

Chemistry for Sustainable Recycling

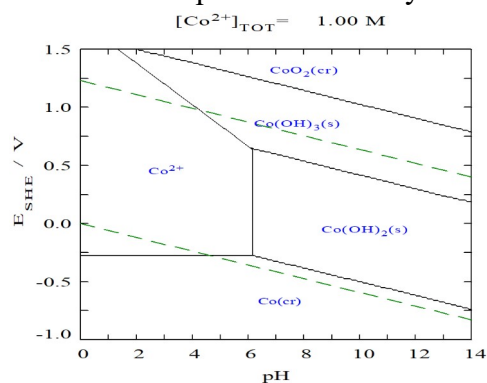
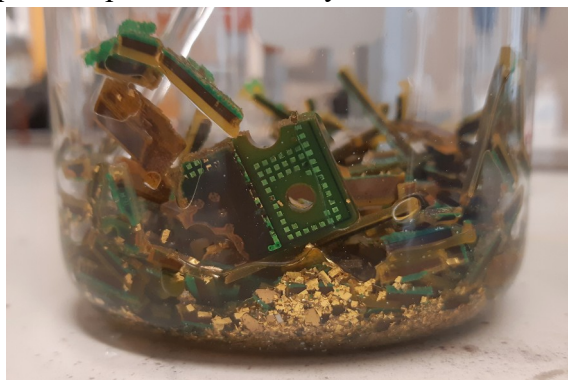
-one course in our master program about Sustainable Chemistry, SU, Stockholm
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The newly developed course (7.5 hp) in "Chemistry for Sustainable Recycling" gives an overview and chemistry background on subjects related to a few different recycling projects. The course is composed of lectures and four different lab project (3 days each) with a follow up seminar.

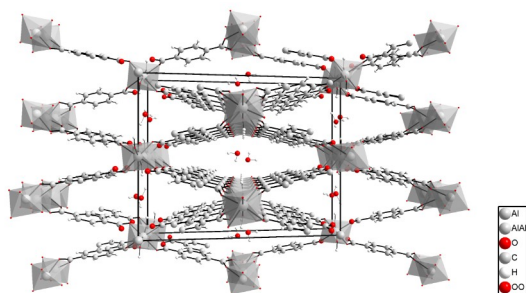
1. Recycling of metals from E-waste, PCB (Al, Au and Cu).
2. Recycling of batteries (Lithium, Cobalt, Manganese and NiMH).
3. Recycling of plastic (PET)
4. Recycling of phosphate from waste water sludge and comparison with horse manure.

Many recycling processes do involve several chemicals where security issues are very important. A long term goal would be to minimize the environmental impact as well from chemicals as the consumption of energy. Lab procedures in this very course do not exactly mimic industrially applicable processes in many cases, but are intended to demonstrate important chemistry concepts.



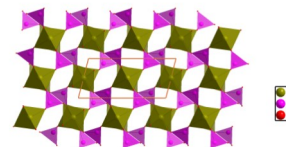
1) Gold metal from E-waste, later dissolved in aqua regia, filtered and finally precipitated with ascorbic acid. 1 g of Au(s) was recovered from 200 g clean-cut E-waste.

2) Recycling some Li-batteries were connected with several problematic issues. Dissolving the positive electrode material, CoO₂ was not easy and also the separation of Li as a salt was problematic.



3) Al-terephthalate MOF produced from recycled Al cans and TPA from basic hydrolysis of PET bottles.

- 1) Drying the wet waste
- 2) Extracting with acid and wet analysis
- 3) Calcining
- 4) Checking P and Fe in SEM



4) Recycling of phosphate from waste water sludge and also from more traditional nutrients as horse manure. Vivianite is a common Fe-phosphate.

Students course evaluation point out, as very positive, the large time spent in lab, both with wet chemistry and dry analysis as SEM and PXRD as well as follow up seminars.