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To:

IRC Treatment Study Coordinator
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Technical Support Center (MS 140)
26 West Martin Luther King Drive
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ICR TREATMENT STUDY SUMMARY REPORT

Final Evaluation of a Rapid Small Scale Column Test System

Testing conducted May 1998 through July 1999
Supplemental testing being performed currently
full report will follow

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For the:
City of San Diego Water Utilities
PWSID # CA3710020

Plant:
Lower Otay Filtration Plant
Plant ICR # 220
1500 Wueste Road
Chula Vista, California 91910

Outline:

Conclusion

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- Problems Encountered
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- RSSCT

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- Annual water quality report

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Summary Report Spreadsheet

Conclusion

The results from this study were complied from five quarters of sampling. The first four quarters of samples were generated using chloramine as the disinfectant with two mg/l being added to the SDS sample. For the fifth quarter chlorine was as the disinfectant at a concentration of two or three mg/l per SDS sample. As expected the fifth quarter results showed higher disinfection by-products levels than the first four quarters. Although the first four quarters were generated using the same final disinfectant as the plant being studied.

Quarters one through four produced only low levels of disinfection by-products or below method reporting levels. All SDS samples generated in these quarters used the same laboratory conditions with the exception of seasonal temperature variation. This was seen only to have a minimal effect on the system from an effluent quality standpoint. The SDS sample water bath was set to use distribution water to regulate the temperature so that the bath would reflect real system variations throughout the study. Seasonal Variation in the influent water was not seen to have an effect on the amount of disinfection products produced, although it would interesting to study the effect of several higher chloramine doses.

The most noticeable factor observed when studying the seasonal variation is the GAC life. In the late Fall and Winter quarters (water collected 11-9-98 & 2-4-99) the hours of operation increased for the GAC to reach the 70% breakthrough . There were modest changes in the influent data collected for all quarters of sampling. Although, the data does not clearly indicate a reason for the extended life of the GAC.

A granular activated carbon filtration system may very well provide the filtration plant a means of producing water with initially lower TOC values and disinfection by-products. Data from the fifth quarter indicated that at approximately the fifty percent breakthrough point the total THM concentration exceeded the 80 ppb limit in the EBCT-10 column and was approaching the limit in the EBCT-20 column. Quarters one through four being spiked with 2.0 ppm chloramine showed minimal disinfection by-product concentrations, although free chlorine residual was low.

Both disinfection techniques used had application flaws when applied to the Otay Filtration Plant that should be addressed. One concern is meeting the contact time required for disinfection if the current plant would be modified to accommodate a GAC system. Currently the CT for disinfection is met by the addition of chlorine to the settled water prior to the filter galleries along with the addition of ammonia and chlorine after the filters. If a GAC system is installed then the chlorination point would need to be moved post filters. This intern would necessitate moving the ammonia addition point down stream to be able to meet CT requirements. It may also require the installation of a mixing chamber in the effluent line prior to entry into the clear well. These changes would make it necessary to move some metered connections downstream to allow for the correct CT before delivery. There are alternative disinfection techniques such as ozone or UV that could be used prior to the GAC system that may allow the Plant to meet the CT requirements without moving connections and ammonia addition points. Although, a pilot and/or a bench scale test would need to be performed to ensure compliance. What would be lost without prefiltration chlorination is the control of growth in the filter beds.

Costs of implementing a GAC system was not evaluated as part of this study. From the data generated it is not clear that an addition of a GAC system alone could produce water quality to meet all current and stage two regulations. As discussed in the previous paragraph modifications to the plant would need to be made to accommodate a GAC system.

Results and Discussion

Problems Encountered

There were a multitude of difficulties that arose throughout this project. The first could be considered the inheritance of the project just prior to its start date without any introduction to background information. This was due to an unfortunate terminal illness that the originally assigned chemist was found to have. Regrettabley this lead to some misinterpretations and oversights with the projects guidelines.

Water collection

Water used for this RSSCT was collected as unchlorinated water from the filter effluent. The chlorination point prior to the filters was shutoff and the Total and Residual chlorine measurements were made until the values approximated the plant settled water values. Settled water is prior to any chlorinated point. Then the RSSCT influent water was collected from the plants filter effluent line. The collected water is believed to be a good representative of normal plant effluent without the addition of chlorine or chloramine.

A problem with this water collection approach is the holding time of the filtered water. The filtered water collected for use with this RSSCT experiment was stored in 50 gallon drums from the time of collection through usage. The RSSCT influent analysis does not indicate much chemical change during this time sequence. Although, the holding time of the RSSCT influent must be considered in the final interpretation of all data collected for this study. The RSSCT influent is very representative of the water produced under normal treatment conditions for this plant. What must be interpreted is the change in water conditions taking place during the holding time and the significance of any change. Under normal operation the water conditions change constantly, although maybe insignificantly over a short duration that is representative of this study viewed as a full scale plant operation.

One of the biggest differences of interpretation was the use of chloramine versus straight chlorine. The first four quarters of the test used chloramine as the disinfectant and the fifth quarter results used free chlorine. As expected the free chlorine disinfection by-products were in greater quantity than the chloramine byproducts. The first four quarters of operation simulate the disinfection technique used by the plant where chloramine is used as the final disinfectant. On a normal basis free chlorine is only added to the system after settling and ammonia is added after filtration. A large portion of the chlorination disinfection byproducts are formed in the filters and the combinational pipeline between the filters and the effluent channel where the ammonia addition and mixing occurs. A simple test of the system showed that a total THM count of the effluent to be 73.5 ug/l (TOC 4.75 mg/l) and that of the first system distribution point to be 85.4

ug/l (TOC 5.80 mg/l). Compare these numbers to the prechlorinated settled water with a total THM of BMRL (TOC 4.84 mg/l), the two plant filter galleries 53.2 ug/l (TOC 5.14 mg/l) and 54.8 ug/l (TOC 4.6 mg/l) and the combined filter effluent 63.7 ug/l (TOC 5.15 mg/l). Therefore, if the disinfection contact time can be met by means other than prefilter chlorination the disinfection byproduct production should be minimized.

The use of granular activated carbon to help lower the total organic carbon content of the water thereby lowering the disinfection byproduct production was seen as effective through this study. The fifth quarter of data showed that further treatment of the filtration plant effluent with activated carbon reduced the TOC concentration and lowered the disinfection byproduct content of the water in connection with the use of free chlorine. The great concern here is how disinfection contact time could be met by the Otay Filtration Plant with the delay in chlorination until post-carbon filtration. The first four quarters of data were generated using chloramine post GAC filtration as the disinfection. The level of disinfection was set at 2.0 mg/l chloramine this was not seen to produce any significant amount of disinfection byproduct in the RSSCT influent SDS sample. Further study would need to be completed using chloramination concentrations to determine if post filter disinfection with chloramine would produce effluent with lower disinfection byproducts levels. Indications are promising although the concern over contact time in still prevalent.

RSSCT

The rapid small scale column test instrument was fairly easy to operate. Some minor problems were encountered with the setup and operation. The carbon for the columns was baked initially and cooled/kept in a desiccator. It was this same carbon that was used throughout the entire test. During the fifth testing cycle the TOC determinations were never found to be BMRL as would be expected when compared to the first four cycles. This is believed to be attributed to the length of time the GAC was kept in the desiccator. The possibility exists that the life of the GAC may have been shortened since the GAC began with a measurable TOC value.

Operation of the first four quarters differed from the fifth quarter in several ways. As mentioned above the disinfectant was chlorine. Another rather large difference was the length of time the sampling took place. The first four quarters of sampling the system was operated only during the daytime hours. This approach was necessary due to the constraints of the analysts available to perform the experimentation. In the fifth quarter the system was operated around the clock with samples being collected at scheduled intervals. This approach allowed the experiment to be completed in a lesser amount of days, although it proved to be very difficult and exhausting to the few chemists available. It is difficult to compare the two operation techniques due to the variance in the disinfectants used

Sep. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
Treatment Plant Name: Otay Filtration Plant						
ICR Treatment Plant ID No: 220						
Treatment Plant Category: CONV						
Process Train Name: Otay Process Train						
Process Train Category: CONV						
1	Rapid Mix	Rapid Mix				
				Organic polymer - coagulant aid	Agfloc WT35	3.00
				Ferric chloride	FeCl	
2	Flocculation	Flocculation Basin				
3	Sedimentation	Sedimentation				
4	Chlorine gas	Disinfectant Addition				
				Chlorine gas	Cl2	
5	Filtration	Filtration				
				Organic polymer - filter aid	Agfloc WT35	1.00
6	CWA Supp	Additional Water Source				
7	South San Diego	Clearwell				
8	Ammonium hydrox	Disinfectant Addition				
				Ammonium hydroxide	NH4OH	

End of Report A.3 --Design Plant Chemical Parameters

Process Train Name: Alvarado Process Train

Process Train Category: CONV

Treatment Plant Name: Otay Filtration Plant

ICR Treatment Plant ID No: 220

Treatment Plant PWS ID:

Treatment Plant Category: CONV

State Approved Plant Capacity (MGD): 40.0

Historical Min. Water Temperature (deg C): 15

Installed Sludge Handling Capacity (DPD): 0.00

Process Train Name: Otay Process Train

Process Train Category: CONV

End of Report A.5 -- Design Water System Information

40 CFR 141 Subpart M(ICR)-Preliminary Applicability Determination

System Name: City of San Diego Water Utilities
PWSID: CA3710020

Official Contact:		ICR Technical contact	
Mr. Khos Ghadari		Ms. Barbara Spade	
Water Production Superintendent		Water Quality Lab	
5530 Kiowa Dr.		5530 Kiowa Dr	
La Mesa, Ca 91942		La Mesa, Ca 91942	
Phone:	619-668-3227	Phone:	619-668-3236
		Fax:	619-668-3250
		E-Mail:	103726,2567@compuservecon

1995 Average Population

Retail(Pr):	1,200,000
Wholesale(Pw):	120,000

System ICR Applicability

DBP:	Yes
Micro:	Yes
Study:	Yes

1995 External Average Flows (MGD)

Purchased Finished Water that is Not Further Treated (Fn	53.2
Finished Water Sold to Other PWSs (Fw)	5.2

			1995 Average Flows (MGD)				1995 Population Equivalent				Plant Cat.	Plant ICR Applicability Table 2			Disinfectants Used 141.142(a) Tables			
ICR Plant ID	Plant Name	Plant PWSID	Surface(Fs)	Ground(Fg)	Disinfect(Fc)	Comb.(Fc)	Surface (Ps	Ground (Pg	Disinfect(Pp)	Comb.(Pc)		DBP	Micro	Study	Cl2	NH3	OCL	ClO2
218	Miramar Filtration Plant	CA3710020	70.2	0	0	70.2	420,569	0	0	420,569	A	Yes	Yes	Yes	Yes	Yes		
219	Alvarado Filtration Plant		63.6	0	0	63.3	381,028	0	0	381,028	A	Yes	Yes	Yes	Yes	Yes		
220	Otay Filtration Plant		15.6	0	2.9	18.5	93,460	0	17,374	110,834	A	Yes	Yes	Yes	Yes	Yes		

Finished Water Produced by All Treatment Plants (Fct): 152

Number of People Served by Finished Water Produced in All Treatment Plants (Pct): 912,431

PWS specific per Capita Finished Water Usage Rate (K) (MGD per Person): 0.000167

EDUCT SCHEMATIC

R STATION

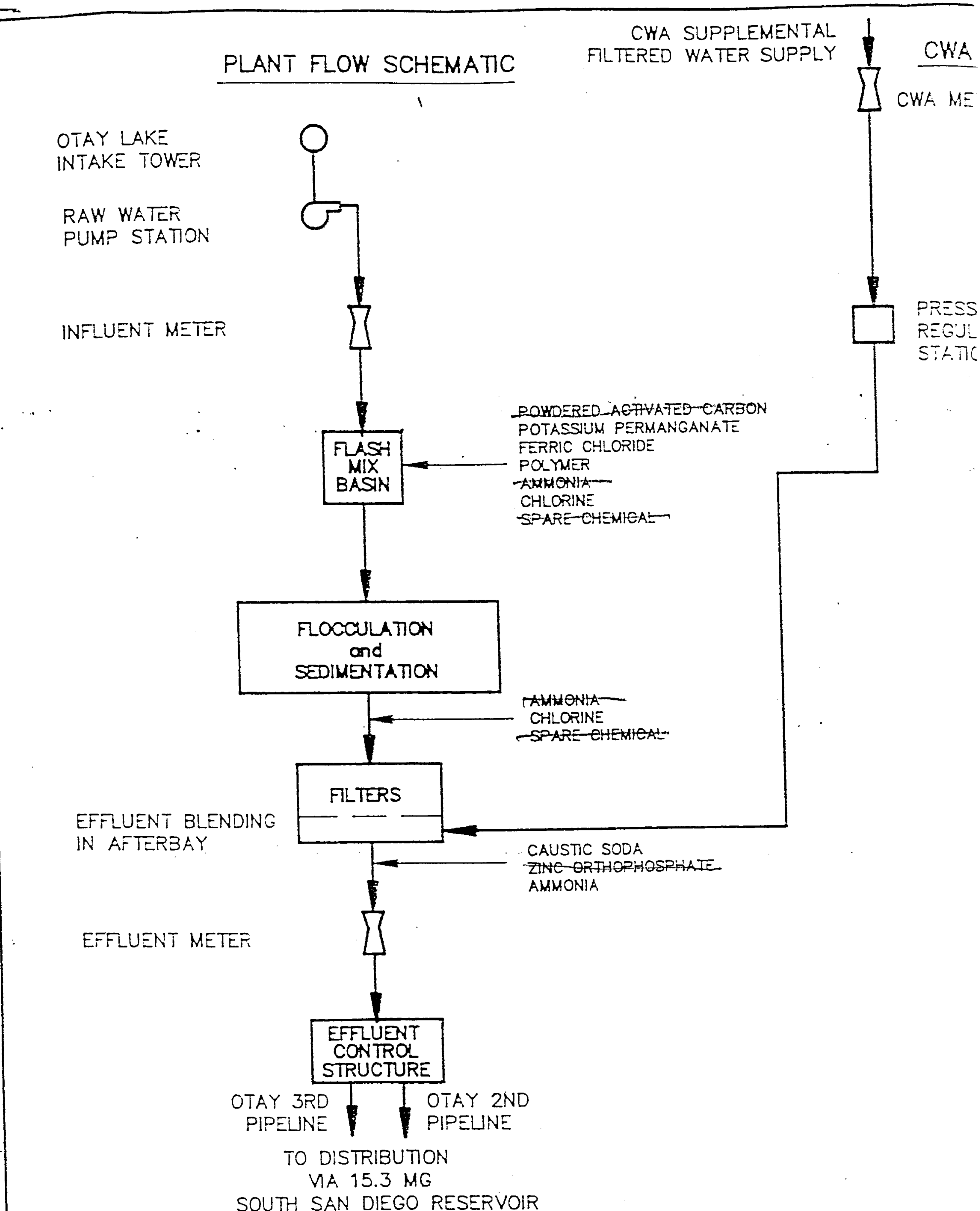
E
NG

EXISTING DESIGN CRITERIA

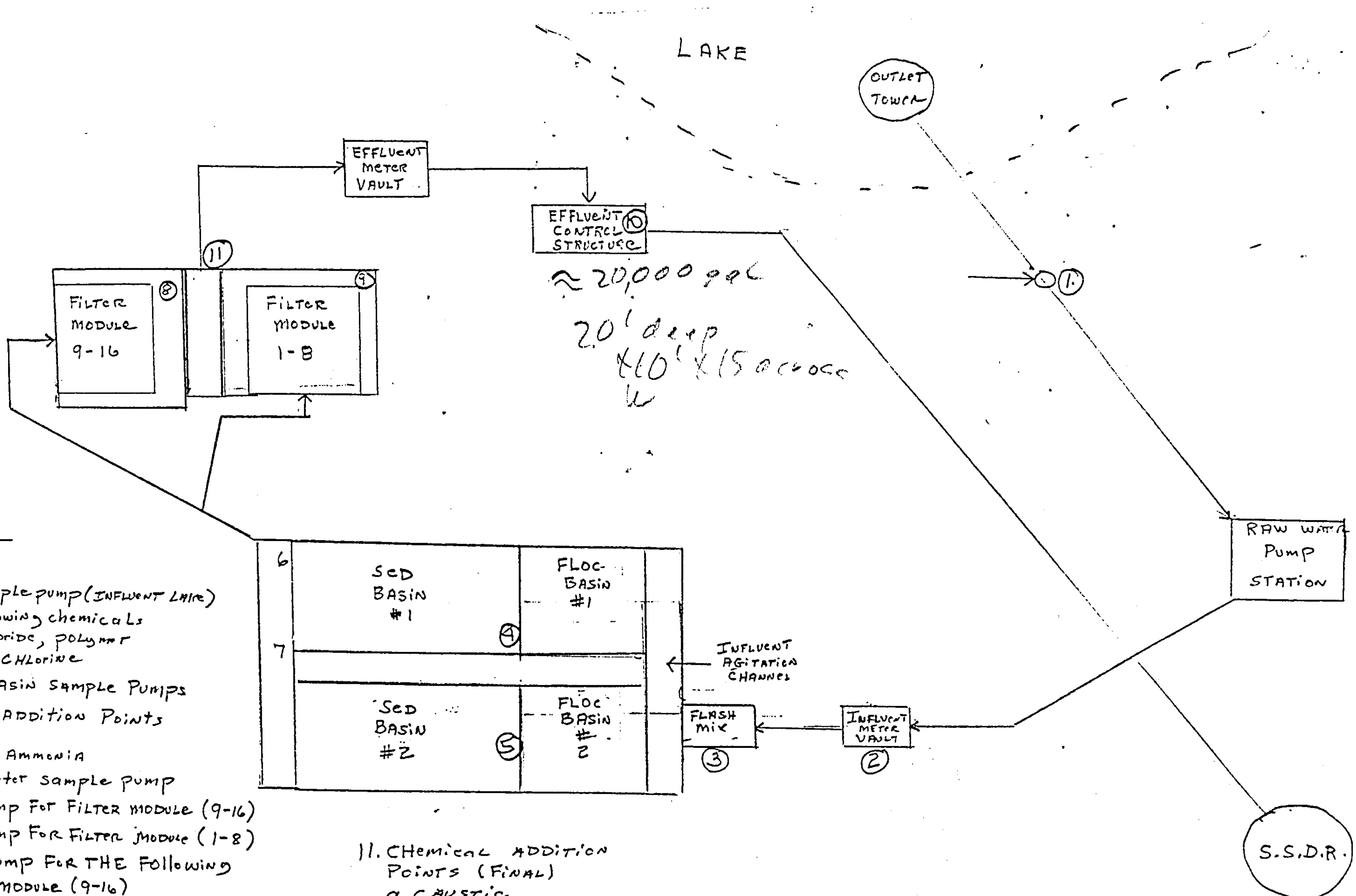
Unit Process	Parameter	Value	Units
Influent	Design Flow	40	mgd
Rapid Mixing	Stages	1	
Flocculation	Type	Vertical Shaft	
	Flow	40	mgd
	Number of Basins	2	
	Stages per Basin	4	
	Length (each stage)	26	feet
	Width (each stage)	26	feet
	Depth (each stage)	13.75	feet
	Total Volume	74,400	cu ft
		0.56	MG
	Total Detention Time	20	min
Sedimentation	Type	Horizontal flow	
	Flow	40	mgd
	Number	2	
	Length (each)	156	feet
	Width (each)	52	feet
	Total Width	104	feet
	Total Depth (each)	14.0	feet
	Total Volume	227,200	cu ft
		1.70	MG
	Overflow Rate	2465	gpd/sf
		1.7	gpm/sf
	Detention Time	60	min
	Horizontal Velocity	2.6	fpm
	Weir Loading Rate		
	No. of weirs (each)	1	
	Weir Length	52	feet
	Total Weir Length	104	feet
	Weir Loading Rate	384,600	gpd/lf
Filters	Type	Equal Loading, Self-Backwashing	
	Number of Filters	16	
	Surface Area (each)	264	sf
	Filtration Rate		
	All filters	6.6	gpm/sf
	One filter out of service	7.0	gpm/sf

CITY OF SAN DIEGO DRINKING WATER QUALITY IMPROVEMENT PROGRAM	FIGURE
OTAY WATER TREATMENT PLANT EXISTING PROCESS AND CHEMICAL FEED SCHEMATIC	3-5

PLANT FLOW SCHEMATIC



POWELL / MALCOLM PIRNIE



LEGEND

1. ADD $KMnO_4$
2. Raw water sample pump (INFLUENT LAKE)
3. ADD the Following chemicals
   a. Ferric chloride, polymer
   b. Ammonia, Chlorine

4+5. FLOC BASIN SAMPLE PUMPS

6. CHEMICAL ADDITION POINTS
   a. Polymer
   b. Chlorine, Ammonia
7. Settled water sample pump
8. Sample Pump For Filter module (9-16)
9. Sample Pump For Filter module (1-8)
10. Sample Pump For THE Following
    a. Filter module (9-16)
    b. Filter module (1-8)
    c. C.W.A WATER

11. Chemical Addition Points (Final)
    a. Caustic
    b. Chlorine
    c. Ammonia

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CITY OF SAN DIEGO

ANNUAL WATER QUALITY REPORT 1997

PARAMETER	Federal MCL	State MCL	Filtration Plant Effluents* Miramar	Alvarado	Otay	State DRLs
PRIMARY STANDARDS (MANDATORY HEALTH RELATED STANDARDS) CLARITY						
Turbidity (NTU)	0.5	0.5	0.1	0.09	0.15	0.07
PRIMARY STANDARDS (MANDATORY HEALTH RELATED STANDARDS) MICROBIOLOGICAL						
Coliform Bacteria	5.0 % positive	5.0 % positive	No MCL violations for 1997 (e)			NS
E.Coli	Presence	Presence				NS
PRIMARY STANDARDS (MANDATORY HEALTH RELATED STANDARDS) ORGANIC CHEMICALS (mg/l) **						
PESTICIDES						
Alachlor	0.002	0.002	ND	ND	ND	0.001
Atrazine	0.003	0.003	ND	ND	ND	0.001
Chlordane	0.002	0.0001	ND	ND	ND	0.0001
Endrin	0.002	0.002	ND	ND	ND	0.0001
Heptachlor	0.0004	0.00001	ND	ND	ND	0.00001
Heptachlor epoxide	0.0002	0.00001	ND	ND	ND	0.00001
Lindane	0.0002	0.0002	ND	ND	ND	0.0002
Methoxychlor	0.04	0.04	ND	ND	ND	0.01
Molinate	NS	0.02	ND	ND	ND	0.002
Simazine	0.004	0.004	ND	ND	ND	0.001
Toxaphene	0.003	0.003	ND	ND	ND	0.001
ORGANICS						
Hexachlorobenzene	0.001	0.001	ND	ND	ND	0.0005
Hexachlorocyclopentadiene	0.05	0.05	ND	ND	ND	0.001
Benzene	0.005	0.001	ND	ND	ND	0.0005
Carbon Tetrachloride	0.005	0.0005	ND	ND	ND	0.0005
1,2-Dichlorobenzene	0.6	0.6	ND	ND	ND	0.0005
1,4-Dichlorobenzene	0.075	0.005	ND	ND	ND	0.0005
1,1-Dichloroethane	NS	0.005	ND	ND	ND	0.0005
1,2-Dichloroethane	0.005	0.0005	ND	ND	ND	0.0005
1,1-Dichloroethylene	0.007	0.006	ND	ND	ND	0.0005
cis-1,2-Dichloroethylene	0.07	0.006	ND	ND	ND	0.0005
trans-1,2-Dichloroethylene	0.1	0.01	ND	ND	ND	0.0005
Dichloromethane (methylene chloride)	0.005	0.005	ND	ND	ND	0.0005
1,2-Dichloropropane	0.005	0.005	ND	ND	ND	0.0005
1,3-Dichloropropane	NS	0.005	ND	ND	ND	0.0005
Ethylbenzene	0.7	0.7	ND	ND	ND	0.0005
Monochlorobenzene	0.1	0.07	ND	ND	ND	0.0005
Styrene	0.1	0.1	ND	ND	ND	0.0005
1,1,2,2-Tetrachloroethane	NS	0.001	ND	ND	ND	0.0005
Tetrachloroethylene	0.005	0.005	ND	ND	ND	0.0005
Toluene	1.0	0.15	ND	ND	ND	0.0005
Total Trihalomethanes (a)	0.1	0.1	0.049	0.057	0.081	0.0005
1,2,4-Trichlorobenzene	0.07	0.07	ND	ND	ND	0.0005
1,1,1-Trichloroethane	0.2	0.2	ND	ND	ND	0.0005
1,1,2-Trichloroethane	0.005	0.005	ND	ND	ND	0.0005
Trichloroethylene	0.005	0.005	ND	ND	ND	0.0005
Trichlorofluoromethane	NS	0.15	ND	ND	ND	0.005
Vinyl Chloride	0.002	0.0005	ND	ND	ND	0.0005

Total Xylenes	10.0	1.75	ND	ND	ND	0.0005

PRIMARY STANDARDS (MANDATORY HEALTH RELATED STANDARDS) INORGANIC CHEMICALS (mg/l)

Aluminum	0.05-0.2(#)	1.0	ND	ND	ND	0.05
Antimony	0.006	0.006	ND	ND	ND	0.006
Arsenic	0.05	0.05	ND	ND	ND	0.002
Barium	2.0	1.0	ND	ND	ND	0.1
Beryllium	0.004	0.004	ND	ND	ND	0.001
Cadmium	0.005	0.005	ND	ND	ND	0.001
Chromium	0.1	0.05	ND	ND	ND	0.05
Copper	1.0 (c)	1.0 (c)	ND	ND	ND	0.1
Fluoride	4.0 (2.0#)(b)	1.4-2.4 (b)	0.31	0.28	0.35	0.2
Lead	0.05/0.015 (c)	1.0	ND	ND	ND	0.005
Mercury	0.002	0.002	ND	ND	ND	0.001
Nickel	0.1	0.1	ND	ND	ND	0.005
Nitrate (as Nitrate)	45	45	ND	ND	ND	2.0
Nitrite (as Nitrogen)	1.0	1.0	ND	ND	ND	0.4
Selenium	0.05	0.05	ND	ND	ND	0.005
Thallium	0.002	0.002	ND	ND	ND	0.001

SECONDARY STANDARDS—AESTHETIC STANDARDS (mg/l)* Recommended Standards***

Chloride	250	250(#)	90.4	86.4	96.9	6.25
Color (units)	15	15	ND	1.0	2.0	1.0
Iron	0.3	0.3	ND	ND	ND	0.05
Manganese	0.05	0.05	ND	ND	ND	0.03
Odor Threshold (units)	3.0	3.0	ND	ND	2.0	1.0
pH (units)	6.5-8.5	6.5-8.5	8.2	8.2	8.2	NS
Silver	0.1	0.1	ND	ND	ND	0.01
Specific Conductance (umho/cm)	NS	900(#)	966	832	768	NS
Sulfate	250	250(#)	230	164	93	2.5
Total Solids	500/1000(d)	500/1000(d)	643	544	470	NS
Zinc	.05	.05	ND	ND	ND	0.05

ADDITIONAL PARAMETERS (mg/l)

Alkalinity as CaCO3	NS	NS	123	125	144	5.0
Calcium	NS	NS	75.2	61.5	51.2	1.0
Hardness as CaC03	NS	NS	290	242	209	0.6
Magnesium	NS	NS	24.3	20.2	19.4	3.0
Potassium	NS	NS	4.5	4.6	4.2	0.5
Sodium	NS	NS	92	83.7	79.3	5.0
Total Organic Carbon	NS	NS	2.5	3.3	5.2	0.5

KEY TO ABBREVIATIONS

MCL = Maximum Contaminant Level
ND = Monitored but Not Detected (MDLs are listed)
NS = No Standard
DRL = Detection Limit for Reporting
NTU = Nephelometric Turbidity Unit
mg/l = milligrams per liter (parts per million)
CFU/100ml = A measure of colony-forming units per 100 milliliters using the membrane filter technique for coliform analysis.
umho/cm = micromnos per centimeter
* = Data shown are annual averages and ranges
** = Compliance is based on running an average of quarterly distribution samples.
*** = Recommended, non-enforceable standards.
# = Recommended maximum level.
(a) = Total Trihalomethanes are calculated based on running an average of quarterly distribution samples.
(b) = Federal level of 2.0 mg/l is a secondary aesthetic standard. State level is dependent upon air temperature.
(c) = The Federal and State standards for lead and copper are treatment techniques requiring agencies to optimize corrosion control treatment. Action level = 0.015, MCL = 0.05.
(d) = Recommended = 500. Upper limit = 1000. Short Term = 1500.
(e) = Total Coliform MCL: if > or = 5.0 % monthly samples collected are Total Coliform positive. E. Coli positive followed by any positive or presence of Total Coliform or E Coli. Total Coliform followed by an E. Coli positive.

Design Summary
and
Operational Instructions

Rapid Small-Scale Column Test Kit
Model ICR-10/20

Manufactured by

Process Optimization Services
1947 S. Wadsworth Blvd., #405
Lakewood, CO 80227
303-948-0213
Fax: 303-948-0216

Caution: Read and understand these instructions before plugging in the pumps. Pumps must not be operated without fluid in the pump cylinder. **Pumps start when plugged in.**

Forward

This document describes how to operate a specific Rapid Small-Scale Column Test (RSSCT) kit manufactured by Process Optimization Services. The RSSCT is a bench-scale system for examining the performance and economics of granular activated carbon (GAC) for removing organics from aqueous solutions.

The RSSCT methodology is comparable in accuracy to that of pilot-scale systems but is much more expedient. The RSSCT can be used to examine the performance and economics of GAC systems by examining the effluent concentration of the contaminant(s) as a function of time (i.e., the breakthrough curve). If multiple empty bed contact times (EBCTs) are examined, an optimization curve can be produced that enables the selection of the optimum EBCT range for least cost operations. The RSSCT methodology is superior to traditional isotherm methods which only examine equilibrium aspects of adsorption. Unlike pilot-scale systems, RSSCT methodology is unable to simulate hydraulic, biological, or filtration phenomena known to occur within GAC systems.

Although the purpose of the Model ICR-10/20 RSSCT kit described herein is for examining the adsorptive behavior of dissolved aqueous constituents (i.e., Natural Organic Matter (NOM) measured as Total Organic Carbon (TOC)) in regard to disinfection by-product formation, RSSCTs have been used in a wide variety of applications including:

- Examining adsorption behavior of taste and odor causing compounds from municipal water supplies.
- Examining adsorption behavior in multi-contaminant waters.
- Quantifying the effectiveness of reactivated carbon.
- Quantifying life cycle costs of competitively bid granular activated carbons.
- Evaluation of candidate process trains.

Thank you for purchasing an RSSCT kit manufactured by Process Optimization Services. As you proceed to assemble and operate your RSSCT system, technical assistance is available by calling (303)-948-0213.

Definitions and Acronyms

This document uses the following terms:

"**Back**" - The side of the pre-assembled base plate that has the five threaded holes to accept support rods.

"**EBCT**"- Empty bed contact time.

"**Front**"- The side of the pre-assembled base plate nearest to the silver colored pumpheads.

"**ICR**"- Information Collection Rule.

"**NOM**"- Natural organic matter.

"**SST**"- Stainless Steel.

Key Assumptions

The Model ICR-10/20 RSSCT (Rapid Small-Scale Column Test) kit is designed to meet the requirements specified in the ***ICR Manual for Bench and Pilot-Scale Treatment Studies (EPA 814-b-96-003).*** This kit has been designed based on the equations published in the ICR documents.

The scaling equations used for this RSSCT design have been developed based on dimensional analysis to maintain similitude to the full scale GAC system. The equations, published in the document above as well as the manual entitled ***ICR Treatment Studies Data Collection Spreadsheets User's Guide (EPA 815-B-97-002),*** assume that intraparticle diffusivity varies with particle size (i.e., proportional diffusivity). The Model ICR-10/20 kit has been designed based on the equations published in the ICR documents and therefore reflect a proportional diffusivity approach. The proportional diffusivity approach may or may not be applicable to other contaminant matrices so care should be exercised in utilizing the kit provided (with operational parameters stated herein) in other situations. The user that wishes to learn more about RSSCT design assumptions is encouraged to seek out the references cited in the ICR publications.

The Model ICR-10/20 RSSCT kit is not equipped with a filtration device to protect against excessive headloss build-up due to the presence of turbidity/suspended solids. Accordingly, pretreatment of the water, either on a batch or continuous basis, is the responsibility of the user. The user is encouraged to refer to page 2-12 of the ***ICR Manual for Bench and Pilot-Scale Treatment Studies (EPA 814-b-96-003)*** for guidance on acceptable filtration methods prior to RSSCT studies.

The full size carbon crushed for use in the Model ICR-10/20 RSSCT kit has been prepared to minimize headloss buildup by the use of an elutration sieve washing procedure. This method physically restrains the desired particle sizes while allowing undesirable smaller particles contributing to excessive headloss build-up to float away. This methodology is employed to avoid high headloss conditions associated with small RSSCT column diameters containing small mesh size carbons.

Design Summary

The design summary presented herein is consistent with the format required of the manual entitled **ICR Treatment Studies Data Collection Spreadsheets User's Guide (EPA 815-B-97-002).** The calculated quantities summarized below are based on an assumed value of the RSSCT dry bed density as stated in the above document. The quantities were calculated primarily for the purpose to determine the water and crushed carbon requirements. The actual amount of carbon loaded into the columns for each EBCT will be slightly different based upon the actual dry bed density as measured by the user as well as the water temperature and TOC level of the study period..

To determine the exact amount of crushed GAC to load into each column, the user must first determine the actual dry bed density for the carbon supplied by measurement. After a value for the dry bed density has been determined, its value along with others reported below can be entered into the software associated with the above document to determine final quantities.

Input Design Parameters

RSSCT Influent TOC (mg/L)	5.5
Inner diameter of the RSSCT column, D_{sc} (mm)	15
Minimum RSSCT Reynolds No., Re_{sc}, min	0.5
Full-scale operating temperature, T°C (°C)	20.3
Full-scale bed porosity, ε_{lc}	0.45
Assumed RSSCT dry bed density, p_{sc} (g/cm^3)	0.5
RSSCT GAC mesh size, upper (U.S. Std Mesh)	100
RSSCT GAC mesh size, lower (U.S. Std Mesh)	200

Estimated Run Length

Bed Volumes to 50% TOC breakthrough, BV_{50}	2366
Estimated Run Length, BV_T (2 x BV_{50})	4732
BV_T+30% safety factor, $BV_{T+30\%}$ (=2.6 x BV_{50})	6151

Design Summary (Continued)

General RSSCT Design Parameters

Kinematic viscosity at T°C, υ_{lc} (m^2/s)	1.0193×10^{-6}
RSSCT carbon particle diameter, d_{sc} (mm)	0.112
Scaling factor, SF	13.16
RSSCT hydraulic loading, v_{sc} (m/hr)	7.34
RSSCT flow rate, Q_{sc} (mL/min)	21.61
Estimated total influent volume required, V_{sc}^{T} (L)	304

10-minute EBCT Run

Full-scale empty bed contact time, $EBCT_{LC}$ (min)	10
Estimated full-scale run time, t_{LC}^{T} (days)	42.7
RSSCT empty bed contact time, $EBCT_{sc}$ (min)	0.76
Estimated RSSCT run time, t_{sc}^{T} (days)	3.2
RSSCT bed length, l_{sc} (cm)	9.3
Estimated volume required for 10-minute EBCT, V_{sc} (L)	102
Mass GAC required, m_{sc} (g)	8.21

20-minute EBCT Run

Full-scale empty bed contact time, $EBCT_{LC}$ (min)	20
Estimated full-scale run time, t_{LC}^{T} (days)	85.4
RSSCT empty bed contact time, $EBCT_{sc}$ (min)	1.52
Estimated RSSCT run time, t_{sc}^{T} (days)	6.5
RSSCT bed length, l_{sc} (cm)	18.6
Estimated volume required for 20-minute EBCT, V_{sc} (L)	202
Mass GAC required, m_{sc} (g)	16.43

Water Requirements (gallons)

	10 Minute RSSCT Run	20 Minute RSSCT Run	Subtotal
1st Quarter	26.7	53.4	80.0
2nd Quarter	26.7	53.4	80.0
3rd Quarter	26.7	53.4	80.0
4th Quarter	26.7	53.4	80.0

The water volumes reported above include a 30% factor of safety for RSSCT feeds per ICR design calculations on page 4A-3 of the document entitled ***ICR Treatment Studies Data Collection Spreadsheets User's Guide (EPA 815-B-97-002)***. The purpose of this additional 30% is to allow for influent sample volumes and variability amongst water sources with respect to NOM adsorption. On page 2-24 of the manual entitled ***ICR Manual for Bench and Pilot-Scale Treatment Studies (EPA 814-b-96-003)*** it is suggested that a factor of safety larger than 30% (i.e., 200%) is appropriate for non-bituminous coal based GAC but does not state why a larger factor of safety is required. CALGON F-300 is a bituminous coal based GAC and therefore the 30% factor of safety is adequate.

Crushed Carbon Requirements (grams)

	10 Minute RSSCT Run	20 Minute RSSCT Run	Subtotal
1st Quarter	8.21	16.43	24.64
2nd Quarter	8.21	16.43	24.64
3rd Quarter	8.21	16.43	24.64
4th Quarter	8.21	16.43	24.64
Subtotal	32.84	65.72	
Total			98.56

OPERATIONAL INSTRUCTIONS

General Approach

This operational document assumes that the RSSCT kit has been assembled per the document entitled **Unpacking and Assembly Instructions**. At this point, the glass columns should be upright and held in place by adjustable clamps and all tubing coming to and from the base plate has been connected/routed. The glass columns should be empty (crushed carbon **not** in place). Safety shields, if supplied, should **not** be installed until after checking the hydraulic path and loading the crushed carbon. The purpose of checking the hydraulic path is to establish the pump flow rates before adding the GAC to the columns and to tighten any connections that may be leaking.

Location

The Model ICR 10/20 RSSCT kit has been designed to be self supporting to facilitate installation on a laboratory bench top or floor. The assembled kit weight (without water) is approximately 40 lbs. The ideal location for the RSSCT kit is one where the:

- pump suction can be flooded.
- column effluents can be collected and routed to a drain (open to atmosphere).
- 120 volt, 15 amp circuit, (2 receptacles needed--each pump less than 1 amp).

Establishing the hydraulic path.

The hydraulic path is defined as the complete circuit of tubing from the source of water (tank or pressurized pipe) through the RSSCT equipment to the drain (open to the atmosphere) receiving the effluent of the RSSCT columns.

If the hydraulic path is not complete and secured in place, efforts to do so should be done now. Use the additional cable ties supplied as necessary to secure tubing in place. Use the teflon or PTFE thread tape (provided) as necessary in the subsequent steps to eliminate leakage at threaded connections.

Please note that the teflon end fittings of the glass columns and the SST tube fittings attached to the teflon end fittings have been shipped without thread tape. Only once the glass columns and tubing have been assembled on the support base and the user familiarized with the arrangement, should thread tape be applied to the remaining fittings. Thread tape should be wrapped around the teflon column fittings two to three times prior to screwing into the glass column threads. Make sure O-rings are seated properly whenever working with the glass columns.

Once the glass columns have had thread tape applied to the bottom teflon end fittings (but not the top teflon end fittings), re-position the columns (without the safety shields or crushed carbon) on the support base and complete the tubing connections. At this point, without crushed carbon in the columns, it is recommended that the water to be tested (or distilled water) be introduced into the pump suction. You may use a non-trivial amount of distilled water if many loose fittings are encountered.

Checking the hydraulic path.

Before starting the pump by plugging the pump into a receptacle, turn the black knob on the pump base until the blue indicator below the pumphead indicates 2 to the **right of the center** 0 position. A position of 2 will result in a flow rate near 12 ml/min. Positions further to the right of 2 are greater. Positions between the center 0 and right 2 are less. Flow direction when the blue indicator is left of 0 are in the reversed direction.

Until all leaks have been addressed, the user should be cognizant that water may be present in close proximity to electrical connections. Valve positions when starting the pump the first time should be as follows.

Red handled diaphragm valve:	Open
Green handled diaphragm valve:	Closed
Blue handled diaphragm valve:	Closed

Valve operation is counter-clockwise to open, clockwise to close.

The above positions allow the user to confirm the proper flow rate by collecting the discharge of the pump from the end of the short tubing associated with the red handled valve. To confirm the flow rate, water should be collected in a large graduated cylinder or beaker. The larger the volumetric container and longer time, the more accurate the flow measurement.

At this time, with the above valve positions, one pump should be started (plugged in). Any leaks encountered should be addressed by tightening fittings or thread taping connections. Once this hydraulic path is leak free, steps to calibrate the dial indicator (see manufacturer's reference material) should be followed. Once the dial indicators is calibrated, manual flow rate measurements should commence with a volumetric container and stopwatch. Start by adjusting the black knob back to the 2 position (20% of maximum). The dial indicator should read 2 on the small dial and near 0 on the large dial, which is consistent.

The black knob should now be adjusted repeatedly until the proper RSSCT flow rate has been established by the volumetric container- stopwatch method. The pump manufacturer recommends that the black knob be adjusted one full revolution of the primary (large) dial past the desired flow rate and adjusted back to avoid system back-lash. Repeat the above procedure for the second pump.

For each pump, record the dial indicator position at which the proper flow rates were established. From this point on, the dial indicator can be used to detect a departure from the desired flow rate. If the proper flow rate is not indicated, the black knob should be adjusted to return the dial indicator back to the originally recorded position. A volumetric container-stopwatch effort may be used to confirm flow rate at any time.

With the pumps off, valve positions should be changed to the following:

Red handled diaphragm valve:	Closed
Green handled diaphragm valve:	Open
Blue handled diaphragm valve:	Closed

After confirming that effluent tubing has been routed to a drain, turn each pump on with the valve positions indicated above to confirm that the column assemblies are leak free. Tighten fittings and re-apply thread tape as necessary to obtain leak free connections. Do not be overly concerned with the glass column top teflon end fitting being leak free because as soon as all other fittings are leak free, crushed carbon may be loaded into the top of the column at which time thread tape can be applied. Turn each pump off as the last leaking connections are fixed.

Loading crushed carbon into the glass columns.

The full size activated carbon that has been crushed for use in the RSSCT kit has been shipped in a labeled glass container. The crushed carbon has been shipped wet to avoid dusting in transport and to require the user to account for moisture pick-up prior to loading the column. Crushed carbon should be weighed to a constant weight in a laboratory furnace at 105°C. Once the carbon has acquired a constant weight, a dry bed density measurement should be performed so that ICR software calculations can be run to determine the actual mass of GAC required. The mass of GAC tabulated in this document is an approximation based on an assumed dry bed density.

The mass of GAC equal to the quantities determined should be loaded into separate large beakers or graduated cylinders for each of the EBCTs to be investigated. In this case, approximately 10.66 grams and 21.31 grams of dry crushed GAC should be placed into separate beakers or graduated cylinders. Distilled water (organic free as possible) should be slowly added to each beaker to facilitate pouring the crushed carbon into the glass columns on the RSSCT kit. **Until now, there has been no distinction made between the 10 minute EBCT RSSCT column and the 20 minute EBCT RSSCT column. Keep track of which column receives the mass of carbon associated with the 10 minute and 20 minute EBCTs.**

At this point, disassembly of the fittings at the top of the glass columns is required. Separate the tube from the SST fitting by loosening the nut. Remove the teflon end fitting from the top of the column with the SST tube fitting still in place. Pour the carbon and water mixture from the beaker into the column. Wash down any carbon on the sides of the column, especially the threaded portions, by applying distilled water from the squeeze bottle. When reassembling the column end fittings, re-align fittings to make the tubing connections as necessary. Thread tape should be applied to both the SST fitting and the teflon threads.

Releasing entrapped air.

After the columns have been reassembled with crushed carbon inside, effluent tubing should be elevated to be higher than the glass columns and water should be introduced to the column by turning on the pumps. Turn off the pumps when the columns have been filled with water. Allow the columns to sit full of water for a day. Gently shake the columns, without inverting and losing carbon, to facilitate trapped air release. The SST cap on the SST fitting can be loosened to release air from the column to the atmosphere. This cap can be loosened during operation of the RSSCT kit to release air that accumulates.

Attach safety shields.

Once the carbon has been successfully loaded into the columns, the columns re-assembled, and initial de-aeration has occurred, safety shields can be installed. To install the safety shields, the pumps must be off and the tubing connection at the top of the column separated. The safety shields are held in place by the bottom clamp. The top clamp must be re-positioned from holding the glass column to holding the top teflon end fitting after the safety shield is in position. The safety shield is in position when the semi-circular metal end pieces can be inserted between the shield and the bottom of the threaded portion of the top of the glass column.

Start-up.

You are now ready to begin operating your RSSCT Kit. Initial carbon mass, carbon volume, flow rate (manual and dial positions), and pressure readings should be recorded at start-up. Pressure and flow rate should be monitored throughout the test. Influent samples may be obtained from tubing associated with the red handled valve. The purpose of the green handled valve is to isolate the column. Effluent samples may be obtained from the blue handled valve.

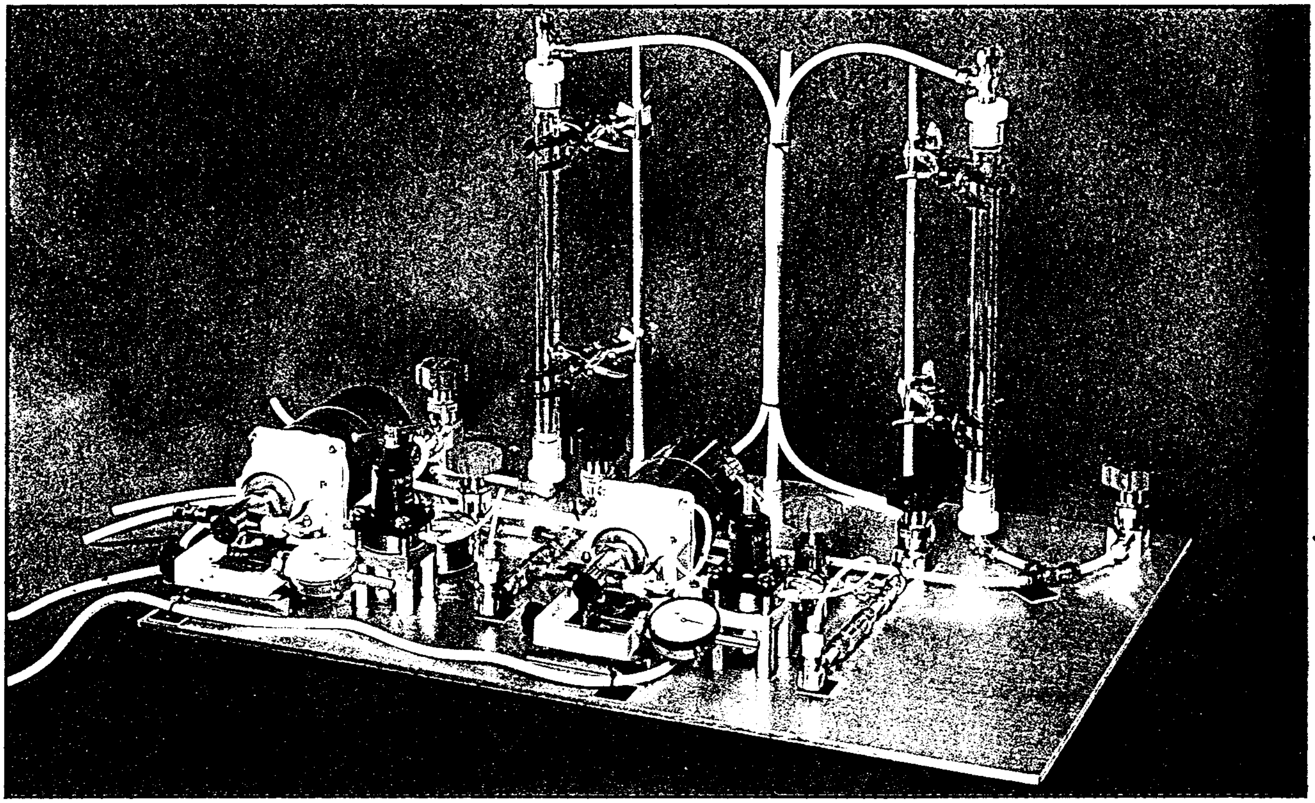
Warnings.

Please note that the absence of a valve on the effluent tubing is deliberate to avoid a positive displacement pump from accidently pumping against a closed valve. If additional back pressure is needed, either to keep the column flooded or to maintain a less variable flow rate, the effluent tubing may be raised or pinched.

The pulsation dampener should be periodically adjusted per the manufacturer's instructions. The pulsation dampener is most effective in the 10 to 65 psig range. Do not be concerned if initial pulsation (without any system back-pressure) cannot be effectively dampened. If pressures exceeding 65 psig are produced by the pump, damage to the diaphragm within the pulsation dampener can occur. The pulsation dampener should be replaced or removed if failure (leakage) is detected.

It is possible with the pump selected to have an instantaneous pressure in excess of the 100 psig nominal rating of the pump due to the tubing arrangement with valves on separate branches. For example, if the green valve is closed and the red valve is open but being closed, pressures will increase and 100 psig or greater pressures will occur. Avoid stressing the pump and "springing" the pressure gauge by always keeping an open fluid path when the pumps are operating..

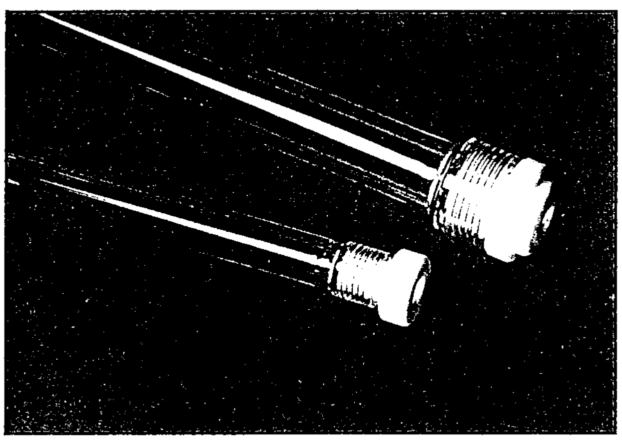
A pressure relief valve, although referenced in other sales literature, is not necessarily supplied with each RSSCT kit. Pressure relief valves are not provided when larger crushed carbon sizes (>100 mesh) or larger diameter columns (15 mm or 25 mm) are selected due to the inability of the low flow rates and system pressures to reliably reseal the valve after cracking (relieving) at a high pressure event.



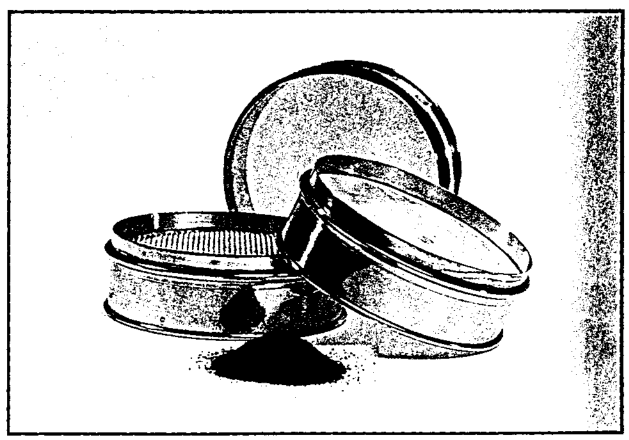
Model ICR-10/20 with EBCTs of 10 and 20 minutes

Rapid Small-Scale Column Test Kits

- Information Collection Rule (ICR) compliance
- Performance and cost evaluations
- Process train selection
- Process optimization



Kit components may be varied to obtain desired testing conditions



Carbon preparation services

Design Services

- Selection of column diameter, length, and flow rate.
- Determination of GAC mass and particle size.
- Incorporation of pressure relief and air release mechanisms.
- System design including structural support.
- Tabulation of key assumptions and design parameters.

GAC Preparation and Procurement

- Grinding, sieving, and washing services.
- Customer furnished carbons accepted.
- Pre-prepared carbons available from inventory.

1947 S. Wadsworth Blvd., #405
Lakewood, CO 80227

303-948-0213; FAX 303-948-0216

PROCESS OPTIMIZATION SERVICES

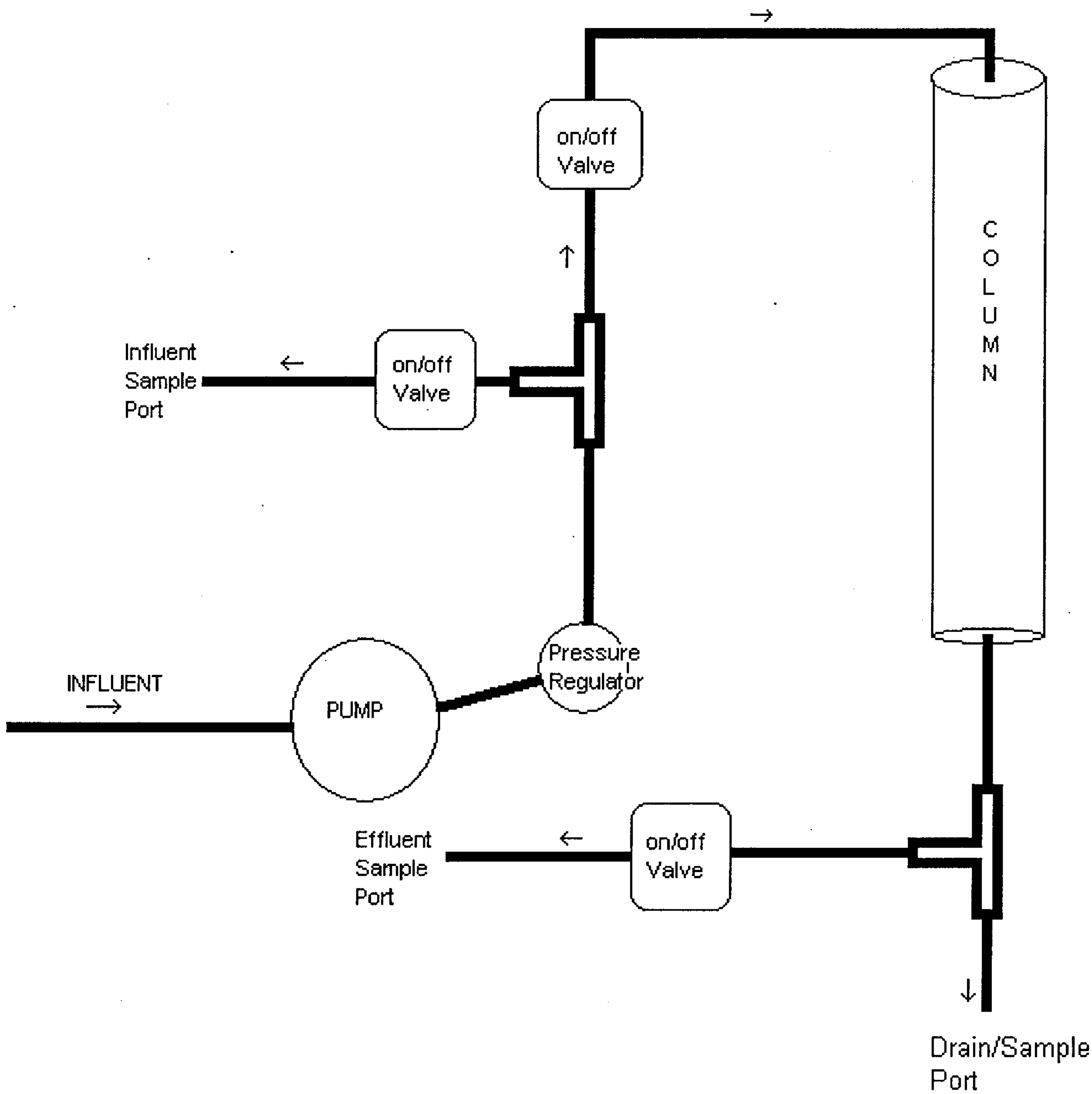
Equipment and Services Price List
Prices valid until June 30, 1998; excludes applicable taxes.
Subject to POS's standard terms and conditions of sale.

RSSCT Kits:	
Model ICR-10/20 with assembly and operating instructions.	$6,800 with valves
Custom Kit with assembly and operating instructions. Single pump and column systems.	Call for Pricing Starting at $3,000
RSSCT Design (included in price of the kits):	Included
includes:	
Determination of flow rate.	Included
Determination of crushed GAC particle size.	Included
Determination of empty bed contact time (EBCT).	Included
Determination of GAC mass.	Included
Estimation of minimum water volume requirement.	Included
Selection of column diameter and length.	Included
Check need for pressure relief.	Included
Check need for in-line filtration.	Included
Tabulation of key assumptions and design parameters.	Included
Customer requested review of sampling plan and/or adjustments in water volume/flow rate.	$200 ea.
GAC Procurement:	
Customer provided crushed GAC.	No Charge
Customer provided uncrushed GAC. (preparation charges apply)	No Charge
Stock uncrushed GAC. (preparation charges apply)	$50
Stock crushed, sieved and washed GAC.	$500
Special order GAC. (preparation charges apply)	At Cost
GAC Preparation:	
Crushing/Sieving/Washing. -includes: Sieve analysis report.	$750
Design Oversight:	
Internal review by a qualified member of POS.	Included
Academic organization affiliated with POS.	Market Price
Consulting engineering firm affiliated with POS.	Market Price
External individual or organization after execution of confidentiality agreement which contains a non-compete clause.	Call for Pricing
Data Interpretation:	
Affiliated academic organization.	Market Price
Affiliated consulting engineering firm.	Market Price
Replacement/Spare Parts:	
Glass column with end fittings (ready for GAC).	$125 - $150 ea.
Positive displacement, variable speed pump with accessories.	$1, 200 ea.
Aluminum support base with rods(3) and clamps(4).	$250 ea.
GAC Pilot Systems:	Pricing Dependent on Objectives, Flow Rate, and Features (excludes freight)
includes: Pilot columns. GAC media Nozzle flow distributor/media support. Structural support. Pressure measurement and indication. Flow rate indication. Flow totalization. Sampling taps and valves.	
Freight (RSSCT Kits):	
typical:	
FedEx 2-day (Second Business Day), insured.	Included
customer specified:	
Other express delivery, at customer's request and responsibility.	At Cost
International deliveries.	At Cost

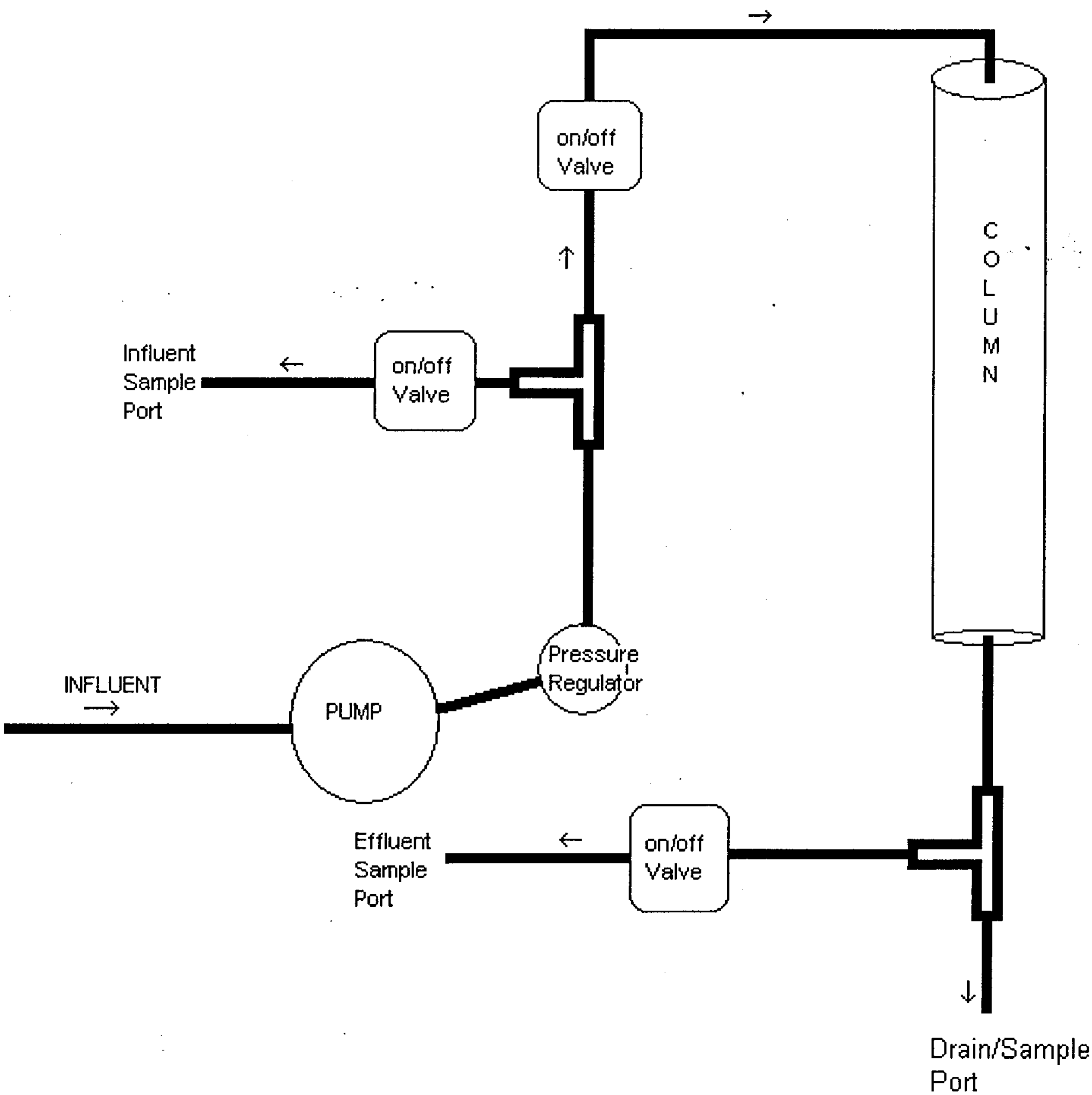
Process Optimization Services
1947 S. Wadsworth Blvd., #405
Lakewood, CO 80227

Phone: 303-948-0213
Fax: 303-948-0216

Schematic of Advanced Treatment Process
Rapid Small Scale Column Test
Empty Bed Contact Time 10 Column



Schematic of Advanced Treatment Process
Rapid Small Scale Column Test
Empty Bed Contact Time 20 Column



EXPERIMENTAL DESIGN SUMMARY FOR A RSSCT STUDY

Season	Pretreatment	EBCT, minutes
Spring	Conventional Treatment	10 & 20
Summer	Conventional Treatment	10 & 20
Fall	Conventional Treatment	10 & 20
Winter	Conventional Treatment	10 & 20

METHODS USED FOR THE ICR BENCH TESTING

Analyte	Method	Minimum Reporting Level
Alkalinity	SM 2320 B	5 mg/L as CaCO3
Ammonia	SM 4500-NH_3 D	0.2 mg NH3-N/L
Bromide	EPA 300.0	10 ug/L
Calcium Hardness	SM 3500-Ca D	5 mg/L as CaCO3
Chlorine Residual	SM 4500-Cl D	0.02 mg/L
BCAA, DBAA, DCAA, MBAA, MCAA, TCAA	EPA 522.2	0.5 ug/L (except MCAA 1 ug/L)
pH	SM 4500-H+	--------
Temperature	SM 2550 B	--------
CHCl3, BDCM, DBCM, CHBr3	EPA 502.2	0.5 ug/L
Total Hardness	SM 2340 B	5 mg/L as CaCO3
TOC	SM 5310 B	0.50 mg/L
TOX	SM 5320 B	25 ug Cl^-/L
Turbidity	SM 2130 B	0.5 ntu
UV_{254}	SM 5910	0.009 cm^{-1}

Run: 9/27/99 22:00

Otay 2-Hour Plant Lab Measurements

Reported for 05/19/98

Test Type	Source	0000	0200	0400	0600	0800	1000	1200	1400	1600	1800	2000	2200	Avg
Hardness	INFL		150				144				146			**147**
	EFFL		148				142				144			**145**
Alkalinity	INFL		132				130				132			**131**
	EFFL		134				132				125			**130**
Turbidity	INFL	1.6	1.8	1.7	1.7	1.3	1.8	1.9	1.7	1.4	1.6	1.8	1.3	**1.6**
	SETT	2.1	2	2.2	2.6	2.6	2.7	2.7	2.9	1.5	2.7	2.5	2.3	**2.4**
	FLTR	0.22	0.16	0.16	0.17	0.23	0.31	0.28	0.26	0.2	0.14	0.13	0.24	**0.21**
	EFFL	0.18	0.16	0.14	0.15	0.21	0.3	0.26	0.37	0.18	0.11	0.12	0.18	**0.2**
	AQUA													
pH	INFL	7.4	7.4	7.5	7.5	7.4	7.4	7.4	7.3	7.3	7.2	7.2	7.3	**7.4**
	SETT	7.1	7.2	7.3	7.3	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.3	**7.2**
	FLTR	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	**7.2**
	EFFL	8.2	8.1	8.2	8.1	8.1	8.2	8.1	7.7	7.4	7.8	8.2	8.1	**8**
	AQUA													
Taste/Odor	FLTR													
	EFFL		2				1.4				1.4			**2**
Temp C.	INFL		16				18				18.3			**17.4**
	FLTR		14.8				15.2				15.8			**15.3**
	EFFL		16.3				16.5				17.1			**16.6**
Free Cl	SETT													
	FLTR	1.5	1.4	1.4	1.4	1.6	1.6	1.5	0	0	1.6	1.5	1.5	**1.5**
	EFFL					0	0	0	1.4					**1.4**
	AQUA													
Totl Cl	EFFL	2.2	2.2	2.1	2.1	2.2	2.2	2.2	1.7	1.4	2.3	2.2	2.1	**2.1**
	AQUA													
Color	FLTR													
Water Inflows	AQUA					0	0	0	0					
	LAKE	31	31	25	25	31	31	31	24	16	25	25	25	**27**
Plant	EFFL	31	31	25	25	31	31	31	24	16	25	25	25	**27**

DAILY ABSTRACT
OTAY TREATMENT PLANT

Run: Sep 28, 1999 18:51 **Report for: May 19, 1998 Tue**

WATER TREATMENT

Influent	27.12	Mg
Effluent	24.75	Mg
Peak Flow	31.00	Mg

8 Hours 18:00 to 2:00

RESERVOIR

SSDR 19.5 Feet 12.03 Mg

FILTER WASHES

Water Used	2.27	Mg
Filters Washed	25	
Average Run	16	Hours
Influent (%)	8.37	%

CWA REQUESTS (CFS)

SD7 0 AM 0 PM

Effluent Demand 24.75 Mg

CWA Influent (Filtered)		MGD
SD7	SD# 7 Treated	0.00
	Total	0.00

CWA Filtered Reject		MGD
SD6	SD #6	0.00
SD6W	SD #6 Wier	0.00
	Total	0.00

DAILY PLANT LAB TEST AVERAGES

LAB TEST	INFLUENT	SETTLED	FILTERED	EFFLUENT	AQUEDUCT	LAKE RAW
Alkalinity	132			133		
Hardness	149			149		
pH	7.4	7.2	7.2	8.2		
Temp C.	17.8		15.3	16.3		
Turbidity	1.6	2.1	0.13	0.12		
Free Cl			1.5			
Color						
Taste/Odor				2		
Plant				27		
Totl Cl				2.1		
Water Inflows						27

CHEMICAL USAGE

CHEMICAL	Lbs Today	Usage LBS/MG	Cost /Lb	Cost/MG	Cost	Inventory
CL2	980	36.14	0.101	$3.65	$99	0 Lbs
Ferric	3,304	121.84	0.138	$16.81	$456	0 Lbs
KMnO4	0	0.00	1.239	$0.00	$0	0 Lbs
NH4OH	490	19.78	0.075	$1.48	$37	0 Lbs
NaOH	3,369	136.12	0.135	$18.38	$455	0 Lbs
PolyR	334	12.32	0.665	$8.19	$222	0 Lbs
			Daily Totals	$48.52	$1,269	

ENVIRONMENTAL

Lake Gauge	138.38	Rain (Inches)	0
Evaporation	4.0	Temp Min/Max	53 / 74 F

EQUIPMENT OUT OF SERVICE

Equip Name	OOS Date	Equip Name	OOS Date
Plc Failure Alarm	11/01/1997	Nanopure Water	03/21/1998
Lake Pump #2	05/18/1998	Fltr. #12 Inlet Valve	04/01/1998
Filter #8 Level Indicator	04/16/1998	Filter Backwash Inc. Alarm	04/24/1998
Filter # 2	05/14/1998	Fltr.#4 Water Level Indicator	05/18/1998

Run: 9/27/99 22:00

Otay 2-Hour Plant Lab Measurements

Reported for 08/17/98

Test Type	Source	0000	0200	0400	0600	0800	1000	1200	1400	1600	1800	2000	2200	Avg
Hardness	INFL		148				148				146			**147**
	EFFL		146				148				148			**147**
Alkalinity	INFL		135				136				133			**135**
	EFFL		132				140				127			**133**
Turbidity	INFL	1	1.1	1.1	1	1	1.1	1.3	1.1	1.2	1.1	1	1.1	**1.1**
	SETT	2.3	2	2.1	2	2.1	2.2	1.7	1.9	1.6	2	2.1	2.1	**2**
	FLTR	0.11	0.09	0.1	0.09	0.1	0.09	0.11	0.1	0.1	0.08	0.11	0.1	**0.1**
	EFFL	0.1	0.08	0.09	0.09	0.08	0.12	0.1	0.09	0.1	0.07	0.09	0.1	**0.09**
	AQUA													
pH	INFL	7.4	7.4	7.4	7.3	7.3	7.3	7.3	7.3	7.4	7.4	7.3	7.3	**7.3**
	SETT	6.9	6.9	6.9	6.9	6.9	6.8	6.9	6.9	6.9	6.9	6.9	6.9	**6.9**
	FLTR	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	**6.9**
	EFFL	8.2	8.2	8.2	8.2	8.2	8.2	8.3	8.2	8.2	8.2	8.2	8.1	**8.2**
	AQUA													
Taste/Odor	FLTR													
	EFFL		1.4				2				2			**2**
Temp C.	INFL		21.5				20.8				21.8			**21.4**
	FLTR		17				16.7				17.5			**17.1**
	EFFL		17.5				18.1				17.2			**17.6**
Free Cl	SETT													
	FLTR	1.3	1.3	1.3	1.3	1.3	0	1	1.2	1.4	1.4	1.5	1.6	**1.3**
	EFFL	0	0	0	0		2.4		0	0	0	0	0	**2.4**
	AQUA													
Totl Cl	EFFL	2.5	2.5	2.5	2.5	2.5	0	2.3	2.5	2.4	2.5	2.6	2.6	**2.5**
	AQUA													
Color	FLTR													
Water Inflows	AQUA	0	0	0	0				0	0	0	0	0	**0**
	LAKE	30	30	30	30	30	30	30	30	30	30	30	30	**30**
Plant	EFFL	30	30	30	30	30	30	30	30	30	30	30	30	**30**

DAILY ABSTRACT
OTAY TREATMENT PLANT

Run: Sep 28, 1999 18:51 **Report for: Aug 17, 1998 Mon**

WATER TREATMENT

Influent	30.03	Mg
Effluent	27.27	Mg
Peak Flow	30.00	Mg
22 Hours	8:00 to 6:00	

FILTER WASHES

Water Used	2.65 Mg
Filters Washed	24
Average Run	13 Hours
Influent (%)	8.83 %

RESERVOIR

SSDR 22.9 Feet 14.48 Mg

CWA REQUESTS (CFS)

SD7 0 AM 0 PM

Effluent Demand 24.53 Mg

DAILY PLANT LAB TEST AVERAGES

LAB TEST	INFLUENT	SETTLED	FILTERED	EFFLUENT	AQUEDUCT	LAKE RAW
Alkalinity	134			130		
Hardness	147			147		
pH	7.4	6.9	6.9	8.2		
Temp C.	21.3		17	17.5		
Turbidity	1	2	0.1	0.09		
Free Cl			1.4	0		
Color						
Taste/Odor				2		
Plant				30		
Totl Cl				2.5		
Water Inflows					0	30

CHEMICAL USAGE

CHEMICAL	Lbs Today	Usage LBS/MG	Cost /Lb	Cost/MG	Cost	Inventory
CL2	1,630	54.28	0.101	$5.48	$165	24,620 Lbs
Ferric	8,436	280.91	0.138	$38.77	$1,164	34,000 Lbs
KMnO4	93	3.10	1.239	$3.84	$115	27,541 Lbs
NH4OH	551	20.20	0.075	$1.51	$41	22,840 Lbs
NaOH	5,424	198.90	0.135	$26.85	$732	12,474 Lbs
PolyR	624	20.77	0.665	$13.81	$415	19,424 Lbs
			Daily Totals	$90.26	$2,632	

ENVIRONMENTAL

Lake Gauge	136.78	Rain (Inches)	0
Evaporation	4.0	Temp Min/Max	68 / 80 F

EQUIPMENT OUT OF SERVICE

Equip Name	OOS Date	Equip Name	OOS Date
Plc Failure Alarm	08/01/1998	Potable Pump 3	06/01/1998
Nanopure Water	08/01/1998	Ammonia Sight Glass	07/09/1998
Raw Pump Lights Out (5)	07/30/1998	Raw Pump Sump Pump Alarm	08/11/1998
Raw Water Pump House Floodi	08/11/1998	Bckwsh Inc. Alarm	08/13/1998
Fltr. Pipe Gallery Flooding Al	08/13/1998	Gallery Flooding Alarm	08/17/1998

DAILY ABSTRACT
OTAY TREATMENT PLANT

Run: Sep 28, 1999 18:51 **Report for: Aug 17, 1998 Mon**

GENERAL COMMENTS

Measure values of 0 ignored

Run: 9/27/99 22:00

Otay 2-Hour Plant Lab Measurements

Reported for 11/09/98

Test Type	Source	0000	0200	0400	0600	0800	1000	1200	1400	1600	1800	2000	2200	Avg
Hardness	INFL		148				148				150			**149**
	EFFL		148				148				148			**148**
Alkalinity	INFL		140				143				139			**141**
	EFFL		128				129				132			**130**
Turbidity	INFL	1.1	1	1	1.1	1.2	1.1	4.7	1.1	1.2	1.2	1.1	0.8	**1.4**
	SETT	1	0.7	0.7	0.8	0.6	1	1.6	2.1	1.4	0.9	1	0.9	**1.1**
	FLTR	0.26	0.23	0.14	0.15	0.12		0.11	0.12	0.11	0.11	0.14	0.13	**0.15**
	EFFL	0.15	0.14	0.11	0.1	0.06	0.1	0.09	0.08	0.07	0.1	0.12	0.09	**0.1**
	AQUA													
pH	INFL	7.8	7.8	7.8	7.8	7.8	7.7	7.8	7.7	7.8	7.6	7.7	7.8	**7.8**
	SETT	7.3	7.3	7.3	7.3	7.3	7.2	7.3	7.2	7.3	7.1	7.2	7.2	**7.3**
	FLTR	7.3	7.3	7.3	7.3	7.3		7.3	7.2	7.3	7.3	7.3	7.3	**7.3**
	EFFL	8.2	8.1	8.1	8.1	8.1	8	8.3	8.2	8.2	8.2	8.3	8.2	**8.2**
	AQUA													
Taste/Odor	FLTR													
	EFFL		2				2				2			**2**
Temp C.	INFL		20.4				19.9				20.3			**20.2**
	FLTR		18.6				18.8				18.6			**18.7**
	EFFL		19.2				19.5				19.6			**19.4**
Free Cl	SETT													
	FLTR	1.4	1.4	1.5	1.5	1.6		1.1	1.3	1.3	1.3	1.3	1.3	**1.4**
	EFFL					0	1.8	0	0					**1.8**
	AQUA													
Totl Cl	EFFL	2.5	2.5	2.5	2.5	2.4	0	2.1	2.5	2.5	2.5	2.6	2.5	**2.5**
	AQUA													
Color	FLTR													
Water Inflows	AQUA					0	0	0	0					**0**
	LAKE	15	15	15	15	15	25	25	25	25	25	25	25	**20.8**
Plant	EFFL	15	15	15	15	15	25	25	25	25	25	25	25	**20.8**

Lab Comments

EPA FILTER TEST @ 1000 LAB.

DAILY ABSTRACT
OTAY TREATMENT PLANT

Run: Sep 28, 1999 18:52

Report for: Feb 4, 1999 Thu

WATER TREATMENT

Influent	16.53	Mg
Effluent	14.20	Mg
Peak Flow	24.00	Mg
24 Hours	0:00 to 0:00	

FILTER WASHES

Water Used	2.24	Mg
Filters Washed	20	
Average Run	16	Hours
Influent (%)	13.55	%

RESERVOIR

SSDR 20.5 Feet 12.75 Mg

CWA REQUESTS (CFS)

SD7 0 AM 0 PM

Effluent Demand 14.27 Mg

DAILY PLANT LAB TEST AVERAGES

LAB TEST	INFLUENT	SETTLED	FILTERED	EFFLUENT	AQUEDUCT	LAKE RAW
Alkalinity	142			135		
Hardness	153			152		
pH	7.9	7.4	7.4	8.2		
Temp C.	15.1		14.3	14.6		
Turbidity	0.83	1.3	0.09	0.1		
Free Cl			1.6	0		
Color						
Taste/Odor				1.4		
Plant				22.7		
Totl Cl				2.5		
Water Inflows					0	22.7

CHEMICAL USAGE

CHEMICAL	Lbs Today	Usage LBS/MG	Cost /Lb	Cost/MG	Cost	Inventory
CL2	820	49.61	0.101	$5.01	$83	33,310 Lbs
Ferric	3,081	186.40	0.138	$25.72	$425	69,465 Lbs
KMnO4	0	0.00	1.239	$0.00	$0	12,128 Lbs
NH4OH	459	32.33	0.075	$2.42	$34	16,709 Lbs
NaOH	1,705	120.05	0.135	$16.21	$230	31,767 Lbs
PolyR	557	33.69	0.665	$22.41	$370	41,843 Lbs
			Daily Totals	$71.77	$1,143	

ENVIRONMENTAL

Lake Gauge	133.02	Rain (Inches)	0.02
Evaporation	2.0	Temp Min/Max	48 / 70 F

EQUIPMENT OUT OF SERVICE

Equip Name	OOS Date	Equip Name	OOS Date
Plc Failure Alarm	11/03/1998	Lake Pump #4	01/29/1999
Potable Pump 3	06/01/1998	Nanopure Water	08/01/1998
Raw Pump Lights Out (5)	07/30/1998	Raw Water Pump House Floodir	08/11/1998
Bckwsh Inc. Alarm	08/13/1998	Fltr. Pipe Gallery Flooding Al	08/13/1998
Gallery Flooding Alarm	08/17/1998		

Run: 9/27/99 22:01

Otay 2-Hour Plant Lab Measurements

Reported for 02/04/99

Test Type	Source	0000	0200	0400	0600	0800	1000	1200	1400	1600	1800	2000	2200	Avg
Hardness	INFL		152				152				152			**152**
	EFFL		152				152				152			**152**
Alkalinity	INFL		145				142				142			**143**
	EFFL		137				136				134			**136**
Turbidity	INFL	0.7	0.8	0.9	0.8	0.9	1.9	0.8	1.3	1.1	0.8	0.8	0.7	**0.96**
	SETT	1	0.9	0.9	1.1	1.2	1.3	1.2	1.1	1.1	1	0.9	0.9	**1.1**
	FLTR	0.07	0.08	0.07	0.07	0.08	0.22	0.13	0.12	0.11	0.1	0.1	0.1	**0.1**
	EFFL	0.09	0.08	0.08	0.08	0.09	0.12	0.08	0.09	0.09	0.08	0.08	0.09	**0.09**
	AQUA													
pH	INFL	7.8	7.8	7.8	7.8	7.8	7.6	7.8	7.8	7.8	7.8	7.8	7.8	**7.8**
	SETT	7.3	7.3	7.3	7.3	7.3	7.1	7.5	7.4	7.4	7.5	7.5	7.5	**7.4**
	FLTR	7.4	7.3	7.3	7.3	7.3	7.2	7.4	7.4	7.4	7.4	7.4	7.4	**7.4**
	EFFL	8.2	8.2	8.1	8.2	8.2	8.1	7.6	8.3	7.3	8.3	8.2	8.2	**8.1**
	AQUA													
Taste/Odor	FLTR													
	EFFL		2				1.4				1.4			**2**
Temp C.	INFL		14				15.2				15.1			**14.8**
	FLTR		13.1				14.1			14	13.9			**13.8**
	EFFL		13.7				14.7				13.7			**14**
Free Cl	SETT													
	FLTR	1.5	1.4	1.4	1.4	1.5	0	1.2	1.5	1.5	1.5	1.5	1.5	**1.5**
	EFFL	0	0	0	0	0	1.8	0	0					**1.8**
	AQUA													
Totl Cl	EFFL	2.6	2.6	2.5	2.6	2.5	2	2.5	2.6	2.6	2.7	2.6	2.5	**2.5**
	AQUA													
Color	FLTR													
Water Inflows	AQUA	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	LAKE	16	16	16	16	16	24	24	24	24	16	16	16	**18.7**
Plant	EFFL	16	16	16	16	16	24	24	24	24	16	16	16	**18.7**

DAILY ABSTRACT
OTAY TREATMENT PLANT

Run: Sep 28, 1999 18:52 **Report for: Nov 9, 1998 Mon**

WATER TREATMENT

Influent	15.06	Mg
Effluent	13.32	Mg
Peak Flow	25.00	Mg
2 Hours	0:00 to 2:00	

FILTER WASHES

Water Used	1.69 Mg
Filters Washed	20
Average Run	20 Hours
Influent (%)	11.22 %

RESERVOIR

SSDR 17.7 Feet 10.73 Mg

CWA REQUESTS (CFS)

SD7 0 AM 0 PM

Effluent Demand 16.57 Mg

DAILY PLANT LAB TEST AVERAGES

LAB TEST	INFLUENT	SETTLED	FILTERED	EFFLUENT	AQUEDUCT	LAKE RAW
Alkalinity	139			125		
Hardness	149			147		
pH	7.8	7.3	7.2	8.2		
Temp C.	20.5		18.6	19.3		
Turbidity	1	1	0.12	0.11		
Free Cl			1.2	0		
Color						
Taste/Odor				2		
Plant				16.7		
Totl Cl				2.5		
Water Inflows					0	16.7

CHEMICAL USAGE

CHEMICAL	Lbs Today	Usage LBS/MG	Cost /Lb	Cost/MG	Cost	Inventory
CL2	680	45.15	0.101	\$4.56	\$69	16,660 Lbs
Ferric	2,593	172.19	0.138	\$23.76	\$358	40,420 Lbs
KMnO4	56	3.72	1.239	\$4.61	\$69	13,094 Lbs
NH4OH	323	24.26	0.075	\$1.82	\$24	20,194 Lbs
NaOH	1,280	96.10	0.135	\$12.97	\$173	16,117 Lbs
PolyR	111	7.40	0.665	\$4.92	\$74	28,293 Lbs
			Daily Totals	\$52.64	\$767	

ENVIRONMENTAL

Lake Gauge	133.16	Rain (Inches)	0.57
Evaporation	-11.0	Temp Min/Max	53 / 70 F

EQUIPMENT OUT OF SERVICE

Equip Name	OOS Date	Equip Name	OOS Date
Plc Failure Alarm	11/03/1998	Potable Pump 3	06/01/1998
Nanopure Water	08/01/1998	Raw Pump Lights Out (5)	07/30/1998
Raw Water Pump House Floodi	08/11/1998	Bckwsh Inc. Alarm	08/13/1998
Fltr. Pipe Gallery Flooding Al	08/13/1998	Gallery Flooding Alarm	08/17/1998
New Poly Pump	11/09/1998		

Run: 9/27/99 21:51

Otay 2-Hour Plant Lab Measurements

Reported for 07/13/99

Test Type	Source	0000	0200	0400	0600	0800	1000	1200	1400	1600	1800	2000	2200	Avg
Hardness	INFL		156				154				154			**155**
	EFFL		156				154				154			**155**
Alkalinity	INFL		152				149				151			**151**
	EFFL		154				151				152			**152**
Turbidity	INFL	0.9	1	1	1	1	0.9	1	1	1.1	1	0.9	1.1	**0.99**
	SETT	1.7	1.6	1.8	1.7	1.6	1.5	1.5	1.6	1.9	1.7	1.8	1.6	**1.7**
	FLTR	0.07	0.08	0.1	0.12	0.08	0.14	0.16	0.11	0.11	0.09	0.1	0.09	**0.1**
	EFFL	0.07	0.08	0.09	0.09	0.08	0.09	0.08	0.07	0.08	0.08	0.07	0.08	**0.08**
	AQUA													
pH	INFL	7.4	7.3	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.3	7.4	7.4	**7.4**
	SETT	7.1	7	7	7	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.2	**7.1**
	FLTR	7.1	7	7	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.2	**7.1**
	EFFL	8.2	8.1	8.1	8.1	8.2	8	8.3	8.2	8.2	8.2	8.2	8.1	**8.2**
	AQUA													
Taste/Odor	FLTR													
	EFFL		2				2				2			**2**
Temp C.	INFL		20.6				20.8				20.9			**20.8**
	FLTR		17.6				18.6				18.8			**18.3**
	EFFL		17.7				17.6				17.8			**17.7**
Free Cl	SETT													**0**
	FLTR	1.4	1.3	1.3	1.3	1.6	0	1.1	0.9	1.4	1.5	1.5	1.4	**1.3**
	EFFL	0	0	0	0	0	2.8	0	0	0	0	0	0	**2.8**
	AQUA													
Totl Cl	EFFL	2.4	2.4	2.4	2.4	2.6	2.9	1.8	1.7	2.5	2.5	2.5	2.5	**2.4**
	AQUA													
Color	FLTR													
Water Inflows	AQUA	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	LAKE	30	30	30	30	30	30	30	30	30	30	30	30	**30**
Plant	EFFL	30	30	30	30	30	30	30	30	30	30	30	30	**30**

DAILY ABSTRACT
OTAY TREATMENT PLANT

Run: Sep 28, 1999 18:53 **Report for: Jul 13, 1999 Tue**

WATER TREATMENT

Influent	27.00	Mg
Effluent	23.94	Mg
Peak Flow	30.00	Mg

4 Hours 20:00 to 0:00

FILTER WASHES

Water Used	2.98 Mg
Filters Washed	26
Average Run	15 Hours
Influent (%)	11.04 %

CWA Filtered Reject

		MGD
SD6	SD #6	0.00
SD6W	SD #6 Wier	0.00
	Total	0.00

RESERVOIR

SSDR 19.5 Feet 12.03 Mg

CWA REQUESTS (CFS)

SD20	0 AM	0 PM
SD7	0 AM	0 PM

Effluent Demand 26.68 Mg

DAILY PLANT LAB TEST AVERAGES

LAB TEST	INFLUENT	SETTLED	FILTERED	EFFLUENT	AQUEDUCT	LAKE RAW
Alkalinity	152			152		
Hardness	155			155		
pH	7.4	7.1	7.2	8.2		
Temp C.	20.8		18	17.6		
Turbidity	0.97	1.4	0.09	0.08		
Free Cl			1.4	0		
Color						
Taste/Odor				2		
Plant				25		
Totl Cl				2.5		
Water Inflows					0	25

CHEMICAL USAGE

CHEMICAL	Lbs Today	Usage LBS/MG	Cost /Lb	Cost/MG	Cost	Inventory
CL2	1,140	42.22	0.101	$4.26	$115	27,070 Lbs
Ferric	3,521	130.41	0.138	$18.00	$486	11,363 Lbs
KMnO4	225	8.33	1.239	$10.33	$279	7,382 Lbs
NH4OH	503	21.01	0.075	$1.58	$38	7,712 Lbs
NaOH	4,339	181.25	0.135	$24.47	$586	7,052 Lbs
PolyR	446	16.50	0.665	$10.97	$296	27,516 Lbs
			Daily Totals	$69.60	$1,800	

ENVIRONMENTAL

Lake Gauge	132.00	Rain (Inches)	0
Evaporation	6.0	Temp Min/Max	66 / 87 F

EQUIPMENT OUT OF SERVICE

Equip Name	OOS Date	Equip Name	OOS Date
Nanopure Water	08/01/1998	Surface Wash Pump #2	07/05/1999
Effluent Cl2 Analyzer	07/10/1999	# 2 Ferric Tank	04/08/1999
Operations Rm. Intrusion Alrm.	04/20/1999	Compressor #2	06/04/1999