**Assignment 2 CE 523**

**Chemical oxidation processes** (due February 11, 2011)

1. Calculate the ozone dosage for the removal of 1 mg/L manganese (in the +II oxidation state) in water down to 0.05 mg/L.
2. What would the chlorine gas dosage required be for the manganese removal as above? As more chlorine will be required, also for disinfection, is there a risk of oxidizing the manganese to higher oxidation states than required for effective removal?
3. What potassium permanganate dosage level will be required in the previous question? What would be the result of overdosage?
4. Calculate the dosage of Na2SO3 required to reduce 5mg/L hexavalent chromium (as Cr) to the less soluble trivalent form. The chromium occurs as Cr2O72- in this particular bleed-off from a cooling water circuit. Estimate the chromium removal possible and suggest a suitable pH to maximize removal.
5. There is a mistake in Example 6.5. The value for y0 should not be 3 mg/L, which is the dosage rate, but y0 needs to be calculated from the O2/O3 conversion fraction, O2/air and air density. What effect will this have on the ozone concentration in the liquid phase?
6. How can bromate formation be prevented during ozonation or chlorination? Two measures, please.

You are welcome to work as a group(s), but make sure that everybody participates. “Passengers” endanger their own success with the course if not fully participating. Don’t subdivide the work! Please ask if any doubts. Make assumptions as necessary.