ASSIGNMENT – Generation and Screening of Alternatives
100 Supplemental Project POINTS = DUE -- FRIDAY SEPT. 5, 2008

- Read Chapter 4 Flowsheet Synthesis and Development pages 125 → 150

Process Synthesis As in Project Problems # 1, 2, & 3 you should work in groups of up to three. Working in your assigned ChE433 lab squads might be convenient for this assignment.

◊ Submit ONE report for the entire group.

Project Problem # 4.

BACKGROUND

Your engineering team has been assigned to a project at a small dye plant that uses crystal violet. Preliminary testing has shown that the reaction products of crystal violet hydrolysis by NaOH are nontoxic to the most sensitive aquatic organisms. In order to support feasibility design calculations for a wastewater treatment reactor for NaOH hydrolysis of crystal violet, your team must obtain the necessary kinetic data.

◊ 453 Design Project Step 1 :

Perform a functional analysis for the design of a complete water treatment equipment system to achieve objectives specified in 433 Lab #1 Crystal Violet neutralization and the attached memo:

- 1. Identify all fundamental functions needed to achieve treatment objective.
- 2. Prepare a block **functions diagram** needed to achieve the objective.
- 3. Prepare a list of alternative technologies to accomplish each function.
- 4. Screen alternatives & recommend a technology to accomplish each function.

Part A ASSIGNMENT Friday, Sept. 5, Requirements

a) be prepared to present and discuss your block diagram in class.

b) submit a group memo progress report addressing the 1st two ? points above.

Part B ASSIGNMENT Wednesday, Sept. 10, Requirements { in same groups as part A }

Using the revised function diagram developed in class, prepare a complete functional analysis and recommend a technology to accomplish each function. The results of this assignment will become a guide to your design for the formal report.

c) submit a group memo report containing a complete functional analysis of the design addressing the four ? points above.

University of Idaho
Department of Chemical Engineering
Inter-Office Memo

Date: Friday, August 29, 2008

To: Ch.E. 453 Class Design Engineers

From: David Drown

Subject: Dye Plant Waste Stream Characterization.

The crystal violet waste stream is generated from multiple sources within the dye plant. These combine and are naturally mixed in an industrial sewer line routed just below the floor of the processing area. This is an atmospheric vented pipe that flows by gravity and is usually only partially full. The line is installed at the building code standard slope of ¼" drop per foot of horizontal run. The top of the pipe is 12" below the ground surface when it exits the process area and continues to drop at the standard slope until it enters the municipal water collection system (which also continues at the same slope) 500 feet away from the process building. The waste stream contains no other regulated contaminants and can be assumed to be municipal tap water and crystal violet. Cafeteria waste and other "domestic" sewage generated at the plant is handled in a separate sewer line until it enters the municipal sewer line outside the plant property. The state regulatory agency has placed a not to exceed limitation of 1 PPM of crystal violet for the plant discharge.

Because of the various batch process cycles within the dye plant, the combined waste stream has a variable flow rate, crystal violet concentration, and temperature. Batch draining and cleaning of process tanks cause flow, concentration, and temperature spikes that last from 5 to 15 minutes. Plant data during the 12 hours of daily operation reveals the following conditions:

Flow rate = Minimum 10 GPM, Maximum 75 GPM, hourly average of 25 GPM

Concentration = Minimum 2 PPM, Maximum 8 PPM, daily average of 5.0 PPM

Temperature = Minimum 80 °F, Maximum 95 °F, daily average of 32 °C

Design a complete waste water treatment processing plant. Land is available in the 500 feet between the dye plant and the municipal water collection system. Determine all equipment items needed to treat the waste stream, including reagent delivery and storage facilities, control sensors, optimum pipe sizes, and quality assurance analytical equipment. Prepare an equipment layout diagram showing the space needed and arrangement of the major equipment items. Determine the capital investment required and annual operating costs. Assume the dye plant is profitable and treatment expenses are a tax deduction. Use MACRS depreciation for tax purposes and 8 year straight line for capital recovery. What is the treatment cost per gallon of wastewater?