Studies on the Adsorption of Flotation Collectors on Iron Oxides

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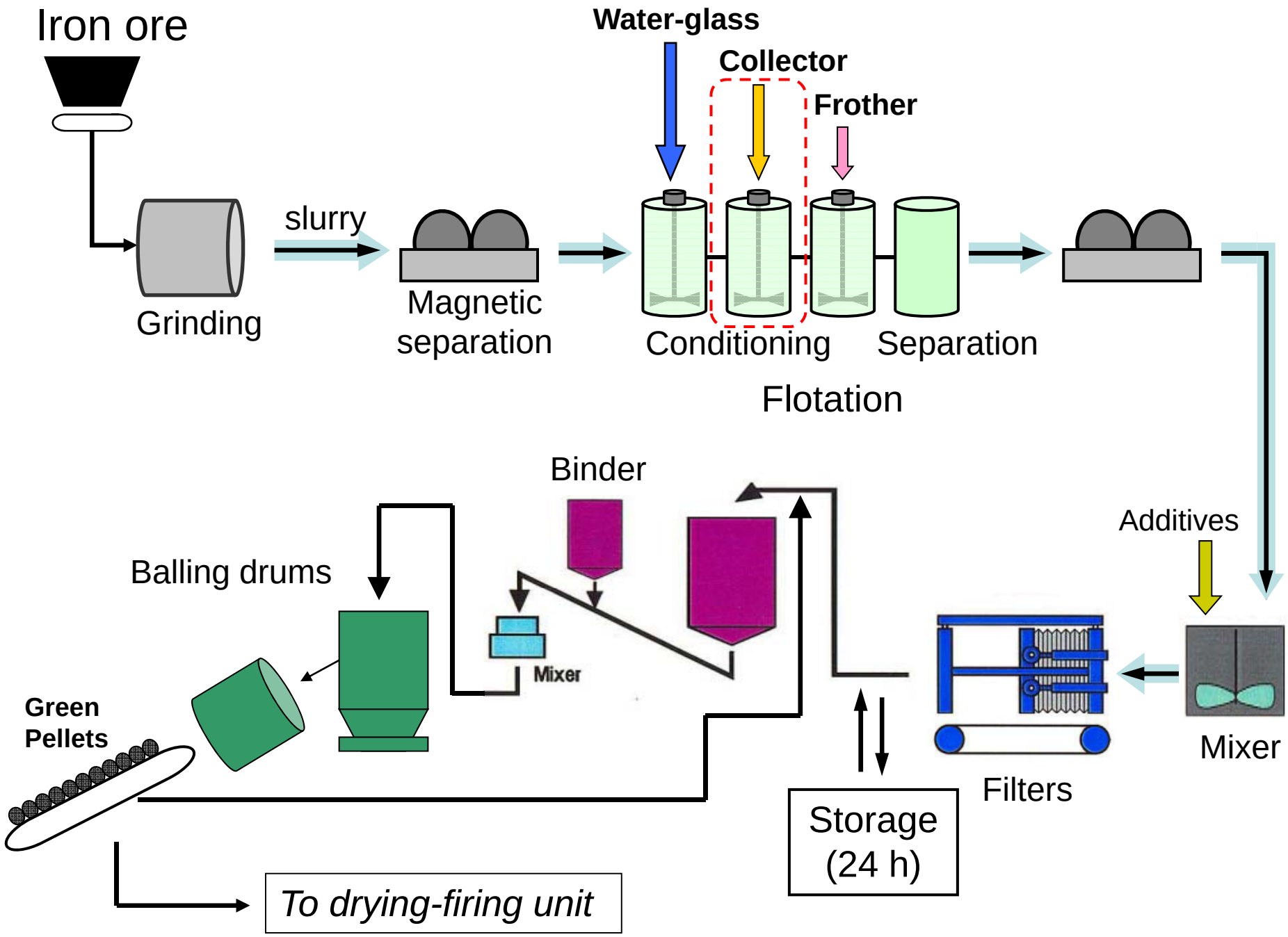
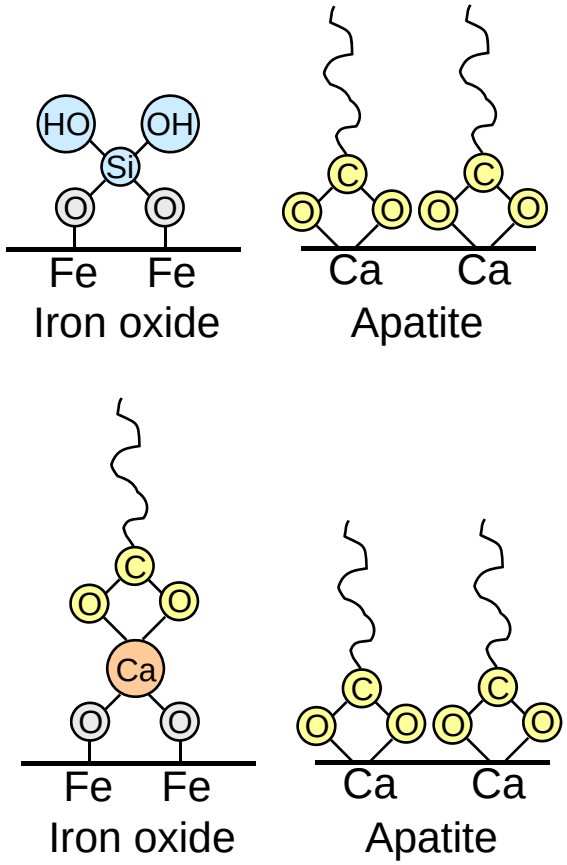

Iron ore
Grinding
slurry
Magnetic separation
Water-glass
Collector
Frother
Conditioning
Separation
Flotation
Binder
Balling drums
Mixer
Additives
Mixer
Filters
Storage (24 h)
Green Pellets
To drying-firing unit

BACKGROUND

- Flotation – to reduce phosphorus content in the ore
- Collector should adsorb selectively on apatite and make it float with the air bubbles
- Sodium silicate is added as dispersant/depressant
- Calcium ions in the process water can cause unwanted adsorption and precipitation of flotation collector on magnetite*
- Adsorbed collector reduces wettability of the magnetite surface decreasing green pellet strength#



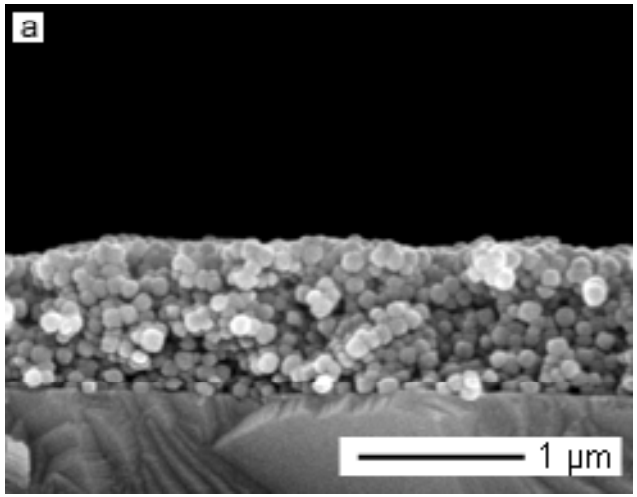
*Rao et al. (1990)
#Forsmo et al. (2008)

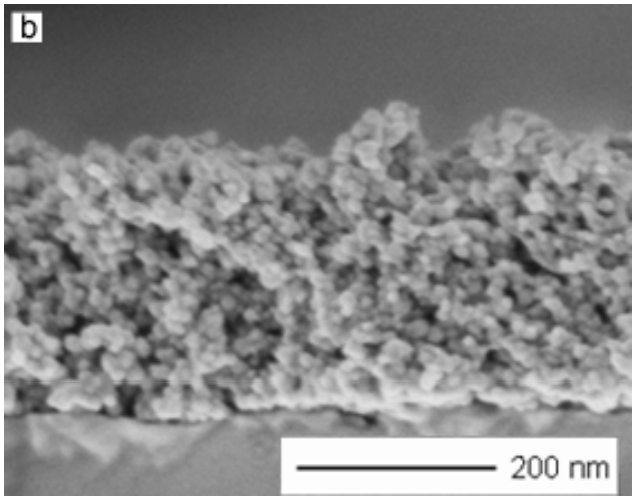
SCOPE OF THE PRESENT WORK

- To develop a method for studying adsorption of flotation collectors on iron oxides.
- To elucidate the mechanism of adsorption.
- To study the effect of different factors on collector adsorption.
- Long term goal – to minimize the effect of flotation step on the agglomeration properties of iron oxide.

EXPERIMENTAL: Materials

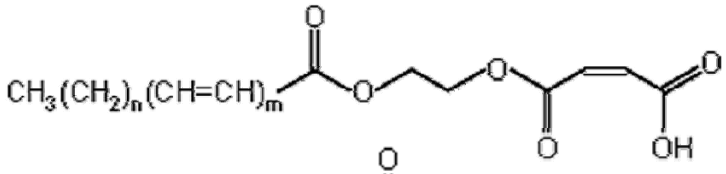
- Films of synthetic hematite (a) and magnetite (b) with a high surface area



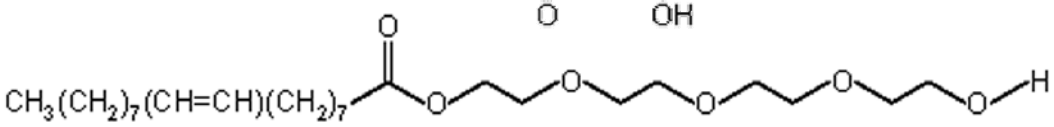


- Collectors studied:

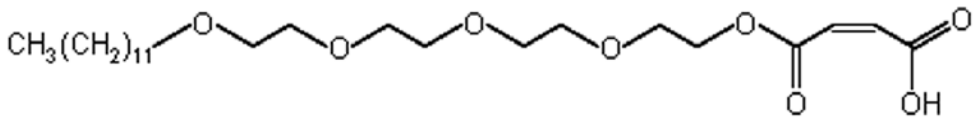
Atrac 1563



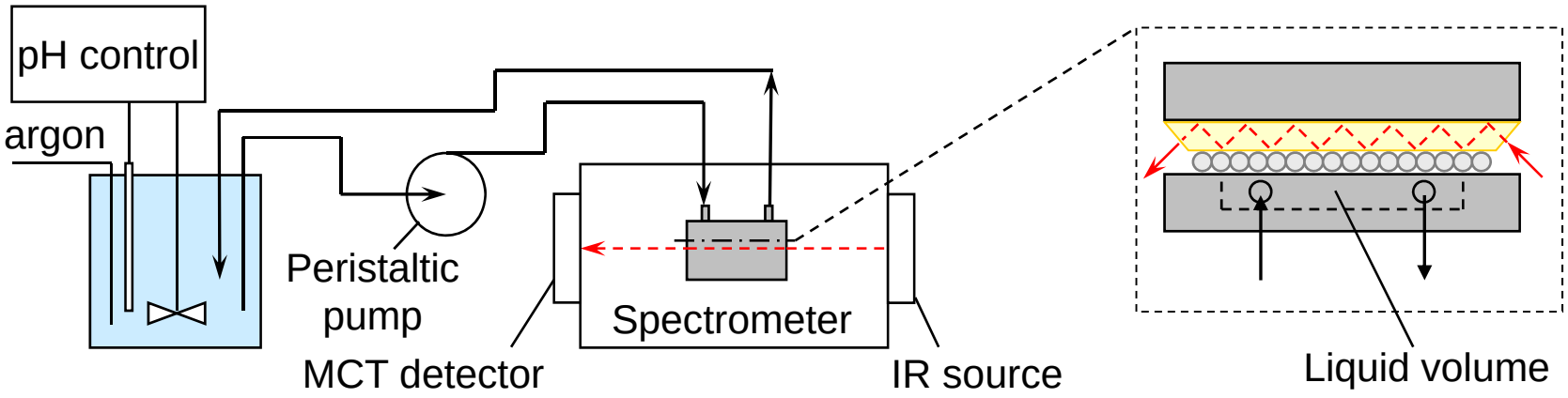
PEGMO

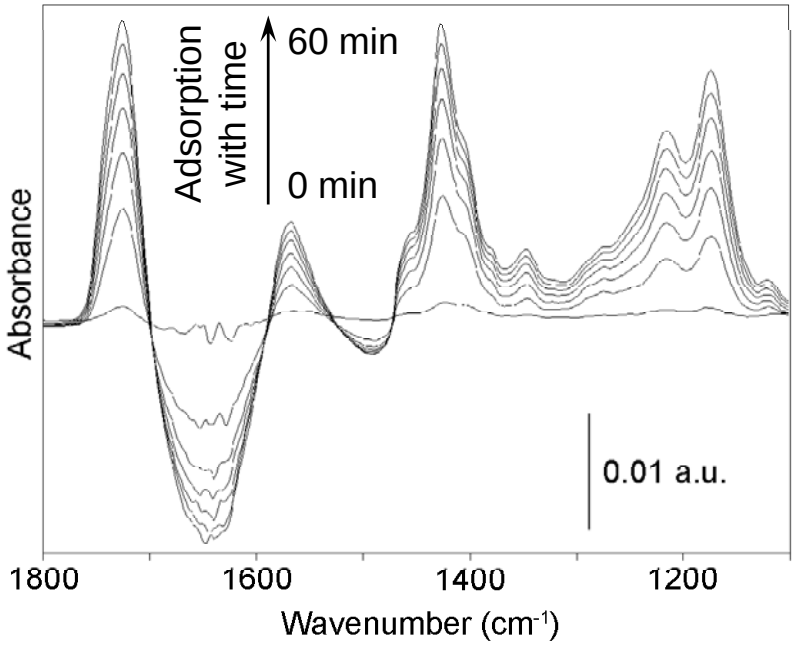


Maleic acid ester



EXPERIMENTAL: ATR-FTIR spectroscopy



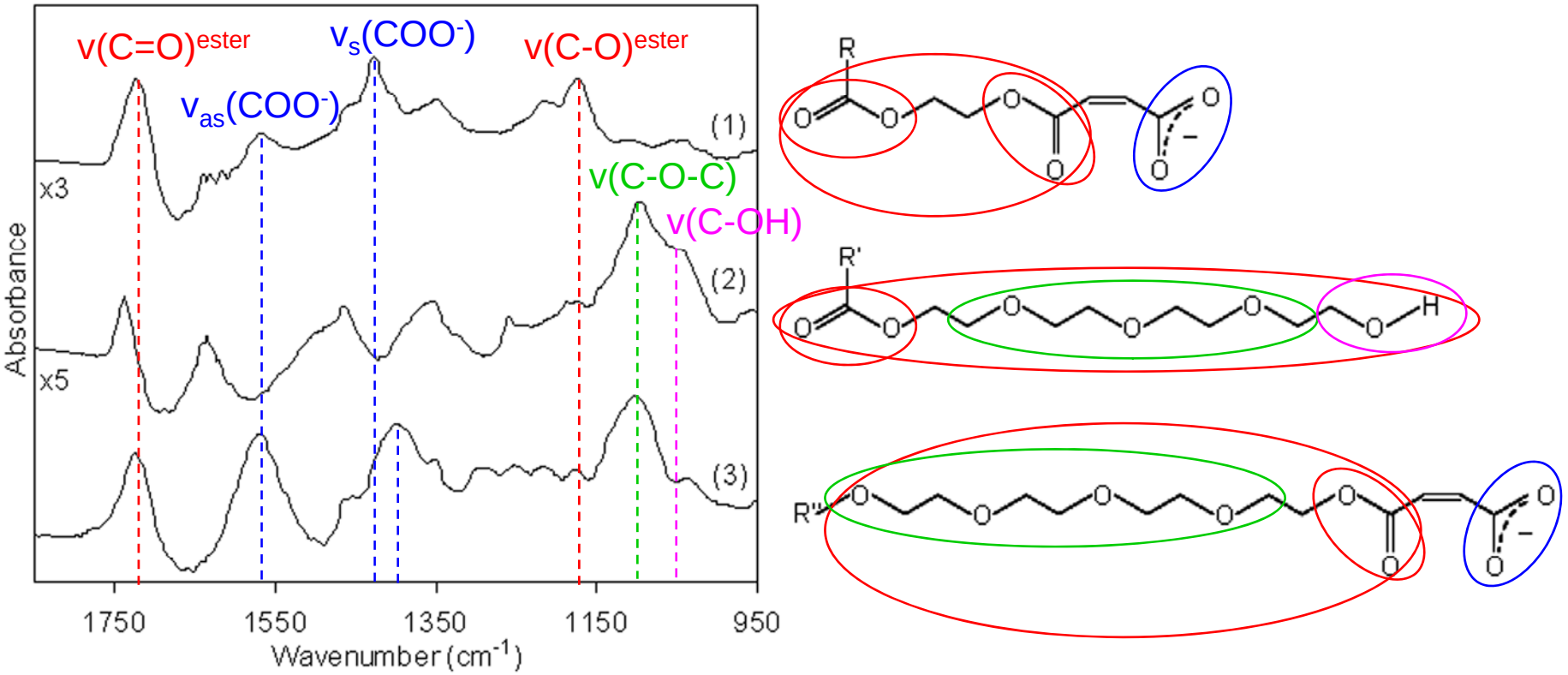


Adsorption of Atrac on hematite, pH 8.5

The Lambert-Beer law:

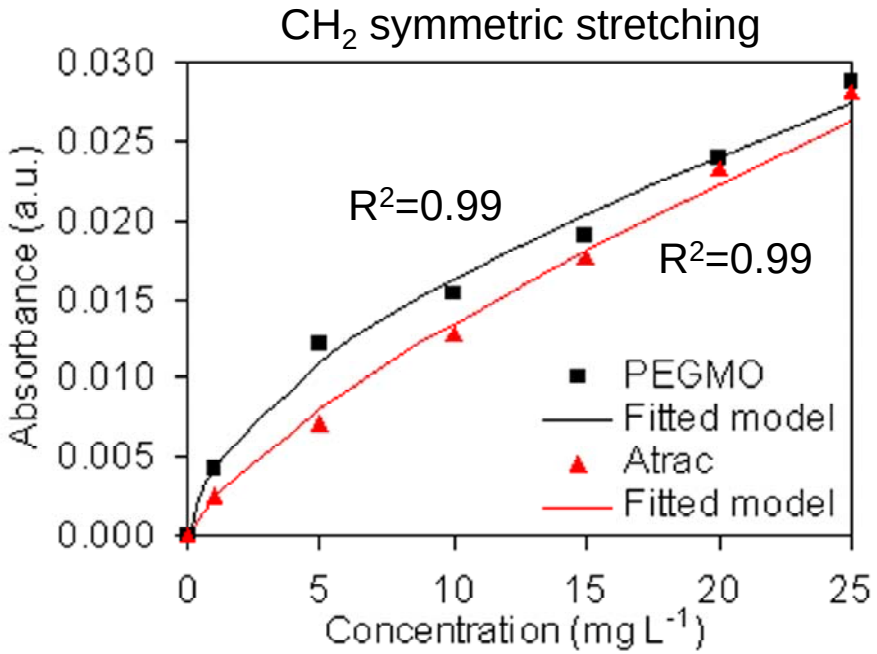
Absorbance $\propto$ amount of the collector adsorbed on the surface

RESULTS: Adsorption mechanism



- Repulsion between carboxylate ions and negatively charged surface
- Non-charged polar groups can interact with the surface
- Hydrophobic chain-chain interactions

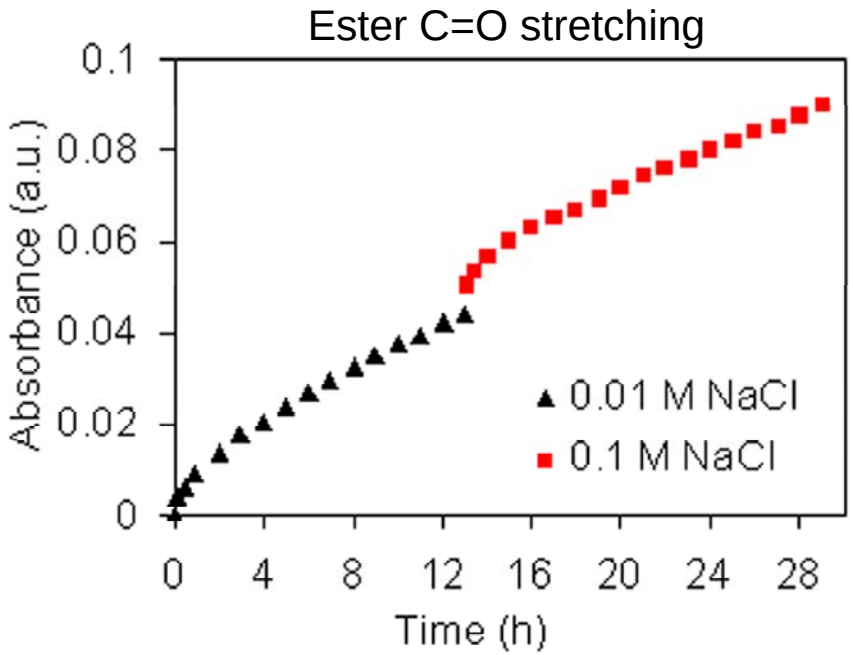
RESULTS: Effect of collector concentration



Adsorption of Atrac and PEGMO on hematite (pH 8.5)

- Good mixing upon collector addition is important
- Good agreement with the Freundlich model of adsorption
- Patchwise adsorption, collector ‘islands’

RESULTS: Effect of ionic strength

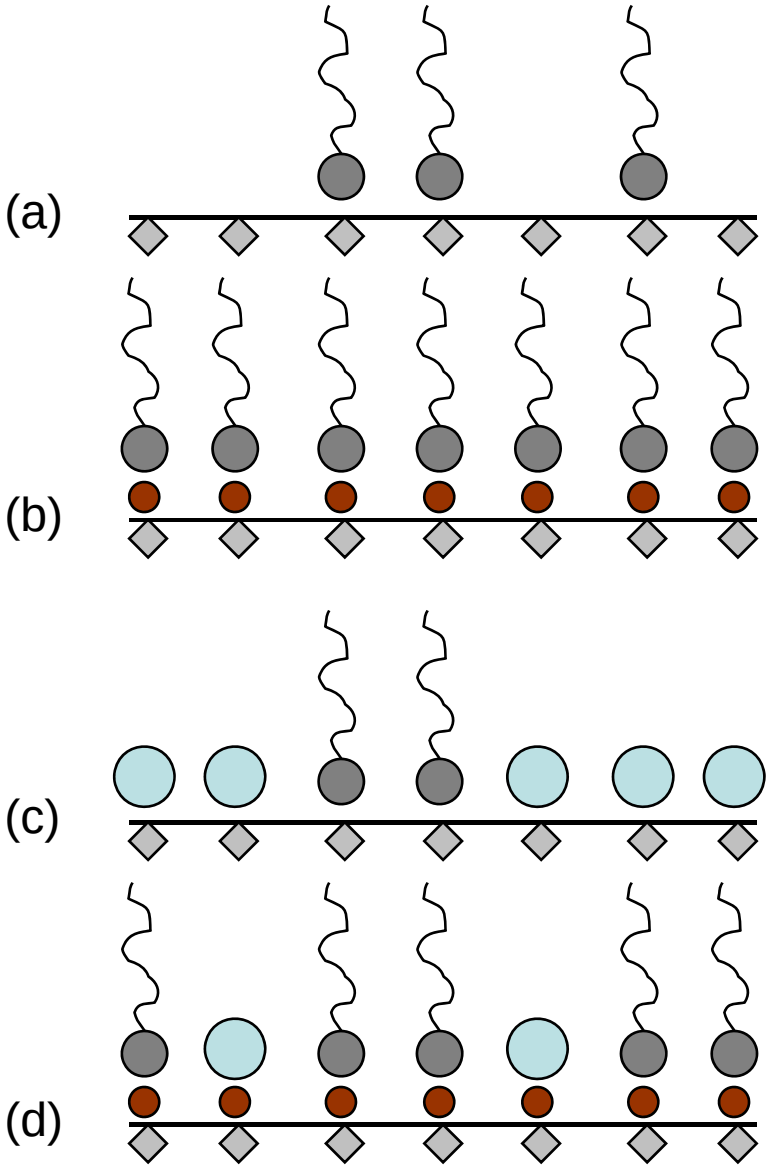


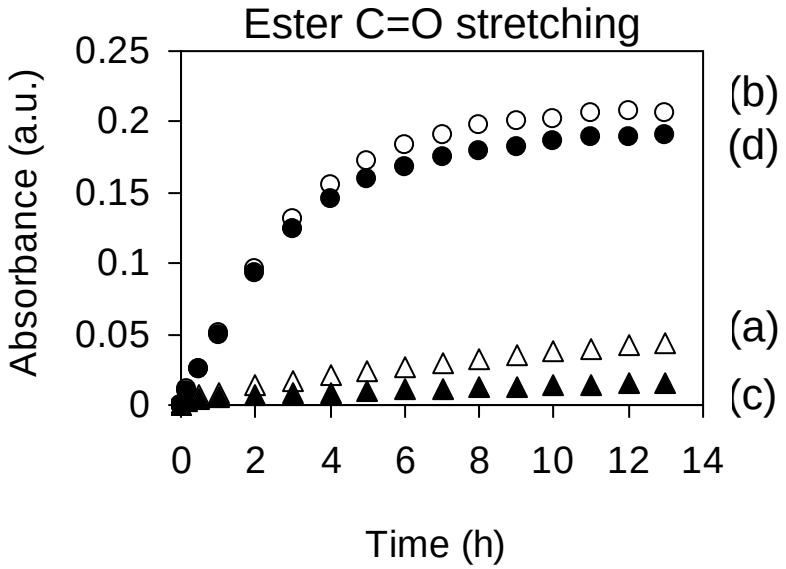
Adsorption of maleic acid ester on magnetite (pH8.5)

Ionic strength = total concentration of ions in solution

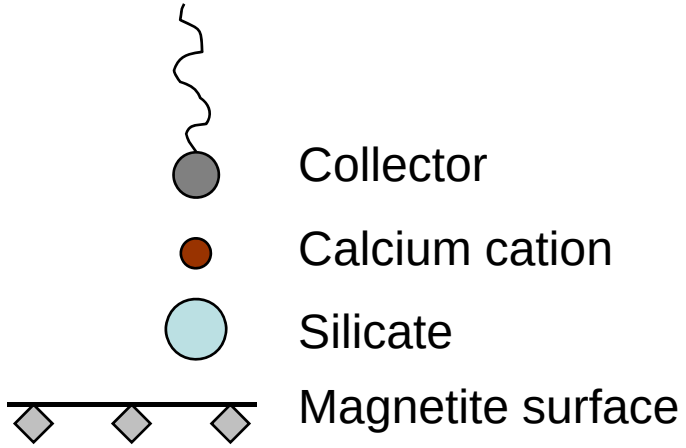
High concentration of positively charged ions in the process water may increase collector adsorption

RESULTS: Effect of calcium ions and sodium silicate





Adsorption of maleic acid ester on magnetite (pH 8.5)



CONCLUSIONS

- Anionic collectors can adsorb on negatively charged iron oxide surfaces specifically via non-charged polar groups
- Positively charged ions in the process water may increase collector adsorption on magnetite
- Calcium ions increase dramatically collector adsorption
- Silicate species reduce collector adsorption
- Depressing effect of silicate on collector adsorption on magnetite is insignificant in the presence of calcium ions

FUTURE WORK

• To develop a procedure to reduce collector coating on the magnetite surface after the flotation step by:

-Adding hydrophobic adsorbents (activated carbon, silicalite-1) to desorb collector from magnetite

-Adding a charged polymer to render magnetite surface hydrophilic

-Decomposing adsorbed collector by strong oxidative agents (ozone, hydrogen peroxide) and UV-light

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Thank you for your attention!