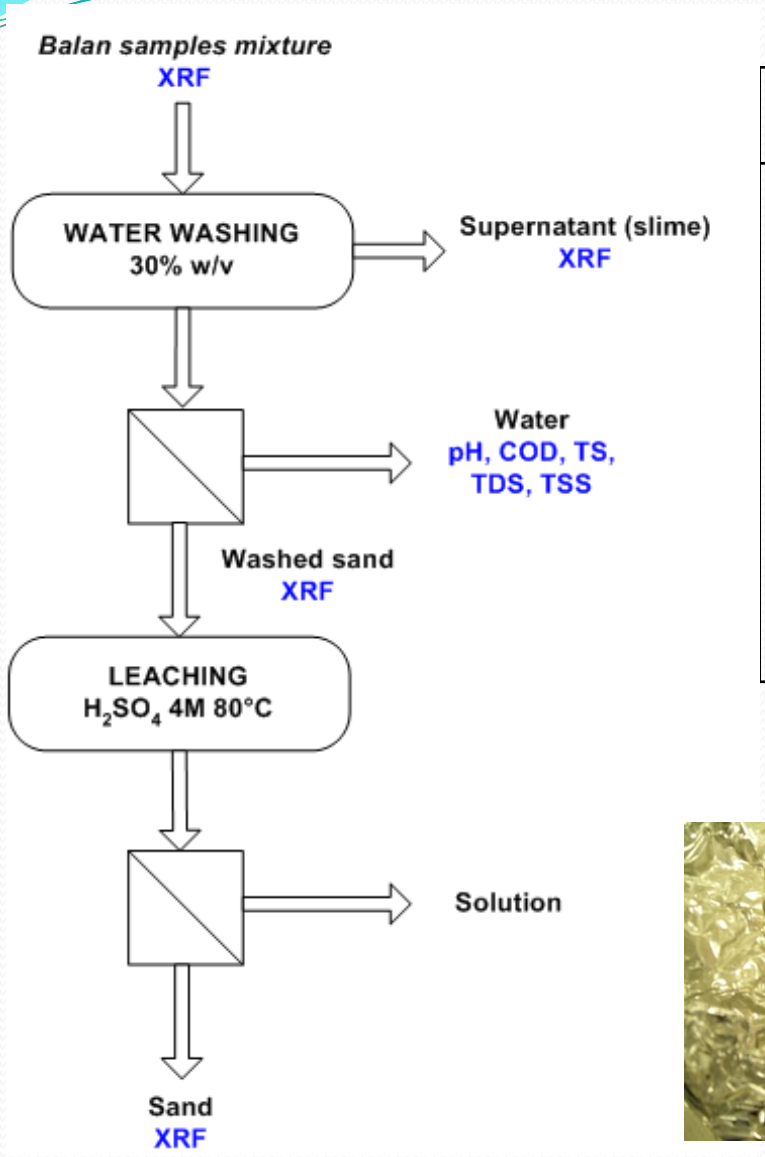
- Quartz - SiO_2 >60% w/w
- Biotite - $K_2Fe_xMg_yAl_z$
- Albite - $NaAlSi_3O_8$

Deva 2



- Quartz - SiO_2
- Albite - $NaAlSi_3O_8$
- Muscovite - $KAl_2(AlSi_3O_{10})(OH)_2$

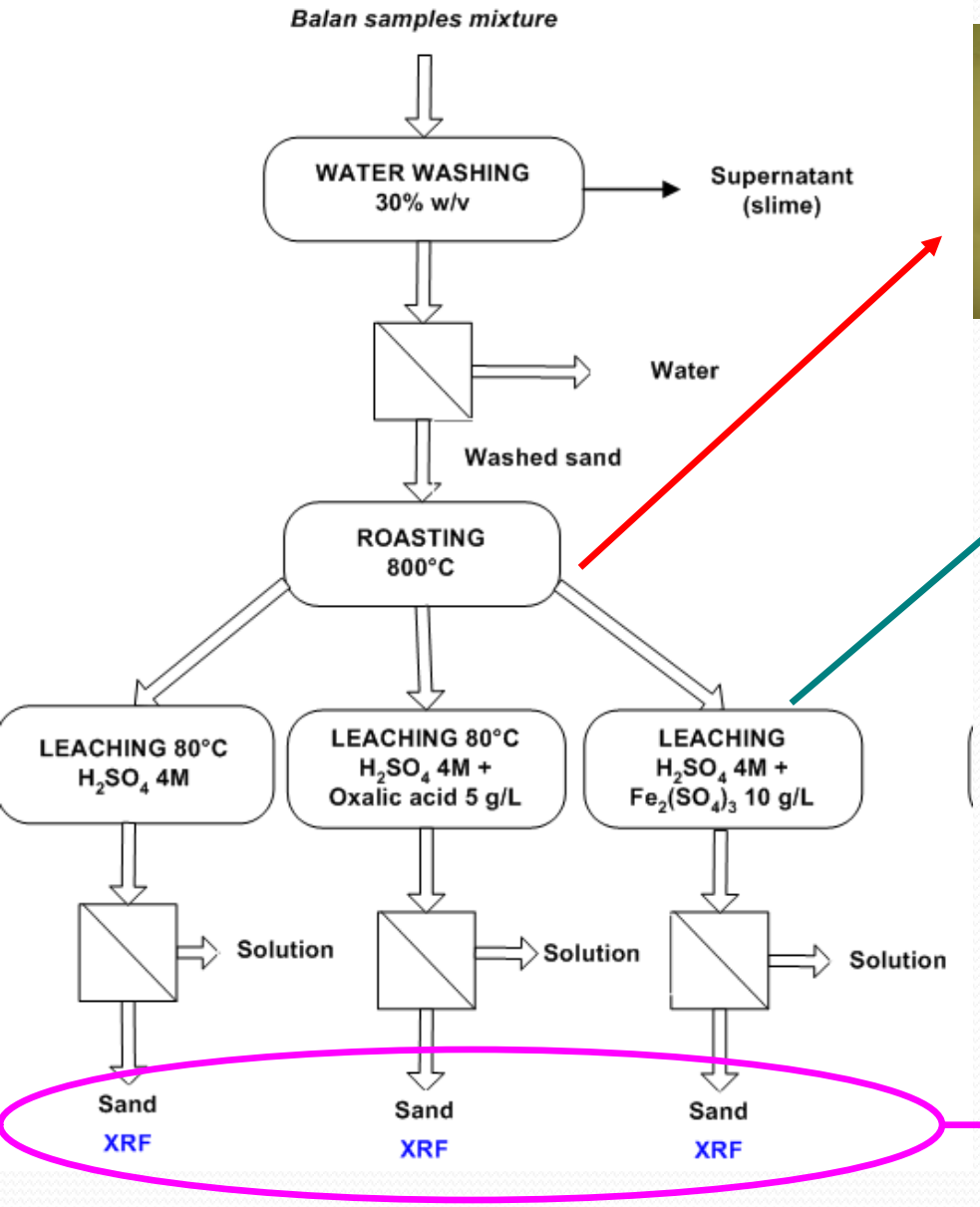
Preliminary tests

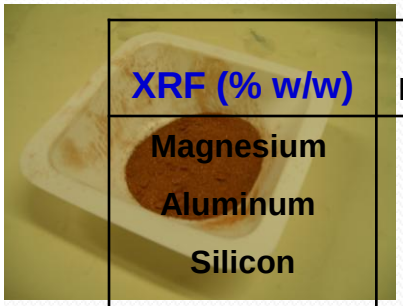


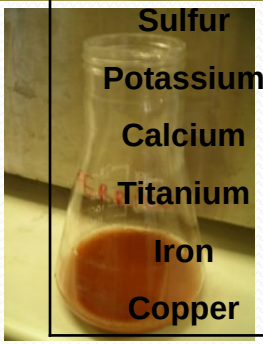
XRF (% w/w)	Mix	Slime	Washed sand	Final sand
Magnesium	2,1	–	2,3	0,5
Aluminum	4,3	–	5,4	0,1
Silicon	23,2	53,7	24,2	0,7
Sulfur	1,6	1,1	1,5	24,3
Potassium	1,0	2,2	1,1	0,1
Calcium	0,5	0,2	0,5	0,1
Titanium	0,3	0,3	0,3	–
Iron	11,1	10,5	11,2	–
Copper	0,2	0,2	0,2	–

Water		
pH	5,4	
COD	125	mg/L
ST	1	g/L
STD	300	mg/L
SST	1,23	g/L

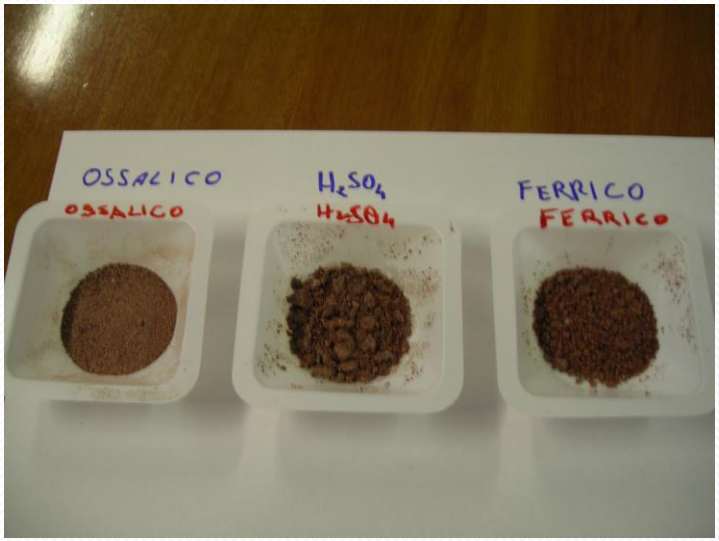
Preliminary tests







XRF (% w/w)	H2SO4	Oxalic acid	Ferric sulfate
Magnesium	–	0,7	1,0
Aluminum	0,8	1,7	1,1
Silicon	8,3	12,9	5,8
Sulfur	3,4	6,8	10,6
Potassium	0,2	0,3	0,2
Calcium	0,2	–	0,1
Titanium	0,1	0,2	–
Iron	5,9	8,4	6,0
Copper	–	–	0,1



Conclusions

- All storage basins have similar composition.
- Quartz concentration is at least 50% w/w.
- Metals at higher concentration: aluminum and iron.
- The thermal treatment is an option but costs have to be carefully investigated.

Further work and development

- Full characterization of the sites.
- Characterization of the groundwater table and subsurface geology.
- Physical/mechanical treatments to obtain different fractions.
- Roasting and leaching tests.
- Recovery of the metals from leach liquor.
- Mass balance and characterization of every flow.
- Economic evaluation of the project.
- Tests on pilot-scale plant.

Laboratory equipment

AAS

UV-Vis

UV-Vis Dr Lange

AAS

XRD

GC-MS

Laboratory equipment

XRF

Porosimeter

Digestion microwave apparatus

Furnace

DTA-TG

TKN analyzer

EC Recycling

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Spin Off

Thank you for your attention