Metal recovery by adsorption-desorption from industrial sidestreams

Kokkola Material Week, WaterPRO project endseminar

Esther Takaluoma

28.2.2022

Programme for Sustainable Growth and Jobs

Leverage from the EU 2014–2020

European Union
European Regional Development Fund

Metal recovery – not precipitation

Rio Tinto near Huelva, AMD

- Conventional industrial wastewater treatment often includes neutralization by lime, while this method removes potentially harmful metals by coprecipitation with gypsum, we lose valuable metals in a difficult, calciumrich matrix, which will be difficult to rework later
- Initially research was focused on battery chemicals, e.g. on Cu and Co

Programme for Sustainable Growth and Jobs
Leverage from the EU 2014–2020
European Union
European Regional Development Fund

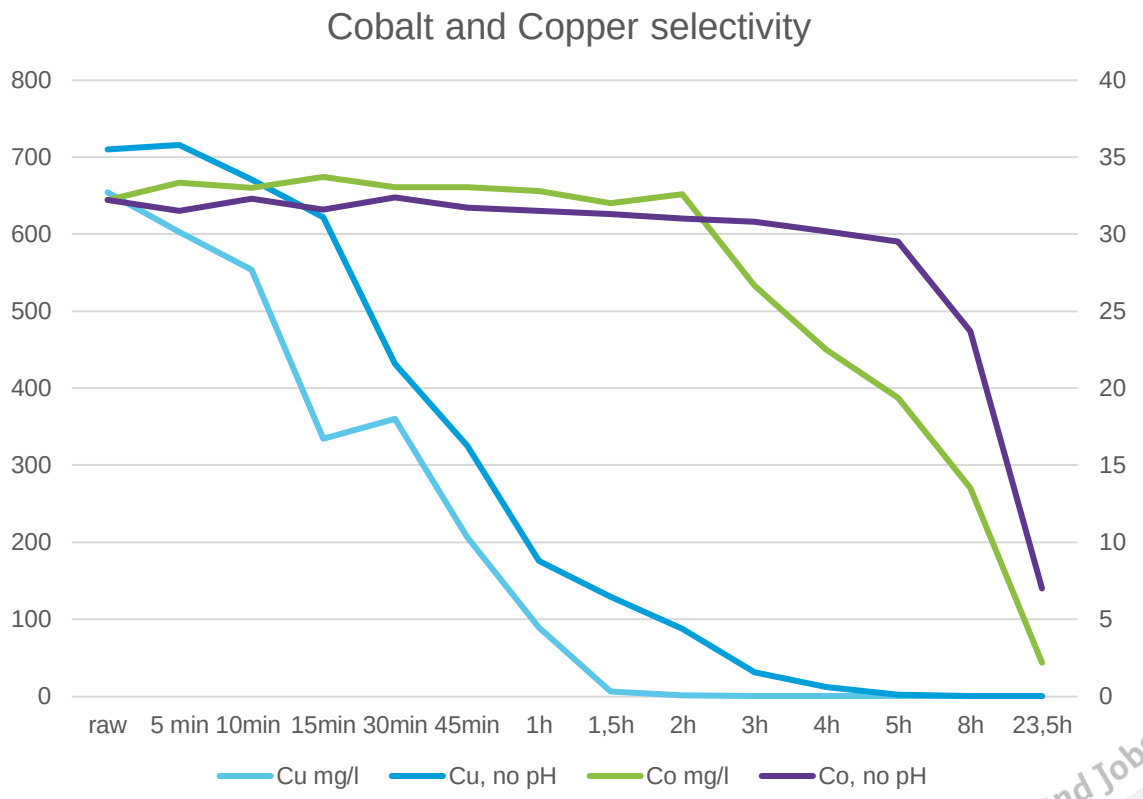
Adsorbent regeneration

- Adsorption not a zero-waste technology
- selectivity difficult
- opex high due to recurrent buying of fresh adsorbents
- Regeneration necessary to reduce waste sludge, reduce costs, and to recover material
- Revenue of material/Circular economy
- Co **59 500** €/t
- Cu **4 400** €/t

Programme for Sustainable Jobs
Leverage from the EU 2014–2020
European Union
European Regional Development Fund

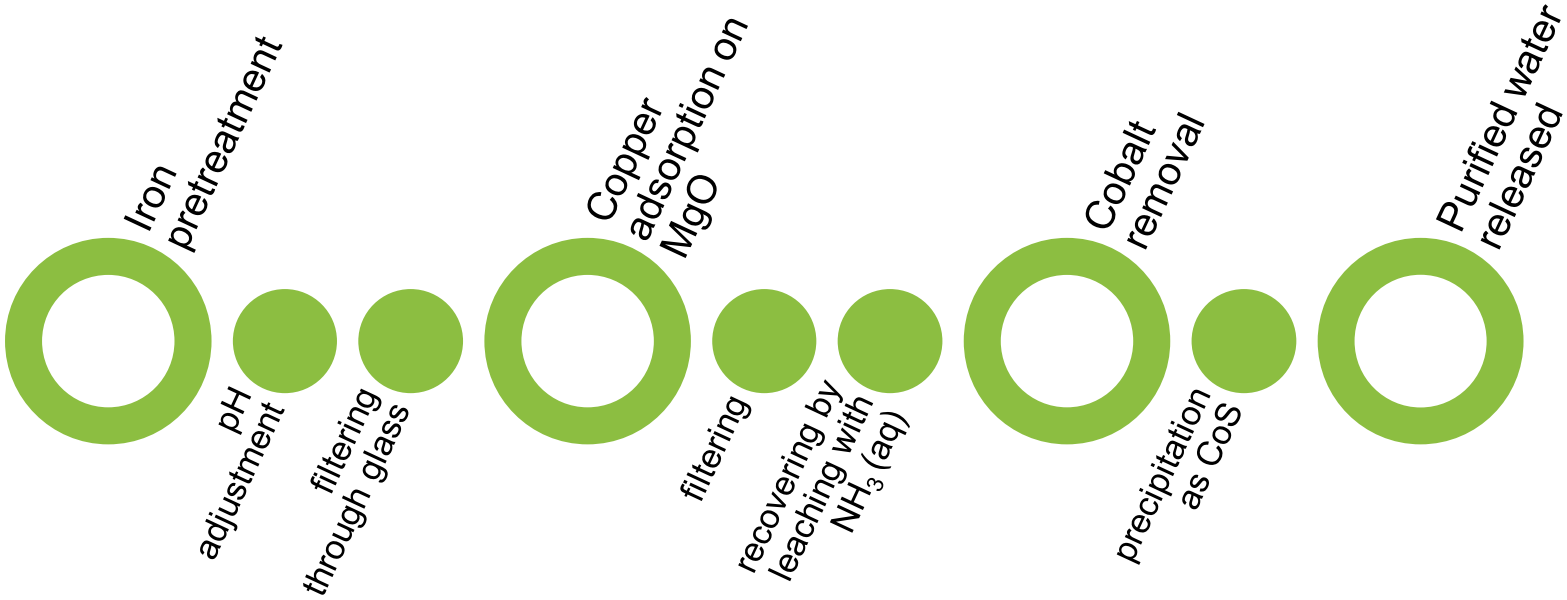
We started research with a mine water sample from Sambia

element	mg/l
Co	37,552
Cu	895,05
Mn	105,14
Fe	15,434
Ca	59
Mg	940
K	-
Zn	2,36



Programme for Sustainable Growth and Jobs
Leverage from the EU 2014–2020
European Union
European Regional Development Fund

New Treatment Concept, Sambian water

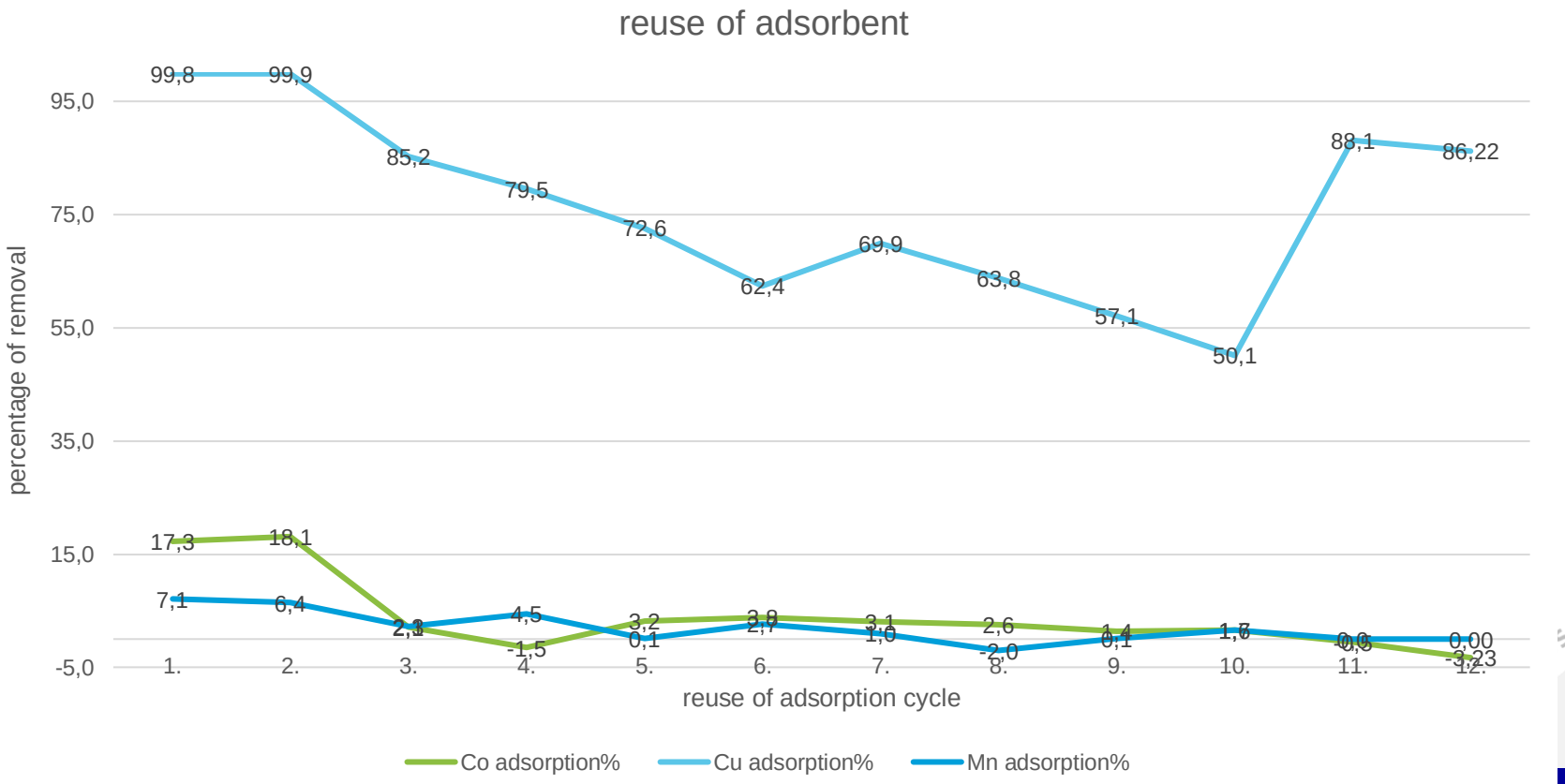


Possible ozonation, filtering through different materials, diatomaceous earth

Possible reuse of adsorbent until saturated, leaching with acid

Programme for Sustainable Growth and Jobs
Leverage from the EU 2014–2020
European Union
European Regional Development Fund

Adsorbent efficiency after desorption in loop



Leverage from the EU 2014–2020
European Union
European Regional Development Fund

Pyhäsalmen mine water

Value of metals dissolved, Co, Cu, Zn
= 1,09 €/m3

element	mg/l
Al	370
Ca	390
Cd	1
Co	1
Cu	29
Fe	**350**
Mg	690
Mn	27
Ni	1
Zn	370

Programme for Sustainable Growth and Jobs
Leverage from the EU 2014–2020
European Union
European Regional Development Fund

Iron removal a bit more problematic….

	Zn mg/l	Cu mg/l	Mn mg/l	Fe mg/l
Raw water pH 2	340	28,6	26,4	153,05
pH5 + filtr	315	**11,6**	25	**7,613**
adsorption	295	0,36	23,6	3,2738

	Zn mg/l	Cu mg/l	Mn mg/l	Fe mg/l
Raw water pH2	320	27,2	28,4	154,1
pH5 + filtration	310	**12,6**	**11,8**	**6,744**
1. adsorption	275	0,49	10,2	2,578
2. adsorption	0,08	0	0	2,716

Programme for Sustainable Growth and Jobs
Leverage from the EU 2014–2020
European Union
European Regional Development Fund

More tests!

pH adsorption with dolomite Cu remains at same concentration

	pH	Cu	Zn	Fe
Raw water	n.2	28,6	455	176,14
dolomite1 g/l	3,06	28,6	430	166,14
Dolomite 5 g/l	3,24	28,8	430	77,6
Dolomite 10 g/l	**3,76**	**28,2**	**460**	**7,545**

Programme for Sustainable Growth and Jobs
Leverage from the EU 2014–2020
European Union
European Regional Development Fund

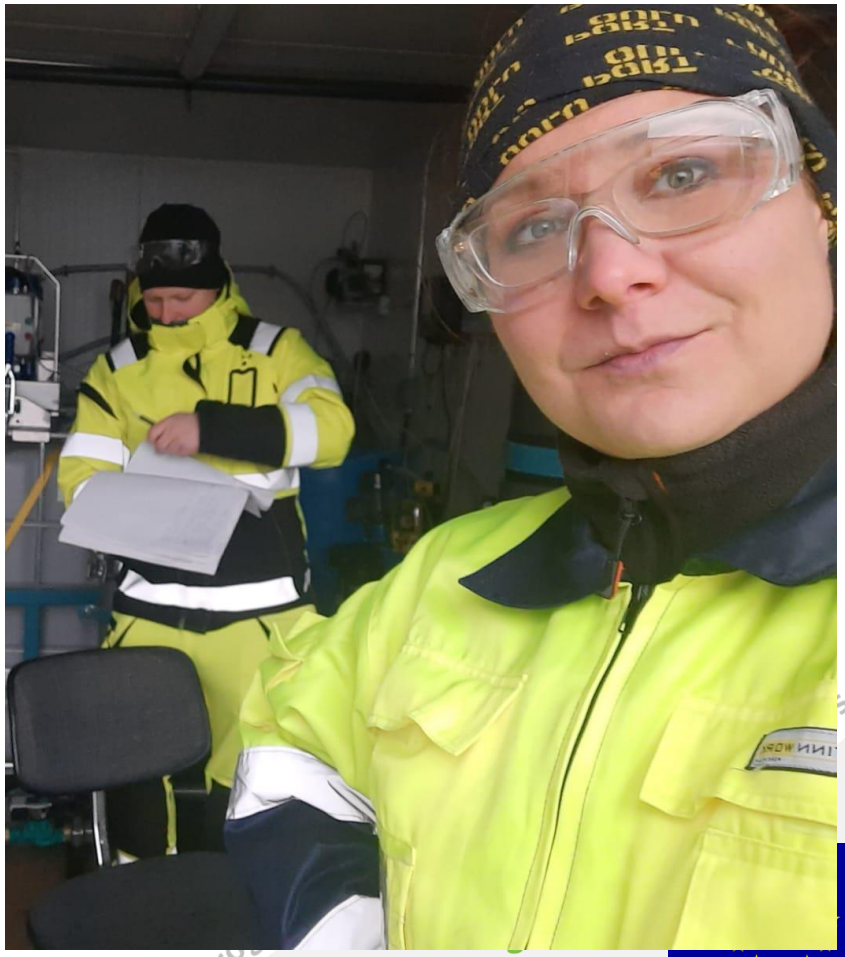
Can we also remove Zinc?

	Fe mg/l	Cu mg/l	Zn mg/l	Mn mg/l
raw	314	28,2	352	29,6
1. ads	0,75	15,8	356	32,2
2. ads	0,01	0,3	285	32,6
3. ads	0,01	0,06	0,03	2,1

- 1.ads: poltettu dolomiittiraetta 10g/l eli 5g, sekoitus hitaalla 2h, suodatus, analyysit
- 2.ads: suodatettu ps vesi 400ml ja 1 g/l MgO eli 400mg, sekoitus 2h, suodatus, analyysit
- 3.ads: suodatettu ps vesi 300ml ja 5g/l MgO eli 1,5g, sekoitus 24h, suodatus, analyysit

Programme for Sustainable Growth and Jobs
Leverage from the EU 2014–2020
European Union
European Regional Development Fund

Ready for piloting! Waiting for results :-D



the EU 2014–2020
European Union
European Regional Development Fund