APPENDIX B

SEQUENCING BATCH REACTOR TROUBLESHOOTING CHART

The following Sequencing Batch Reactor Troubleshooting Chart (pages 21–23) was adapted from the University of Florida TREEO Center's *Sequencing Batch Reactor Operations and Troubleshooting Manual*.

SEQUENCING BATCH REACTOR TROUBLESHOOTING CHART

PROBLEM OR OBSERVATION	CONDITION	PROCESS CONTROL ANALYSIS	POSSIBLE CAUSES	CONTROL ACTION
I. Loss of solids from reactor due to a high blanket	Poor sludge settling velocity and compaction	SSV_X, SSV_5, SVI, diluted SSV_X, microscopic examination, NH_3 - N, COD, D.O., SOUR	• Glutting (old sludge)	• Decrease MCRT.
			• Classic bulking (young sludge)	• Increase MCRT.
			• Filamentous bulking	• Identify conditions contributing to filamentous growth and correct. See comments in narrative below.
			• Slime bulking	• Add nutrients.
			• Foam Trapping	• Optimize pretreatment removal of oil and grease.
			• Highly nitrified or oxidized sludge	• Increase anoxic cycle, reduce aerobic cycle.
			• Toxicity	• Isolate or split flow, identify source of toxic influent and eliminate, increase aeration cycle, increase MCRT.
			• High organic loading	• Short-term, increase aerobic cycle; long-term, increase MCRT.
II. Rapidly settling blanket leaving particulate. Difficulty in maintaining waste concentration	Rapid sludge settling velocity and compaction	SSV_X, SSV_5, SVI, F/M, SOUR	• Low F/M ratio	• Increase F/M ratio by decreasing MLVSS.
III. Turbid or cloudy effluent, disinfection problems	**A.** High effluent BOD or TS	MLSS, MLVSS, D.O., pH, temperature, Influent COD or TOC, Influent NH_3 –N, D.O., SOUR	• Low MLSS or MLVSS	• Increase MLSS/MLVSS.
			• Low D.O., temperature or pH	• Increase aeration cycle in fill react, increase MLSS, add alkalinity.
			• High organic loading	• If long-term, increase MLSS/MLVSS and aeration cycle.
			• High nitrogenous loading	• If long-term, increase MLSS/MLVSS and aeration cycle.
			• Toxicity	• Isolate or split flow, identify source of toxic influent and eliminate, increase aeration cycle, increase MCRT.
	B. High effluent NH_3 – N (Incomplete nitrification)	Influent and process NH_3 – N, influent and process alkalinity, pH, temperature, SOUR, D.O.	• Influent NH_3-N overload	• Increase aerobic cycle.
			• Low D.O.	• Increase aerobic cycle.
			• Low temperature	• Increase aerobic cycle.
			• Inadequate aerobic retention time	• Increase aerobic cycle.
			• Low pH or alkalinity	• Add alkalinity.
			• Low MLVSS (nitrifiers)	• Increase MLVSS.
			• Toxicity	• Isolate or split flow, identify source of toxic influent and eliminate, increase aeration cycle, increase MCRT.

Source: University of Florida TREEO Center's *Sequencing Batch Reactor Operations and Troubleshooting Manual.*

SEQUENCING BATCH REACTOR TROUBLESHOOTING CHART (CONTINUED)

PROBLEM OR OBSERVATION	CONDITION	PROCESS CONTROL ANALYSIS	POSSIBLE CAUSES	CONTROL ACTION
IV. High-effluent TSS	Individual particle washout	Effluent and recycle TSS or turbidity, F/M, microscopic exam, SOUR	• Pin floc – low F/M,	• Increase waste cycle, decrease MLSS.
			• Pin floc – denitrification	• Increase waste cycle, decease MLSS, increase anoxic cycle.
			• Pin floc – solids recycle	• Optimize solids handling.
			• Straggler floc – high F/M	• Decrease waste cycle, increase MLSS, increase aeration cycle.
			• Straggler floc – filamentous	• Identify filamentous organism (see filamentous control above).
			• Straggler floc – hydraulic	• See mechanical troubleshooting section.
			• Individual bacterial cells in effluent	• Decrease waste cycle, raise MLSS, increase aeration cycle, if toxicity, remove source of toxic influent.
V. High-effluent NO_3 - N	High effluent NO_3 – N	NO_3 – N, pH, TOC or COD	• Lack of or inadequate anoxic conditions	• Increase anoxic cycle (may require decreasing oxic cycle).
			• Lack of or inadequate carbon source	• Add carbon (methanol or acetic acid).
			• Low pH, temperature or MCRT	• Add alkalinity, increase MCRT.
VI. Difficulty in maintaining chlorine residual	Chlorine (Cl_2)residual fluctuation, no chlorine residual	Cl_2 residual, supernatant NH_3-N., NO_2-N, turbidity or TSS	• Incomplete nitrification/denitrification resulting in high NO_2-N in supernatant.	• High NO_2-N in supernatant will result in increased demand. Optimize nitrification and denitrification processes.
			• High TSS in supernatant	• High TSS in supernatant will result in increased demand. See Problems I, III, IV.
			• Reducing agents in supernatant	• Reducing agents such as H_2S, Fe, Mn in supernatant. Investigate source and eliminate. Increase chlorine feed rate to overcome demand.
VII. High fecal coliform values	Sufficient chlorine (Cl_2)residual, but high fecal coliform values	Supernatant TSS, free and total Cl_2 residual, supernatant NH_3-N, theoretical and actual CCC detention time	• Excessive TSS in supernatant	• High TSS in supernatant can result in "blinding" of disinfection process. See Problems I, III, IV.
			• Short circuiting of chlorine contact chamber (CCC)	• Calculate the theoretical CCC detention time. Conduct dye testing to determine actual detention time.
			• Chloro-organic compounds	• If there is no NH_3-N in effluent but organic nitrogen is present, then false residual (DPD)may be present due to formation of chloro-organic compounds. Use free chlorine to establish residual not total chlorine. Reduce aeration cycle to de-optimize nitrification rate.

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SEQUENCING BATCH REACTOR TROUBLESHOOTING CHART (CONTINUED)

PROBLEM OR OBSERVATION	CONDITION	PROCESS CONTROL ANALYSIS	POSSIBLE CAUSES	CONTROL ACTION
VIII. Foam	Excessive foam or scum on surface of SBR, flow EQ tank or chlorine contact chamber	Microbiological examination, NO_3-N, C-N-P ratio, SRT, oils and grease, D.O.	• Excessive filamentous bacteria.	• The presence of hydrophobic filamentous bacteria may lead to excessive scum and foam. See section I.5.
			• Denitrification	• Denitrification can result in sludge and foam on surface of SBR.
			• Nutrient deficiency	• Foam may also indicate a possible nutrient deficiency. This type of foam may be due to bacteria producing a natural polymer when subjected to nutrient deficient conditions for an excessive period of time.
			• SRT	• Both too low and too high an SRT can cause foam problems.
			• Fats, oil or grease	• Fats, oils grease and other non-degraded surface active organics can cause foam problems.
			• Overaeration	• Excessive (D.O. > 4.0 mg/L) may cause foaming.

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