

ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

Treatment Study ID	1070
Study Protocol	GAC full-scale treatment study
Plant ICR Number	456
PWS Name	Manchester Water Works
City, State, Zip	Manchester, NH 03109

These are general comments that do not need to be responded to directly.

Major comments:

1. This study presents results obtained from a full-scale GAC contactor operating at an EBCT of 15 minutes in post-filter adsorber mode. This was the only EBCT and GAC run examined. The contactor used was maintained at a constant flow resulting in a 15 minute EBCT for 4 hours prior to each sample taken. At other times, the filter was placed into general service. Therefore, the contactor EBCT when not being sampled varied based on plant water demand (range: 9.1 - 45 minutes). The average EBCT over the course of the study was 16.5 minutes. The GAC used was 40 percent virgin Calgon F-300 and 60 percent plant reactivated GAC.
2. As explained on page 9 of the Summary Report, a coagulant change, from polyaluminum chloride (PACl) to alum, was made one month into the three month GAC run. This resulted in an improvement in TOC removal after coagulation. The mean GAC influent TOC concentration decreased from 2.9 mg/L to 2.4 mg/L. Alum produced a slight decrease in the coagulation pH, but the measured GAC influent pH was not affected, averaging 6.6 ± 0.1 throughout the entire run. Two weeks later, a mixture of PACl and alum was used as coagulant, and this was continued for the remainder of the run. The second change in coagulant did not alter GAC influent TOC concentrations. Other than this change in pretreatment, the influent water quality based on TOC data was fairly stable during the run.
3. Pretreatment included the addition of sodium hypochlorite prior to GAC adsorption at an average dose of 1.5 mg/L. This dose is regulated to provide a detectable chlorine residual at the influent to GAC. Measured THM4 at this point yielded 4 µg/L (January), 10 µg/L (April), and 8 µg/L (October). The study was conducted between January 5 and March 31.
4. Although seasonal variability was not investigated, the SDS incubation temperature used during this study was low (4.0 - 6.5°C), reflecting January to March distribution system

temperatures. Based on Table I in the Summary Report, finished water temperature varies between 5 and 26°C throughout the year. Application of these higher incubation temperatures to SDS testing should increase measured SDS-DBPs over those observed during this study.

General Comments:

1. The influent and effluent UV-254 data did not correlate well with TOC data. There was more variability in the UV-254 data, and the effluent data, expressed as percent breakthrough, was more variable than that for TOC, especially after 50 days of operation.

Cost information provided by utility not included in Summary Report:

Cost Estimates on the operation of Manchester Water Works GAC Filters

	Capital Costs Filters and Building (20 yr straight line) ¹	Reactivation Cost based on a 4 year replacement cycle ⁴	Electrical and Backwash	Repair and Maintenance	Total
\$ / MG (based on a flow of 15 MGD)	\$11.25	\$10	\$4.56	\$1.83	\$27.64
\$/Yr (1998) ²	\$61,594	\$60,000	\$25,000	\$10,000	\$156,594
\$/lb reactivate (1998) ³		\$0.25			

Notes:

¹ Capital cost figures for this unit process have been somewhat problematic to obtain. The filters were built in 1974 as a fraction of a single bid and their estimated 1974 worth is not known.

Based upon their overall fraction of the WTP expense, the estimated capital structure is about \$750,000 (including building and filters) of the overall WTP expense (\$5,900,000). Add to that an initial charge of GAC valued at approximately \$400,000 and the total cost for this system is estimated at \$1,150,000.

² Values based upon straight line depreciation for equipment and structure, a reactivation expense of approximately \$0.25 / lb, power expense at \$0.10 / KWH backwash water at \$350 / MG and repair and maintenance reflecting filter maintenance and backwash pump repairs

³ Reactivation cost is based upon all utility, repair and maintenance, labor and depreciation costs divided by the total mass of spent GAC reactivated that year

As such it depends entirely on how often the GAC is replaced or reactivated. Since 1981 this value has ranged from approximately \$8 to \$10 per million gallons processed. This reflects the reactivation of a single carbon filter (estimated 200,000 lb virgin: 246,000 lb spent) each year at a total cost of about \$60,000. For Manchester this is a four (4) year replacement frequency.

Outlier Data:

No outliers were removed.

Cell: A1

Comment: 1070-SAS.xls 2/13/00 18:41

All curve fits reviewed and approved. See below for log of refit datasets.

Cell: C16

Comment: 1070-15-01 - Run 1 (MCAA) 2/13/00 18:39

Original value (CoefA0) = -1.2336 New value = -0.1601

Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: D16

Comment: 1070-15-01 - Run 1 (MCAA) 2/13/00 18:39

Original value (CoefAf) = 9.135 New value = 3.8676

Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: E16

Comment: 1070-15-01 - Run 1 (MCAA) 2/13/00 18:39

Original value (CoefB) = 6.0365 New value = 13.1146

Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: F16

Comment: 1070-15-01 - Run 1 (MCAA) 2/13/00 18:39

Original value (CoefD) = 0.0305 New value = 0.0758

Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: J16

Comment: 1070-15-01 - Run 1 (MCAA) 2/13/00 18:39

Original value (S) = 0 New value = 0

Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

ICR Information

ID / ICR#: 1471010 / 456
 ICR Contact: David Paris
 Phone No.: 603-624-6482
 Period: 1/5/99 - 3/31/99 (85 days)

Design Information

Design TOC: 2.4 mg/L
 Col Diameter: NA mm

Full-Scale GAC Size: 8x30 US Std Mesh
 Full-Scale particle dia.: 1.480 mm
 Meas Dry Bed Density: 480.0 kg/m3

Water Quality Summary

Influent	Mean	SD	Count	Min/Max
TOC	2.7	0.3	15	2.3 - 3.1
pH	6.6	0.1	15	6.2 - 6.7
UV254	0.036	0.010	15	0.018 - 0.059
SUVA	1.33	0.31	15	0.7 - 1.9
Bromide	0	0	15	0 - 0
SDS-TOX	205	40	15	124 - 270
SDS-THM4	32	6	15	22 - 43
SDS-HAA6	67	15	15	48 - 95
Ammonia	0.00	0.00	15	0.00 - 0.00

Cumulative SDS Conditions

	Mean	SD	Count	Min/Max
Res (0)	0.93	0.43	30	0.46 - 2.08
Temp	4.7	0.6	30	4.0 - 6.5
pH	7.5	0.2	30	7.1 - 7.9
Time	24.0	0.0	30	24.0 - 24.0

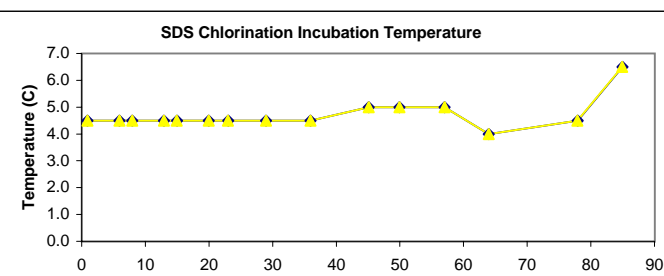
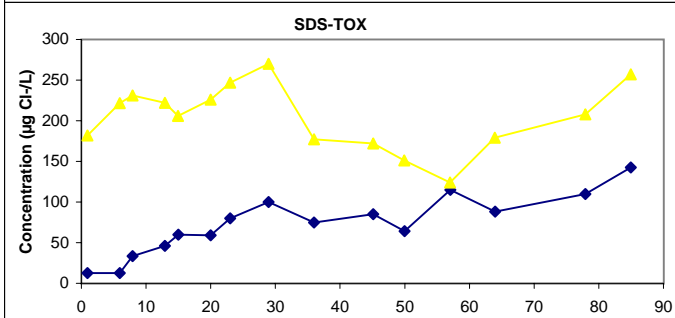
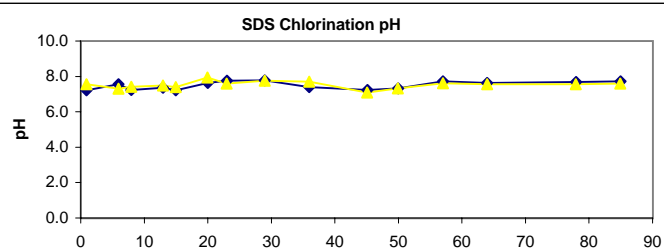
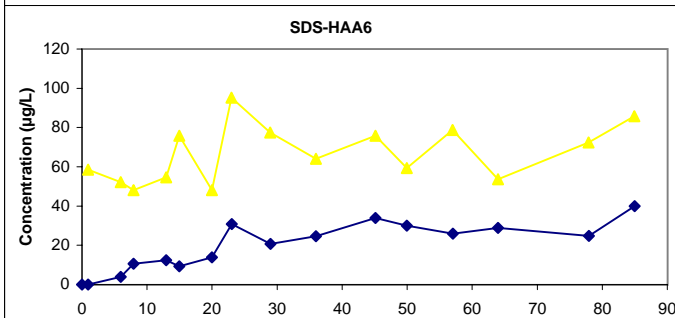
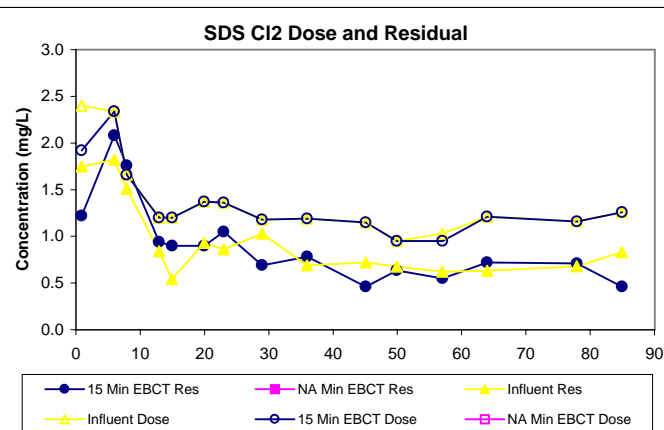
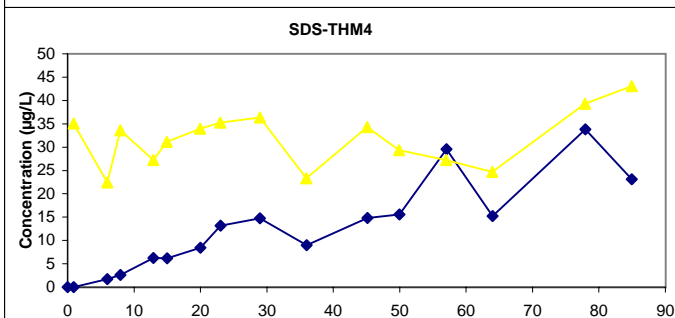
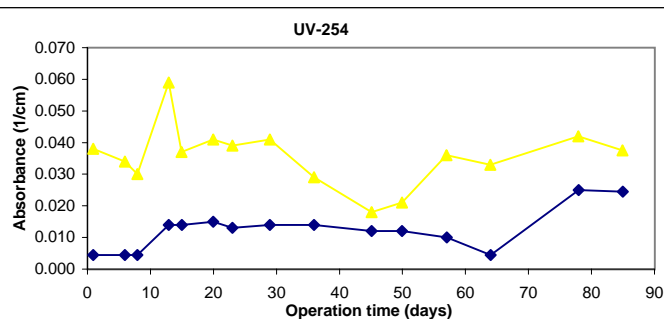
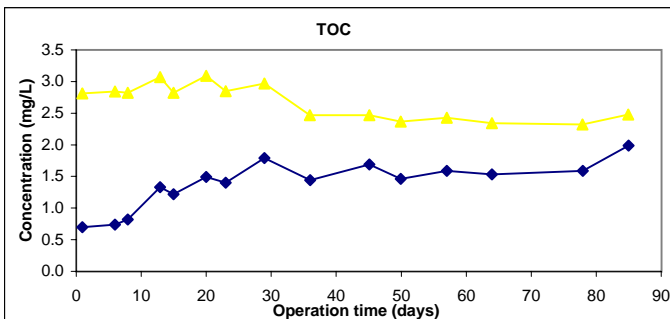
Comments:

Chart Legend:

- 15 Min EBCT
- NA Min EBCT
- ▲— Influent

Effluent	15 Min EBCT	(85 days)	NA Min EBCT	(0 days)
Effluent pH	6.8	0.2	15	6.5 - 7.5
Effluent Temp	4.7	0.6	15	4.0 - 6.5

Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)

