MSCA-ETN SULTAN

European Training Network for the Remediation and Reprocessing of Sulfidic Mining Waste Sites

Synthesis of Novel Chelating Surfactants for Ion Flotation

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KU Leuven (Leuven, Belgium); start date: 16 Jan 2019

Objectives

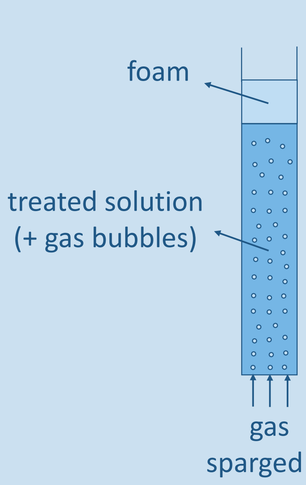
- ❑ Design and synthesis of surfactants containing chelating groups using renewable starting materials or abundantly available natural products.
- ❑ Elucidation of the efficiency and selectivity of metal removal by ion flotation.
- ❑ Study of the recovery of metals from the collected foam.

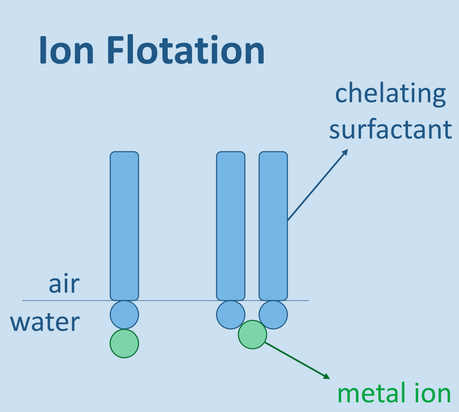
Milestones

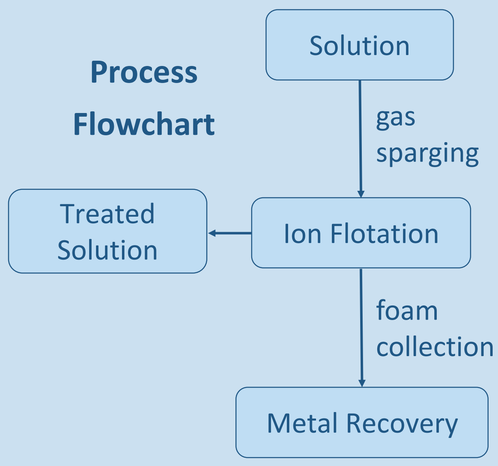
- ❑ **Aug 2020** – Library of 20 new compounds containing > 4 different ligands including 5 natural product derived surfactants. Initial results on their efficiency in selective ion flotation.
- ❑ **Dec 2021** – Extended library of compounds and selection of the 5 most promising ones for industrial implementation. Optimized procedure for the selective removal of ions by flotation.

Deliverables Progress

1st Scientific paper
2nd Scientific paper
Doctoral thesis







Design of Chelating Surfactants - HLB approach

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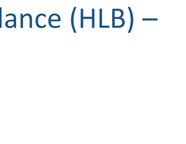
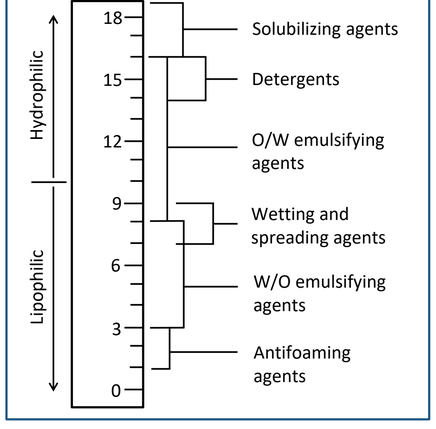
- ❑ Modelling of the structure to surface activity relation by hydrophilic-lipophilic balance (HLB) – an empirical parameter.

HLB (Davies) = $n_H \times X_H - n_L \times Y_L + 7$

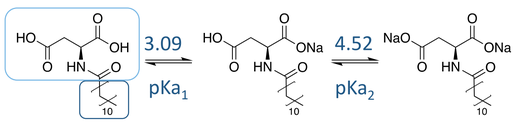
n_H , n_L – respective number of hydrophilic and lipophilic groups
X_H , Y_L – empirical numbers assigned to each hydrophilic and lipophilic group, respectively



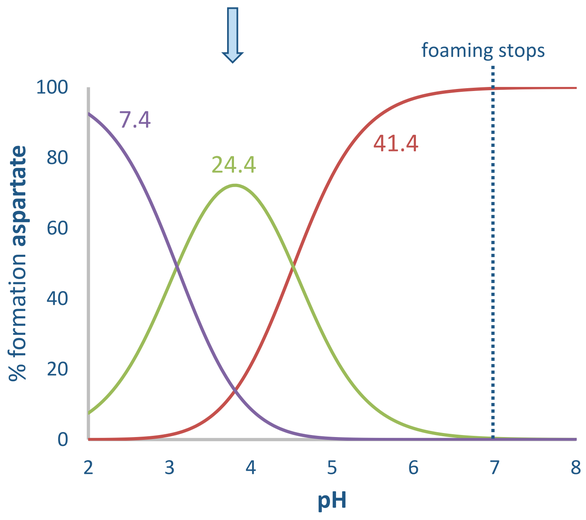
HLB = 40.0

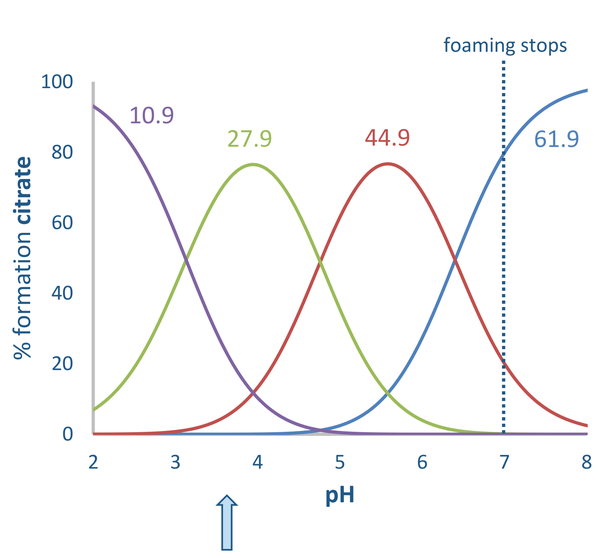


HLB scale of non-ionic surfactants

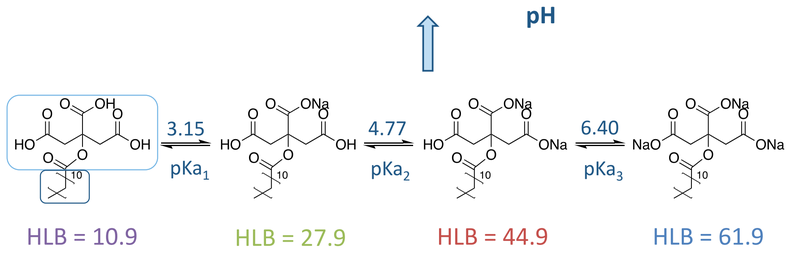


HLB = 7.4 HLB = 24.4 HLB = 41.4





HLB range of foam-forming species: **21 – 28**

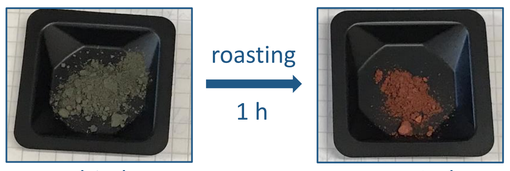


HLB = 10.9 HLB = 27.9 HLB = 44.9 HLB = 61.9

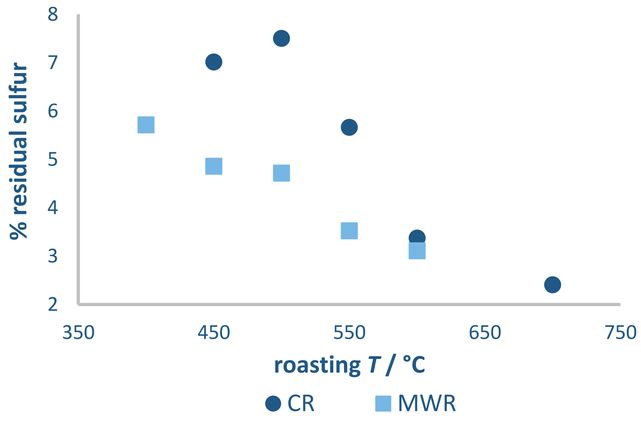
MW Roasting and Leaching of Neves-Corvo Tailings

VITO (Mol, Belgium), supervisor: Jeroen Spooren, 21 Oct – 20 Dec 2019 with Panagiotis Xanthopoulos (ESR10)

vito

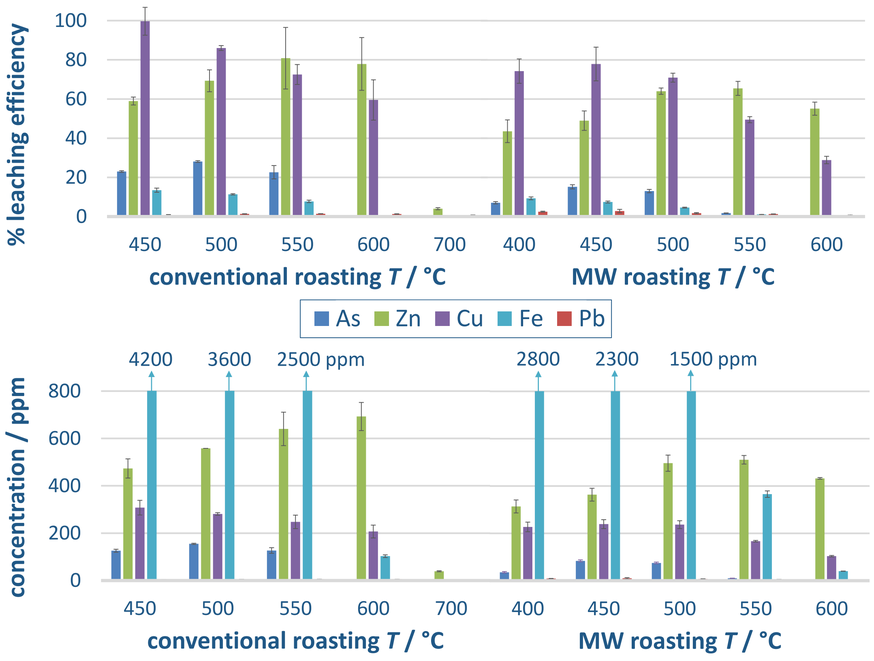


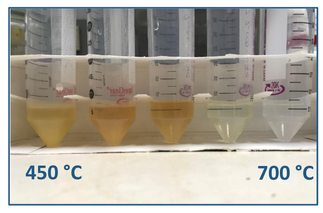
- ❑ Sample used: SUL-NC-02 (dried under N_2 at 40 °C), preparation and previous analyses of the starting material were done by Maja Vučković (ex ESR7).
- ❑ Conditions: T = 400 – 700 °C, t = 60 min, m(CR) = 5.0 g in porcelain cup crucibles, m(MWR) = 6.0 g in alumina boat crucibles, samples were ground prior to roasting.
- ❑ Characterization:
  Starting material – XRD, XRF, TGA
  Roasted material – XRD, XRF
  Leachates – ICP-OES
  Solid residues – XRF
- ❑ Crucial parameters: roasting t and T, size and shape of the crucible, position within the oven.

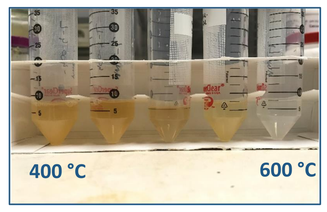


Water Leaching

Conditions: L/S = 10, t = 30 min, T = r.t.







Conclusion

- ❑ HLB model describes the structure to surface activity relation well, but there are other structural characteristics influencing the foaming properties such as vicinity of the charged groups within the molecule.
- ❑ The model might be improved using computational methods.
- ❑ HLB is affected by the chelation of metal ions – foaming properties need to be investigated in aqueous solutions containing metal ions.

Upcoming Steps

- ❑ Ion Flotation: single element solution experiments – metal removal efficiency and foaming properties in the presence of metal ions.
- ❑ Surfactant Characterization – CMC determination at 3 distinct pH values to gain more insight into the influence of pH.
- ❑ Synthesis of histidine and glutathione surfactants.

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