Week 2 Mini-Research Projects

NO PRELAB FOR THIS WEEK COME DIRECTLY TO LAB (PSB Rm 182)

Assume that your research team is part of an environmental clean up company hired to remediate groundwater at a defunct indigo carmine dye manufacturing site. Samples of groundwater taken from the site confirm a dye concentration hovering around the 20.0 ppm level. Environmental clean up engineers working for the company have many questions about the PRB proposed for the remediation, from which several interesting research problems have developed:

1. Groundwater temperatures vary considerably -- depending on the location and the time of year -- and range from the single digits into the high 20s (^oC). Would the remediation technique of this experiment be suitable over the entire temperature range? Part of it? Estimate the activation energy of the reaction (E_A) from the temperature data by preparing an Arrhenius plot (consult your text). The Arrhenius equation for the reaction is $ln(k_{obs}) = (-E_A/R)(1/T_K) + constant$.

2. What effect, if any, does the mass of Fe used have on the remediation technique?

3. What happens to the reaction rate as the Fe surface becomes coated with rust? (Note: Dilute aqueous HCl can be used to remove rust it, though some rust will re-form unless you dry the iron quickly. Hydrogen peroxide can be used to build a rust layer on the iron particles.)

4. Can the technique be used to degrade other dyes? Are the degradation reaction rates comparable to that of indigo carmine? Other possible dyes to test are methylene blue and 5, 5′, 7, 7′-indiogotetrasulfonic acid, tetrapotassium salt. These dyes are structurally similar to indigo carmine, the dipotassium salt.

5. Can other materials be used to remediate the dye. Other materials to test include activated carbon and dried orange peel.

Your group will pick one of these mini projects. Devise a general plan for your group to follow so that you can make recommendations concerning the design of PRBs for dye-contaminated groundwater remediation. Be sure to check your plan with your TA or myself before starting experiments. *As you work in lab, be sure to save and email copies of all spreadsheets, graphs, etc. you create to all group members*

Be sure to include all the details of your experiments and any raw data in your lab notebook to use for the final group report.

Writing your Report

Final Group Report (one group/due one week from you lab day at 11:59 pm via the Moodle assignment)

Organize your report in the following way:

Introduction (10 pts): Describe the experiment that your group designed and what questions it should answer about contaminant degradation using iron PRBs.

Experimental (10 pts): Describe how you carried out your experiment. You do not have to rewrite the general protocol given in the lab manual (simply reference it). Instead, focus on the steps that you modified to answer the question you raised. You should also describe how you addressed any problems that arose and any control experiments that you ran.

***Excel* Spreadsheets of Numerical Data (5 pts):** These may duplicate your laboratory notebook data tables somewhat, but they will undoubtedly be neater and easier to read. Be sure to use labels to make it clear what experiments each column in the spreadsheet represents. While it is unlikely that you will show spreadsheets of data in your final presentation, making sure that they are in good order will give you confidence that the graphs you create from them are meaningful.

***Excel* Graphs (5 pts):** Include all kinetics plots, etc. from your "good" experiments. Label to make it clear what each plot represents.

Results (5 pts): Tabulate or otherwise concisely summarize your kinetics results, such as reaction order, kobs and half-life.

Analysis/Conclusions (10 pts): What were some of the difficulties you encountered? How did you try to overcome them or what would you change to avoid them if you were to repeat the experiment? What did you learn about the degradation using iron PRBs? Relate your observations, when possible, to what you know about the chemistry of the degradation reaction. How can your results be used to improve the efficiency of iron walls?

Total: 45 pts