CVEN 5534: Wastewater Treatment
Spring 2001
SSSP Project Assignment

For this project you will use the computer program, *Simulation of Single-Sludge Processes (SSSP)* to investigate biological nitrogen removal in a full-scale activated sludge process. You have a detailed description of the U.S. Air Force Academy Wastewater Treatment Plant (AFAWWTP) near Colorado Springs. In addition a spreadsheet containing two years (1998-99) water quality data from the plant is on a spreadsheet in the directory named: "Bioprocess Models\SSSP" on the class website (http://bechtel.colorado.edu/~silverst/cven5534/). In the AFAWWTP, both nitrification and denitrification are achieved in an Modified Ludzack Ettinger (MLE) activated sludge process using a first-stage anoxic denitrification basin receiving nitrified recirculation from an aerated carousel-type reactor. The plant has been experiencing problems during the past year meeting its standard for effluent total organic nitrogen (TIN), which varies during the year, but is as low as 10.6 mg/L. The purpose of this project is to use SSSP to investigate improving the nitrogen removal at the AFAWWTP.

1. Develop a hypothesis of why the TIN permit exceedences occurred in 1999. This will require thinking carefully about the plant operating data. Justify your hypothesis, you will be testing it using SSSP.

2. Using the design data and schematics, develop a simulation of the AFAWWTP for SSSP ("Definition of the Physical Plant). Make your own schematic flow diagram showing reactor sequences and flows you have used to do this.

3. Determine a set of bio-kinetic and stoichiometric parameters ("Heterotrophic" and "Autotrophic Parameters") to calibrate your simulation to the AFAWWTP performance data from 1998-99. Summarize these parameters in a table. Prepare a table comparing your SSSP output to AFAWWTP performance data. Investigate output sensitivity for the three or four most significant parameters, showing the results in graphs and/or tables.

4. Test your hypothesis using the calibrated model in SSSP. If your explanation is not verified, explain why. The next step (below) is to investigate improvement in AFAWWTP operations and/or facilities that will improve nitrogen removal.

5. Investigate the effect on nitrogen removal (nitrification and denitrification) of three variables: 1) recirculation of nitrified mixed liquor back to the anoxic basin, 2) organic carbon limitation on denitrification, and 3) dissolved oxygen concentration in the anoxic basin, by:

    a) Changing the recirculation flows which are used to bring effluent from on reactor back to reactors earlier in the flow stream.

b) Removing the primary clarifier process, which will increase the organic particulate concentration in the influent (you have data on wastewater COD before and after primary clarification.
c) Varying the dissolved oxygen concentration from its measured value of approximately 0.15 mg/L DO.
d) Other ideas

Show the effects of your changes in tables and graphs.

6. Make recommendations to the facility operators about what you found to be the most effective changes they can make to improve nitrogen removal. (this may be a combination of the variations you investigated with SSSP. For example, changing recirculation flows is straightforward to implement but may have some adverse effects on other variables. Likewise, you should discuss all the implications of removing the primary clarifier from the process sequence, not just the added carbon. Finally, in discussing the effect of changing the anoxic basin DO, use your best engineering expertise to recommend ways to do that.