18B.5.1

✓ 9-11-06

VARIANCE REQUEST

Iowa Department of Natural Resources

1. Date: April 4, 1996
2. Review Engineer: Bill Graham
3. Date Received: April 2, 1996
4. Facility Name: Sully WWTF
5. County Number: 50, Jasper
6. Program Area: CP (wastewater)
7. Facility Type : C05
8. Subject Area : 374
9. Rule Reference: 567-64.2(9)a
10. Design Stds Ref: 18B.5.1, Return Sludge Rate, ext. aer.
11. Consulting Engr: Shive-Hattery Engrs., Iowa city, Iowa
12. Variance Rule: 567-64.2(9)c

13. **Decision:** Approved 4/10/96
Date:

14. **Appeal:**
Date:

15. Description of Variance Request:

The city has proposed using a proprietary activated sludge extended aeration treatment system called Biolac to meet permit ammonia limits. Design Standard 18B.5.1 requires that extended aeration return sludge rate be variable from 50 to 150 % of AWW design flow. The Biolac system proposed will have a return sludge rate of 50% of AWW flow. Because the Sully facility has 2 large equalization basins, flows to the plant never exceed 0.675 MGD, i.e., AWW, MWW, and PHWW plant flows are the same and there are no peaking flows above the AWW flow. There are no existing Biolac systems in Iowa.

16. Consulting Engineer's Justifications

Parkson Corporation, makers of Biolac systems, says that their standard design uses average annual flow as a design flow rather than AWW flow as required by the design standards and that this has worked on 150 installations in the US. Their technical argument centers on clarifier detention time. They argue that the hydraulic detention time decreases as the return sludge pumping rate is increased and that this decreased hydraulic detention time affects sludge settling negatively.

17. Department's Justifications

Recommend approval based on reasons other than those provided by Parkson. Parkson's claim that their approach has worked at 150 US installations is unsubstantiated and anecdotal. The data provided on three facilities, two in Indiana and one in Arkansas, is incomplete and design conditions do not appear to be similar to those in Sully. Parkson's argument about hydraulic detention time is based on a misunderstanding of return sludge flow, taking water from the bottom of a tank and putting it back in the top of the tank has no affect on hydraulic detention time. Hydraulic detention time is a function of plant flow only and is not influenced by RAS pumping. What is important to clarifier settling is the overflow rate based on peak hour plant flow, clarifier depth, and solids flux. Solids flux is controlled by MLSS concentration. MLSS concentration is controlled by RAS pumping rate.

Departmental approval for this variance is recommended because equivalent treatment is provided by the city's proposal based on the following:

- Parkson originally proposed an RAS pumping rate which was 178% of the average annual flow rate (0.135 MGD). 178% of the average annual flow (0.239 MGD) is 35% of the maximum plant flow (0.675 MGD). Calculations show that to maintain the design MLSS of 2200 mg/l at maximum plant flow, a minimum RAS pumping rate of 0.260 MGD is required (see attached sheet). Therefore, at the return sludge pumping rate originally proposed, the MLSS concentration would gradually decrease affecting the treatment process at maximum plant flow. Parkson has agreed to provide at least 50% of maximum plant flow as the minimum RAS pumping rate, or 0.338 MGD.

- The equalization basins prevent flows to the plant greater than 0.675 MGD. Since there will not be any peaking flow above the "AWW flow" of 0.675 MGD, a return sludge rate of 50% would provide approximately equivalent RAS capacity to the design standard of 150% AWW flow RAS pumping capacity if it is assumed that MWW and PHWW flows are two or three times higher than AWW flow. Without peaking, MLSS washout is avoided

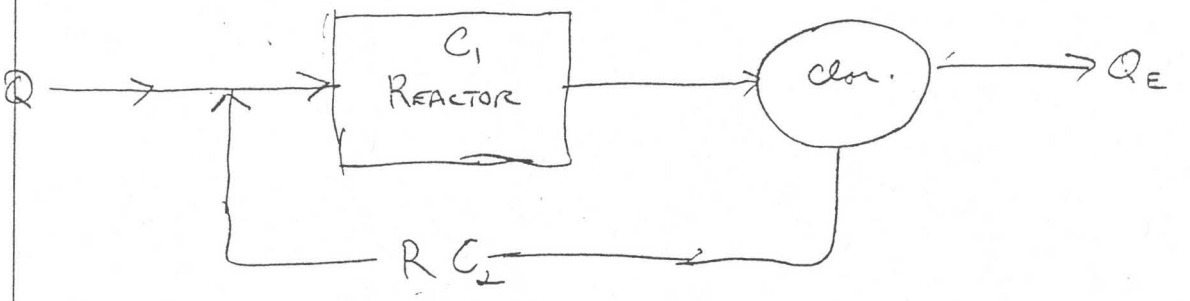
- The design MLSS of 2200 mg/l is the maximum MLSS concentration at which the Biolac system will operate. Conventional activated sludge MLSS concentrations range from 1500 to 3000 mg/l and typical extended aeration MLSS concentrations range from 3000 to 6000 mg/l. The maximum operating MLSS concentration of 2200 mg/l for this particular extended aeration process is closer to that of a conventional activated sludge process for which the design standard RAS pumping range is from 25 to 100% of AWW flow.

- A condition will be in the construction permit requiring the city to increase RAS pumping capacity if it is found that the design capacity does not provide adequate treatment performance.

18. Precedents Used

The City of Tama constructed an extended aeration oxidation ditch with an RAS pumping rate of from 25 to 100% of AWW flow. This facility also includes large wet weather equalization basins which eliminate peaking flows above AWW flow and a relatively low MLSS concentration for an extended aeration process and is operating as designed.

19. Staff Reviewer: William Graham Date: 4/5/96
20. Supervisor: Date: 4/5/96
21. Authorized by: Date: 4/10/96



Design: MLSS = 2200 mg/l

F/M = 0.05

Q = 0.675 MGD	SS ≈ 0 mg/l
R = (?%) Q	SS ≈ 8000 mg/l
Q_E = 0.675 MGD	SS ≈ 20 mg/l

$(C_2)(R) = (C_1)(R+Q)$

C_1 = 2200 mg/l (MLSS) C_2 = 8000 mg/l (underflow conc.)

Q = 0.675 MGD

↖ MAYBE TOO HIGH ?!?

$8000(R) = (2200)(R + 0.675)$

$8000(R) = 2200(R) + 1485$

$8000(R) - 2200(R) = 1485$

$5800(R) = 1485$

$R = \frac{1485}{5800} = 0.26$

R = 0.26 MGD = 0.39 Q

use 40% of AWW

0.26 MGD = 180 gpm

at 0.5 Q ⇒ 234 gpm