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Kunnskap for en bedre verden

Adsorption of fluoride on iron hydroxide

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NTNU

Outline

- Background
- Precipitation of iron hydroxides
- Adsorption of fluoride
- Initial experiments – effect of pH
 - Preparation of iron hydroxides
 - Adsorption experiments
 - Results
 - Conclusions
- Future work



Background

- Cathode sticking problem
- Desirable to improve removal of fluoride and increase cathode lifetime
- Removal of fluoride with iron precipitate in the neutral leaching

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Precipitation of iron hydroxide

- Complex
- Different types of iron hydroxides
 - Goethite
 - Hematite
 - Magnetite
 - Maghemite
 - Akaganeite
 - Lepidocrocite
 - Amorphous iron hydroxides

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Adsorption of fluoride

- Results from SINTEF – even distribution of fluoride on the precipitate
 - Adsorption?
- Literature research
 - Iron hydroxides as adsorbent for fluoride in water treatment*

*Mohapatra, M., Anand, S., Mishra, B. K., Giles, D. E., & Singh, P. (2009). Review of fluoride removal from drinking water. *Journal of Environmental Management*, 91(1), 67-77.

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Adsorption of fluoride

- Proposed mechanism
 - Ligand exchange*
- Important factors
 - pH
 - Surface area
 - Competing anions
 - Fe(II)/Fe(III) ratio
 - Temperature

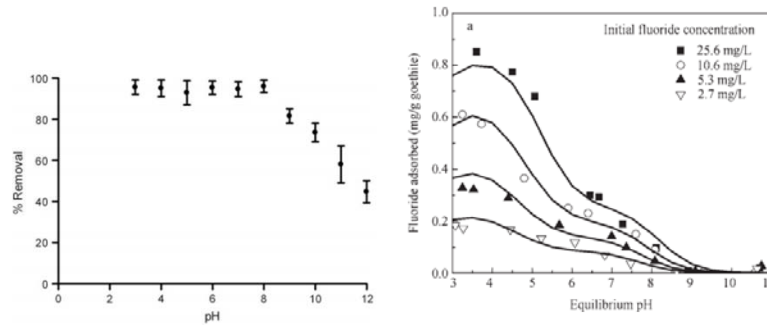
*Ding, X. (2012). Identity of Fluoride and Phosphate-Binding Sites at FeOOH Surfaces.

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Initial experiments – effect of pH

- From the literature:



Kumar, E., Bhatnagar, A., Ji, M., Jung, W., Lee, S.-H., Kim, S.-J., . . . Jeon, B.-H. (2009). Defluoridation from aqueous solutions by granular ferric hydroxide (GFH). *Water research*, 43(2), 490-498.

Tang, Y., Wang, J., & Gao, N. (2010). Characteristics and model studies for fluoride and arsenic adsorption on goethite. *Journal of Environmental Sciences*, 22(11), 1689-1694.

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Initial experiments – effect of pH

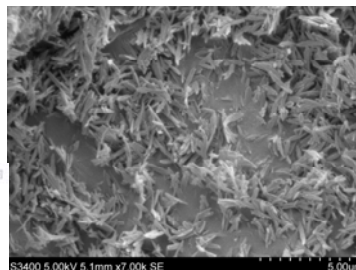
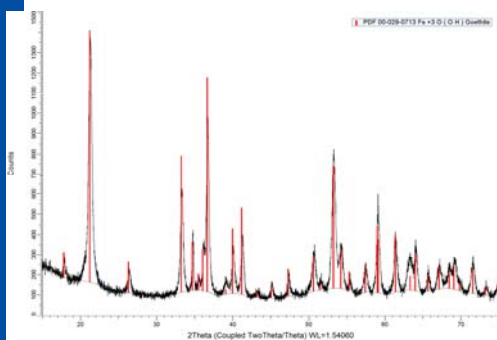
- Preparation of ferric hydroxides
 - Crystalline
 - Amorphous
- Adsorption experiments

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Initial experiments – effect of pH

- Ferric hydroxide samples
 - Goethite
 - 1 M $\text{Fe}(\text{NO}_3)_3$
 - 5 M NaOH
 - pH 12, 80 °C, 3 days

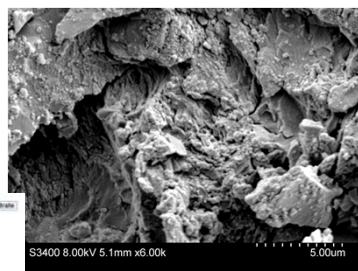
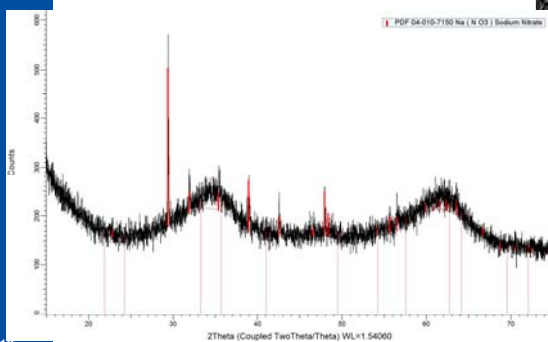


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Initial experiments – effect of pH

- Amorphous ferric hydroxide
 - 1 M $\text{Fe}(\text{NO}_3)_3$
 - 1 M NaOH added until pH 7



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Initial experiments – effect of pH

- Adsorption experiments - procedure
 - Method adopted from the literature*
 - 25 °C, 2 hours
 - pH range 4 - 10
 - 20 mg/L fluoride
 - 10 g/L adsorbent (goethite and amorphous ferric hydroxide)
 - Fluoride concentration before and after adsorption
 - Fluoride selective electrode

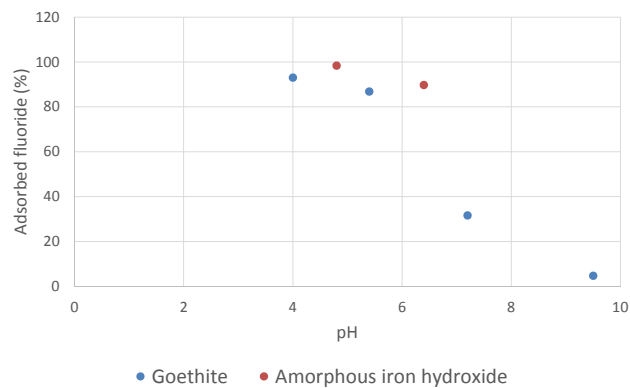
*Kumar, E., Bhatnagar, A., Ji, M., Jung, W., Lee, S.-H., Kim, S.-J., . . . Jeon, B.-H. (2009). Defluoridation from aqueous solutions by granular ferric hydroxide (GFH). *Water research*, 43(2), 490-498.

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Initial experiments – effect of pH

- Results
 - Percent fluoride adsorbed

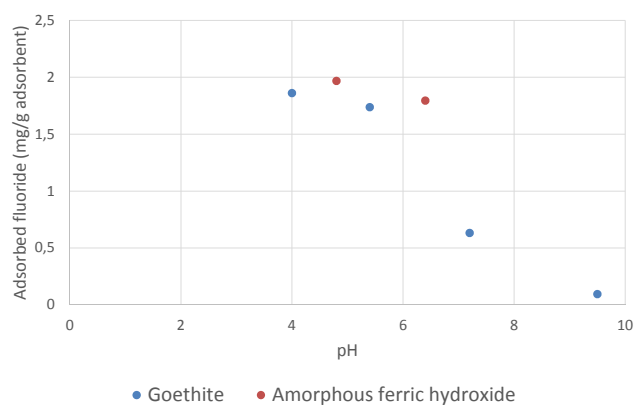


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Initial experiments – effect of pH

– Amount fluoride adsorbed – mg/g adsorbent



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Initial experiments – effect of pH

- Conclusions
 - Fluoride adsorption strongly dependent on pH
 - Amorphous better than crystalline

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Future work

- Surface area
- Ratio of Fe(II)/Fe(III)
- Adsorption mechanism
- Experiments with Boliden's conditions

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Thank you for your attention



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