Chapter 10
Pretreatment Authorization to Construct Reviews

Section A. Quick Reference Info

1. Definition - An authorization to construct is the written authorization from a Control Authority to an SIU for construction or modification of a pretreatment process.

2. Acronyms:

- A to C - Authorization to Construct
- AC - Activated Carbon
- DAF - Dissolved Air Flotation
- IUP - Industrial User Permit
- SIU - Significant Industrial User
- UF - Ultrafiltration
- WWTP - Wastewater Treatment Plant

3. Purpose: To review and authorize requests to construct pretreatment systems. The review is to determine the pretreatment devices to be installed, if the system should meet the IUP limits, and if the devices have adequate slug discharge controls.

4. Regulatory References

- 15A NCAC 2H .0906 (b)(6)
- NCGS 143-215.1

5. DEM Requirement

- Authorizations to Construct must be written and maintained as part of the permittee record.
- Authorizations to Construct must be issued to the permittee prior to the beginning of construction.
- SIU Inspections that reveal the construction of pretreatment facilities were completed without prior approval of Authorization to Construct must be enforced as a violation of IUP.

6. Implementation Frequency

- Requests to construct pretreatment facilities may occur at any time; therefore, this can be considered a continuous implementation requirement.

7. Appendices

- 10-A, A to C Example Letter
- 10-B, Biological Treatment Facility A to C Review Checklist
- 10-C, Dissolved Air Flotation A to C Review Checklist
- 10-D, Chemical Precipitation Treatment Facility A to C Review Checklist
- 10-E, Ultrafiltration A to C Review Checklist
- 10-F, Air Stripping & Activated Carbon Review Checklist

8. Other Guidance Documents

- Groundwater Remediation and Petroleum - A Guide for Underground Storage Tanks, David C. Noonan and James T. Curtis, 1990, Lewis Publishers.

- Groundwater Treatment Technology, Evan K. Nyer, 1985, Van Nostrand Reinhold.

- Industrial Waste Treatment, A Field Study Training Program, First Edition, 1991, US EPA, Office of Water Enforcement and Permits, California State University, Sacremento.

- Industrial Water Pollution Control, Second Edition, W. Wesley Eckenfelder, Jr., 1989, McGraw-Hill, Inc.

- Plating Waste Treatment, Kenneth F. Cherry, 1982, Ann Arbor Science Publishers, Inc.

- The Removal of Oil from Wastewater by Air Flotation: A Review, Gary F. Bennett, Environmental Progress, American Institute of Chemical Engineers, New York, New York; and Environmental Institute for Waste Management Studies, University of Alabama, Tuscaloosa, Alabama.

- Treatment of Metal Wastestreams, A Field Study Training Program, Second Edition, 1993, US EPA, Office of Water Enforcement and Permits, California State University, Sacremento.

- Ultrafiltration Handbook, Munir Cheryan, Ph.D., 1986, Technomic Publishing Company, Inc.

* • WASTEWATER ENGINEERING Treatment, Disposal, and Reuse, Third Edition, Metcalf & Eddy, Inc., 1991, McGraw-Hill, Inc.

* (Highly Recommended , as it is a good general reference.)

Chapter 10
Pretreatment Authorization to Construct Reviews

Section B. Division Requirements and Recommendations Discussion

Division requirements for Authorizations to Construct (A to C's) are as follows:

- A to C letter is written by the Control Authority or the Division and sent to the Industry. The A to C letter becomes a part of permittee record and should be kept in the Control Authority and Industry files. The A to C letter must include the list of pretreatment devices approved to be constructed. An example A to C letter is provided in Appendix 10-A.

  A written A to C letter will aid in preventing misunderstandings between the Industry and the Control Authority on the devices to be installed. The A to C letter also documents the industry's compliance with the A to C requirements of the IUP.

- A to Cs must be issued to permittee prior to the beginning of construction primarily to avoid questions of unauthorized changes of pretreatment systems and possible bypasses, and to avoid the SIU wasting money due to design changes required due to the A to C review.

- Upon discovery of pretreatment systems installed without an A to C, the POTW must take enforcement of the violation of an IUP condition. In the Generic Permit provided in Chapter 6, the A to C requirement is provided in Part I.C.3. and Part II.26.

  The enforcement should be as specified in the POTW's Enforcement Response Plan (ERP) and should also require submission of plans and specifications of the additional pretreatment systems installed. If the installed unauthorized pretreatment system specifications do not meet the POTW's requirements, then the POTW may require modifications to the system.

As specified above, the Division's requirements for pretreatment A to C's are very simple. The Division requirements do not specify the contents of the review, the experience or education level of the reviewer, or any registration or certification requirements for the reviewer. **A to C's are to be completed by the POTW with aid if necessary from the POTW's engineers and consultants.** In the rare instance where the pretreatment system is an extremely unusual design, the Division of Environmental Management may be requested to complete the A to C for "Full" Pretreatment Program POTWs. "Modified" pretreatment programs may complete their own A to C's or the Division of Environmental Management may be requested to complete the A to C's for them.

In addition to the minimum set of requirements the Division does have some recommendations for A to C reviews as follows:

- Reviews should focus on:
  - If the system should meet the IUP limits if operated and maintained to specification,
  - If the system has adequate flexibility for completing maintenance, and
  - If the system is designed to prevent slug discharges, spills and bypasses.

To help the POTW focus on these items, the Division's pretreatment group has developed pretreatment unit operations checklists. The checklists and main references are listed below:

Unit Operation Checklist	Appendix	Main Reference
Biological Treatment	10-B	Wastewater Engineering, Metcalf & Eddy
Dissolved Air Flotation	10-C	The Removal of Oil from Wastewater by Air Flotation, Gary Bennett
Chemical Precipitation	10-D	Plating Waste Treatment, Kenneth F. Cherry
Ultrafiltration	10-E	Ultrafiltration Handbook, Munir Cheryan
Air Stripping & Activated Carbon	10-F	Groundwater Treatment Technology, Evan K Nyer
		Groundwater Remediation and Petroleum A Guide for Underground Storage Tanks, David C. Noonan and James T. Curtis

The POTW may choose to use these checklists as part of their local A to C reviews. These checklists were designed based on typical pretreatment process designs and include a few "rule of thumb" design values. The POTW should also use any design values or information gathered from experience or research.

- In addition to completing a design review, pilot plant studies of treatment of the SIU's discharge with the process designed should be completed. The pilot plant studies may indicate possible problems, such as emulsified oils that need chemical additives prior to DAF, or fouling problems with UF.

- A to C reviews may serve as an appropriate time to request or require that sampling equipment and/or flow monitoring equipment for the monitoring point be installed. The sampling equipment required can increase the validity of the sample, and reduce the workload on the sampling technician. For instance, the sampling technician may not have to continuously haul ice to the sampling point.

  The sampling equipment design could include:
  - a fixed sampler probe location,
  - refrigeration to 4°C,
  - a flow proportional sampler
  - flowmeter with interface to flow proportional sampler,
  - Lockable/Secureable sampler for POTW sample collection,
  - Shelter for Sampler and Sampling Technician,
  - Continuous POTW access to Sampler, and
  - 110V Electrical Supply.

- Strong Recommendation. To also help ensure that the construction was completed per the submitted Plans and Specifications, and to notify the POTW that the discharge is changing, the POTW may require advance notice of operation of the pretreatment system, and complete an inspection of the system.

- The POTW may wish to request multiple copies of the plans and specifications for the A to C review. One of these can be a working copy that the reviewer may make notes or doodle on. Another can be stamped "Reviewed By Name/Date" on each page of the approved Plans and Specifications and kept in the POTW files for reference. A final set can be stamped "Reviewed By Name/Date" on each page of the Authorized Plans and Specifications and sent to the Industry to be maintained in their files at the pretreatment site. As, the POTW and Industry exchange copies of plans and copies of modified plans, it is important to be able to identify the final set of plans and specifications authorized to be constructed.

- To help ensure that the design plan and specifications follow "good engineering practice", the POTW may require that all plans and specifications whether generated within the company or by an outside consultant are stamped by a North Carolina Professional Engineer, (especially when generated by smaller SIUs without engineering staff).

- To help ensure that the construction was completed per the submitted Plans and Specifications, the POTW may require that the industry or a Professional Engineer certify that the permitted facilility has been installed in accordance with the Authorization to Construct, the Pretreatment Permit and the approved plans and specifications

- In some instances, the construction will vary slightly from the plans and specifications reviewed, for example there may be construction material availability problems, or plumbing and electrical routing problems. The POTW may require the submittal of "as built" drawings of the pretreatment facility for use both as a future reference and to review that these "minor" variances should not create POTW problems.

To summarize:

- The POTW must review their current A to C procedures to ensure that the Division's requirements are met in full, and must modify their A to C procedures if necessary.

- The POTW may modify their A to C procedures to include any of the Division's recommendations.

- A to C's should be completed by the POTW, with aid from the POTW's engineers and consultants if necessary. For "Full" pretreatment programs, only extremely unusual A to C designs should be reviewed by the Division. For "Modified" pretreatment programs, either the POTW or the Division can complete the A to C review.

City of Metropolis

City of Love, Understanding and Tall Grass

January 1, 2001

Joan Splat
Plant Manager
Metropolis Textile Works
PO Box 001
Metropolis, North Carolina 29999

Subject: Authorization to Construct Pretreatment System
Permit Number: *0001*

Dear *Ms. Splat*:

A letter requesting an Authorization to Construct was received on *October 1, 2000* by the *City of Metropolis*. The final plans and specifications for the subject project have been reviewed and found to be satisfactory. Authorization is hereby granted for the installation (or modification) of the *Metropolis Textile Works* wastewater pretreatment system to include additional treatment for *BOD, TSS, and color*. The installation will include:

- *Two Parallel 0.5 million gallon Activated Sludge Basins with four 25 HP surface aerators per basin,*
- *Two Parallel 100,000 gallon clarifiers,*
- *A 200,000 gallon aerobic digestor with two 15 HP surface aerators,*
- *A polymer addition tank with gallon per minute feed pump,*
- *An effluent flowmeter,*
- *An effluent sampler, and*
- *All associated valves, piping and appurtenances.*

The Authorization to Construct is issued in accordance with *Part II, Paragraph 26* of Pretreatment Permit Number *0001*, and shall be subject to revocation unless the wastewater treatment facilities are constructed in accordance with the conditions and limitations specified in Permit Number *0001*, and in accordance with the final plans and specifications submitted for review. A copy of the authorized plans and specifications shall be maintained on file at the pretreatment facility by the Permittee for the life of the facility.

(Recommendation: Upon completion of construction and prior to operation of this permitted facility, a certification must be received by the *City of Metropolis* from you or a Professional Engineer certifying that the permitted facility has been installed in accordance with the Pretreatment Permit, this Authorization to Construct and the approved plans and specifications.)

(Recommendation: *Metropolis Textile Works* **must notify** *Carolyn Smith, of the City of Metropolis at telephone number (919)555-5555* **at least** *forty eight (48)* **hours in advance of operation of the installed facilities so that an in-place inspection can be made. Such notification shall be made during normal office hours of** *8:00 a.m. until 5:00 p.m. on Monday through Friday, excluding City Holidays.***)**

The sludge generated from these treatment facilities must be disposed of in accordance with G.S. 143-215.1 and in a manner approved by the North Carolina Division of Environmental Management. The issuance of this permit does not preclude the Permittee from complying with any and all statutes, rules, regulations, or ordinances of the *City*, **the State, or the Federal Government. Failure to abide by the requirements contained in this Authorization to Construct may subject the Permittee to an enforcement action by the** *City* **, the State, or the Federal Government in accordance with the** *City's* **Sewer Use Ordinance, North Carolina General Statutes 143-215.6A to 143-215.6C, and Federal Regulations.**

In the event that the facilities fail to perform satisfactorily, including the creation of nuisance conditions, the Permittee shall take immediate corrective action and notify the *City*. **Construction of additional or replacement pretreatment facilities requires another Authorization to Construct.**

(Recommendation: One (1) set of approved plans and specifications is being forwarded to you.) If you have any questions or need additional information, please contact *Carolyn Smith, of the City of Metropolis at telephone number (919)555-5555* **.**

Sincerely,

Carolyn Smith

Carolyn Smith
Pretreatment Coordinator

BIOLOGICAL TREATMENT FACILITY
AUTHORIZATION TO CONSTRUCT REVIEW CHECKLIST

Industry Name:______________________________

Project Identifier:______________________________

1. EQUIPMENT LIST:

Influent Surge Tank	Yes/No	Capacity:	
Grit Removal Chamber	Yes/No		
Flow Splitter Box	Yes/No		
Bar Screen	Yes/No		
Comminutor	Yes/No		
Flow Measurement Device	Yes/No	Type:(influent, effluent)	
Sampling Equipment	Yes/No	Type:	
Aeration Tank	Yes/No	Number:	Capacity:
Clarifier/Final Settling Tank	Yes/No	Number:	Capacity:
Sludge Holding Tank	Yes/No	Number:	Capacity:
Blowers	Yes/No	Number:	Capacity:
Sludge Handling Equipment	Yes/No		
High Water Alarms	Yes/ No	Type:	Location:
		Type:	Location:
		Type:	Location:

2. DESIGN REVIEW

a. Is Equipment Design Flow ≥ Permitted Flow? ______________

b. Is predicted effluent discharge ≤ permitted effluent limits? ______________

c. Are reasonable calculations provided to justify predicted effluent discharge concentration? ______________

d. Is a sludge disposal method provided? ______________

e. Are facilities protected from the 100 year flood? ______________

f. Are recycle lines for biological process provided? ______________

g. Are there bypass lines around the processes? ______________

h. If there are bypass lines, are the valves locked? ______________

i. Do all pumps have influent and effluent valves, so that pumps may be rapidly changed out? ______________

j. How are below ground tanks lined? If the tanks are not concrete or equivalent, then NCDEM Groundwater Regional Contact should be contacted for comments. ______________

k. Do all blowers have gate and check valves? ______________

l. In the event of power outage does influent to treatment works cease? Backup Power needed? ______________

2. DESIGN REVIEW (continued)

l. Equalization Basin Review:

I. Working Volume = __________ gallons
Working Volume to Daily Flow Permitted Discharge Ratio = ________ %
Working Volume to Daily Flow Permitted Discharge Ratio >20%? Yes/No

II. Equalization Tank Aeration:
Aeration Capacity per 1000 gallons tank volume = ____________________
[1.25 to 2 CFM /1000 gal required per 1991 Metcalf & Eddy p. 470 typically]

m. Biological Unit Aeration Verification

I. Basin Detention Time = (Basin Volume / Permitted Daily Flow)*24 hrs/day
Basin Detention Time = __________________ hrs
[Compare to 1991 Metcalf & Eddy p. 550 V/Q, h values for plant type]

II. Minimum Air Requirement for Conventional Pollutant Reduction in Basins

A. BOD Oxygen Requirement:
(Permitted Flow in MGD)*8.34*(BOD Inf. Conc. - BOD Eff. Conc. in mg/l) =
__________________________ lbs/day BOD Removed
(_________ lbs/day BOD Removed)*(1.5 lbs Oxygen per Pound BOD) =
__________________________ lbs Oxygen for BOD Removal

B. Ammonia Oxygen Requirement:
(Permitted Flow in MGD)*8.34*(NH3 Inf. Conc. - NH3 Eff. Conc. in mg/l) =
__________________________ lbs/day NH3 Removed
(_________ lbs/day NH3 Removed)*(4.6 lbs Oxygen per Pound NH3) =
__________________________ lbs Oxygen for NH3 Removal

C. Total Oxygen Requirement:
BOD Oxygen Requirement + NH3 Oxygen Requirement =
__________________________ lbs Total Oxygen for Removal

D. Convert Oxygen Requirement to Air Requirement
(Standard Conditions assumed)
Air Requirement = lbs Oxygen / (ß * Σ * eff. * 1440 min/day)
Density of air at MSL, ß = 0.075 lbs/cf
% Oxygen in air at MSL, Σ = 0.2 as a decimal
Oxygen Transfer Efficiency Selection

Surface Aerators	=	5%
Coarse Bubble Diffusers	=	5-10%
Fine Bubble Diffusers	=	10 - 20 %

Aeration Requirement in CFM for Pollutant Removal = _____________ CFM
Aeration Provided = ___________ CFM of Air
[Generally at least 200% of Required Aeration for Pollutant Removal should be available.]
Sufficient Air for Pollutant Removal? Yes / No / Maybe

2. DESIGN REVIEW (continued)

E. Minimum Air Requirement for Basin Mixing:

Mixing will usually have a greater aeration requirement than pollutant removal. [Metcalf & Eddy 1991 p. 573 suggests 20 - 30 cubic feet per minute per 1000 cubic feet of tank volume for diffused air].

Mixing Aeration Requirement:
= (25 CFM/1000 CF aeration volume)*(aeration volume)=_______CFM
Aeration Provided = _____________CFM of Air
[Metcalf & Eddy 1991 p.574 suggests mechanical aerators should be 0.75 to 1.5 hp per 1000 cubic feet of tank volume. Table 10-11 provides typical tank dimensions to aerator size.]
Sufficient Mixing? Yes / No / Maybe

IV.Trickling Filter/Biofilter Design Review

[From Metcalf & Eddy 1991 p. 624 - 625, for plastic packing the following equation may be used]

A. BOD Effluent Conc. = BOD Influent Conc. $\exp[-k_{20}D((Q/A)^{-.5})]$

Predicted BOD Effluent Concentration = ________________________ mg/l

Where: D is depth of filter, feet
Q is total flowrate to filter without recirculation, gal/min
A is cross sectional area of filter, ft^2
k_{20} = treatability constant at 20°C
[Table 10-16 of 1991 Metcalf & Eddy p.625 provides typical k values for different types of wastewater and equation (8-74) for depth correction]

Is BOD Effluent Concentration predicted within permit limits? Yes/No/Maybe

B. Compute Hydraulic Loading = gallons/surface area in sq.ft minute =________
Compute BOD Loading = Inf. lbs BOD/surface area in sq.ft minute =________
Depth =_______________ feet
BOD Removal Efficiency per specifications = ______________%
Do these specifications compare to typical design info? Yes/No/Maybe
[Typical Design Info is provided in Table 10-13 of 1991 Metcalf & Eddy]

C. Air Flow Requirements - "Rules of Thumb from 1991 Metcalf & Eddy p. 624"

i. Open Area of the slots in the top of the underdrain blocks should not be less than 15% of the area of the filter.
% Open area of underdrain blocks to filter area = _________________ %

ii. One square foot gross area of open grating in ventilating manholes and vent stacks should be provided for each 250 sq. ft of filter area.
Area of Open grating to 250 Filter Square Footage =_______________ ft^2

iii. Air Flow sufficient ? Yes/No/Maybe

2. DESIGN REVIEW (continued)

n. Biological Unit Clarifier Design Verification

I. Detention Time = Clarifier Volume/Permitted Flow * 24 Hrs/day

= ________________Hours

Should be: ≥ 4.0 Hours for Daily Flow ≤ 0.05 MGD
≥ 3.6 Hours for Daily Flow >0.05 MGD & ≤ 0.15 MGD
≥ 3 Hours for Daily Flow >0.15 MGD

Detention Time Sufficient? Yes/No/Maybe

II. Surface Loading Rate = Permitted Daily Flow/ Clarifier Surface Area

= ________________ GPD/ft^2

For Conventional Activated Sludge Facilities = 800-1000 GPD/ft^2
For Extended Aeration Facilities
≤ 300 GPD/ft^2 for Daily Flow ≤ 0.05 MGD
≤ 450 GPD/ft^2 for Daily Flow >0.05 MGD & ≤ 0.15 MGD
≤ 600 GPD/ft^2 for Daily Flow >0.15 MGD

Surface Loading Rate Adequate? Yes/No/Maybe

III. Overflow Rate = Permitted Daily Flow/Weir Length

= ________________GPD/FT

Overflow Rate less than 10,000 gpd/ft? Yes/No/Maybe

o. Sludge Holding Tank Design Verification

I. Minimum Energy Requirements for Aerobic Sludge Digestion Mixing:
("Rules of Thumb" from p. 837 of Metcalf & Eddy)

Mechanical Aerators - .75 to 1.50 hp/1000 cubic feet of
Diffused Air Mixing - 20 to 40 CFM/1000 cubic feet of sludge
Sufficient? Yes / No / Maybe

3. General Comments:____

____
____
____
____
____

Reviewed by:____

Date:____

DISSOLVED AIR FLOTATION TREATMENT FACILITY
AUTHORIZATION TO CONSTRUCT REVIEW CHECKLIST

Industry Name:____

Project Identifier:____

1. EQUIPMENT LIST:

Bar Screen	Yes/No	
Equalization Tank	Yes/No	Capacity:
Oil & Grease Separator	Yes/No	Type:
Chemical StorageTank	Yes / No	Chemical:
	ID:	Capacity:
		Construx Material:
		Mixer: Yes/No
		Overflow Control: Yes /No
Chemical Feed Pump	Yes / No	Capacity:
	ID:	Type:
		Check Valve: Yes/No
Unit Feed Pump	Yes / No	Capacity:
	ID:	Type:
		Check Valve: Yes / No
Feed Tank	Yes / No	Capacity:
	ID:	Mixer: Yes / No
		Overflow Control: Yes / No
Air Induction System	Yes / No	Pressure:
	ID:	Strained/Cleaned: Yes / No
Retention Tank	Yes / No	Capacity:
	ID:	Control Valve Type:
Flotation Tank	Yes / No	Capacity:
	ID:	Retention Time: (min)
		Hydraulic Loading: (gal/min/ft^2)
		Flight Scrapers? Yes / No
		Sediment Cleanout? Yes / No
Inlet Header	Yes / No	Even Distribution? Yes / No / Maybe
Chemical Inlet Header	Yes / No	Even Distribution? Yes / No / Maybe
Flow Measurement Device	Yes/No	Type:(influent, effluent)
Sampling Equipment	Yes/No	Type:
Sludge Holding Tank	Yes/No	Capacity:
Sludge Handling Equipment	Yes/No	Type:
		Capacity:

2. DESIGN REVIEW

a. Is Equipment Design Flow ≥ Permitted Flow? ______________

b. Is predicted effluent discharge ≤ permitted effluent limits? ______________

c. Were jar test or pilot plant data provided to justify predicted effluent discharge concentration? ______________

d. Are all design variables within typical ranges? ______________

e. Is a sludge disposal method provided? ______________

f. Do all pumps have influent and effluent valves, so that pumps may be rapidly changed out? ______________

g. Are pumps sized appropriately? ______________

h. Are there bypass lines around the processes? ______________

i. If there are bypass lines, are the valves locked? ______________

j. Is the process within containment dike? ______________

k. Percent recycle in the pressurization sequence? ______________ %

l. Are facilities protected from the 100 year flood? ______________

m. Do all automatic control valves have secondary manual control valves? ______________

n. Potential problem with influent feed temperature? ______________

o. Do all open tanks have high water alarms? ______________

p. Was an Alternatives Analysis completed? ______________

3. General Comments: ______________

____

____

____

____

____

Reviewed by: ______________

Date: ______________

(Pressurized DAF process flow diagram and recommended design variables are provided on Pages 3 and 4 of this Appendix)

Pressurized DAF Process Flow Diagrams

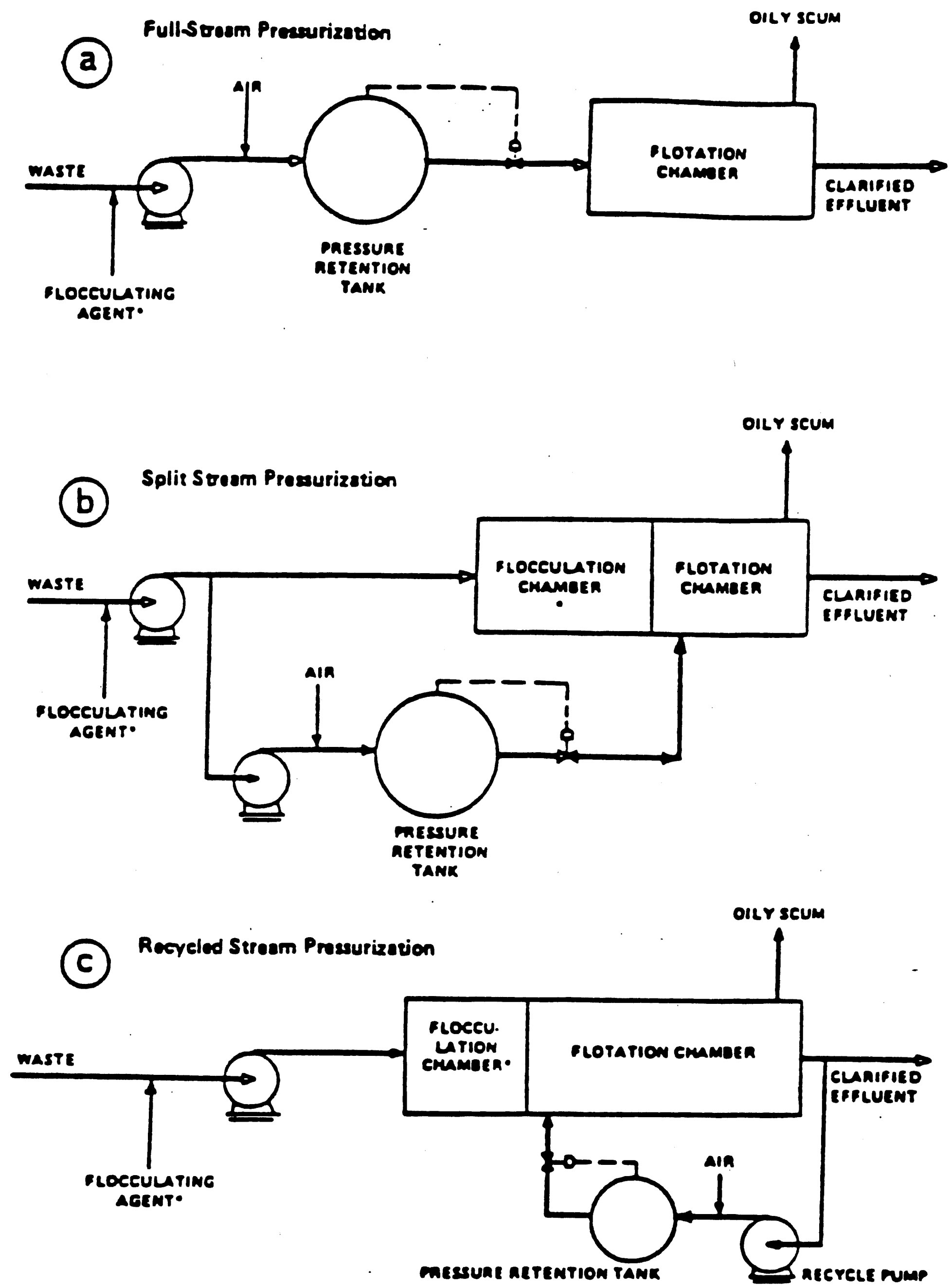


FIGURE 11.-- Pressurized dissolved air flotation process flow diagram.

taken from <u>The Removal of Oil from Wastewater by Air Flotation</u>, p. X-B-25

DAF Recommended Design Variables

Table 20
RECOMMENDED DESIGN VARIABLES AND RANGES FOR DISSOLVED AIR FLOTATON SYSTEMS[1]

Parameter	Variable
Flotaton tank retention time	20—40 min
Air pressure	40—60 lb/in.^{2}
Hydraulic loading	1—4 gal/min/ft^2 (including recycle)
Recycle ratio	10—60%

Table 21
TABULATION OF VARIOUS RECOMMENDED DESIGN PARAMETER RANGES FOR DAF

Air pressure in saturaton tank (lb/in.^{2})		
Adams et al.[1]	40—60	
DeRenzo[41]	25—70	
Beychock[20]	35—55	
Retention time (min)	**Flotation tank**	**Pressurization tank**
DeRenzo[41]	20—60	0.5—3.0
Beychock[20]	15—20	2
API[5]	10—40	1—2
Hydraulic loading (gal/min/ft^2)		
Adams et al.[1]		1—4
Beychock[20]		3—0
API[5]		2—2.5
Air requirement (SCF/100 gal)		
Beychock[20]		0.25—5.0
API[5]		0.5—1.0

Note: SCF = standard cubic feet.

taken from The Removal of Oil from Wastewater by Air Flotation, p. X-B-30

CHEMICAL PRECIPITATION TREATMENT FACILITY AUTHORIZATION TO CONSTRUCT REVIEW CHECKLIST

Industry Name:____

Project Identifier:____

1. Equipment List:

Screening Device	Yes/No	Type:
Equalization Tank	Yes/No	Capacity:
Oil & Grease Separator	Yes/No	Type:
Precipitant/ pH Adjustment StorageTank I	Yes / No	Chemical:
	ID:	Capacity:
		Construx Material:
		Mixer: Yes/No
		Overflow Control: Yes /No
Precipitant/ pH Adjustment StorageTank II	Yes / No	Chemical:
	ID:	Capacity:
		Construx Material:
		Mixer: Yes/No
		Overflow Control: Yes /No
Precipitant/ pH Adjustment StorageTank III	Yes / No	Chemical:
	ID:	Capacity:
		Construx Material:
		Mixer: Yes/No
		Overflow Control: Yes /No
Polymer/Coagulant I Storage Tank	Yes / No	Chemical:
	ID:	Capacity:
		Construx Material:
		Mixer: Yes/No
		Overflow Control: Yes /No
Polymer/Coagulant II Storage Tank	Yes / No	Chemical:
	ID:	Capacity:
		Construx Material:
		Mixer: Yes/No
		Overflow Control: Yes /No

Batch Tank I	Yes / No	Chemicals Added:
	ID:	Capacity:
		Construx Material:
		Mixer: Yes/No
		pH Probe: Yes/No
		Chemical Addition Control: Yes/No
		Overflow Control: Yes /No
Batch Tank II	Yes / No	Chemicals Added:
	ID:	Capacity:
		Construx Material:
		Mixer: Yes/No
		pH Probe: Yes/No
		Chemical Addition Control: Yes/No
		Overflow Control: Yes /No
Batch Tank III	Yes / No	Chemicals Added:
	ID:	Capacity:
		Construx Material:
		Mixer: Yes/No
		pH Probe: Yes/No
		Chemical Addition Control: Yes/No
		Overflow Control: Yes /No
Clarifier/Settling Tank I	Yes / No	Polymer added:
	ID:	Capacity:
		Construx Material:
		Polymer Addition Control: Yes / No
		Overflow Control: Yes /No
Clarifier/Settling Tank II	Yes / No	Polymer added:
	ID:	Capacity:
		Construx Material:
		Polymer Addition Control: Yes / No
		Overflow Control: Yes /No
Final pH / Reaction Tank	Yes / No	Chemicals added:
	ID:	Capacity:
		Construx Material:
		Mixer: Yes/No
		pH Probe: Yes/No
		Chemical Addition Control: Yes / No
		Overflow Control: Yes /No

Effluent Filter	Yes/No	Type:
		Capacity:
Flow Measurement Device	Yes/No	Type:(influent, effluent)
Sampling Equipment	Yes/No	Type:
Sludge Holding Tank	Yes/No	Capacity:
Sludge Handling Equipment	Yes/No	Type:
		Capacity:

2. Design Review

a. Is Equipment Design Flow ≥ Permitted Flow? ______

b. Is predicted effluent discharge ≤ permitted effluent limits? ______

c. Were jar test or pilot plant data provided to justify predicted effluent discharge concentration? ______

d. Are the precipitants typical for pollutant to be removed? ______

e. Is the polymer/coagulant typical? ______

f. Is a sludge disposal method provided? ______

g. Do all pumps have influent and effluent valves, so that pumps may be rapidly changed out? ______

h. Are pumps sized appropriately? ______

i. Are there bypass lines around the processes? ______

j. If there are bypass lines, are the valves locked? ______

k. Is the process within containment dike? ______

l. Are all process tanks made of material to withstand the pH expected? ______

m. Are all pipes and valves made of material to withstand pH expected? ______

n. Are facilities protected from the 100 year flood? ______

o. Are all pumps made of material to withstand pH expected? ______

p. Do all automatic control valves have secondary manual control valves? ______

q. What excess treatment chemicals are possibly discharged with the effluent? (i.e. Sulfides, Chlorine, polymers) ______

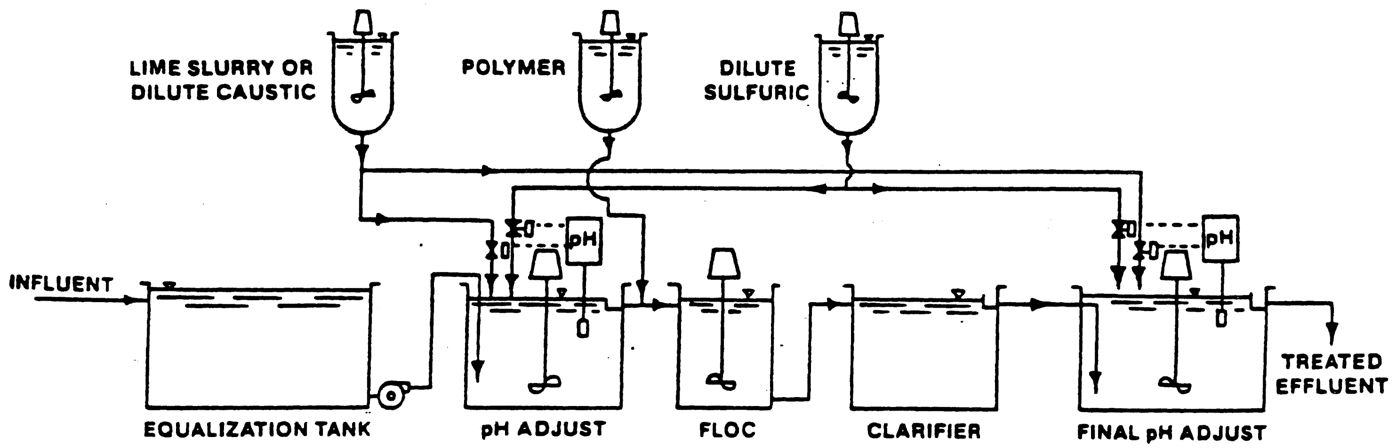
r. Are the discharged treatment chemicals in "safe" amounts? ______

s. Are cyanide and ammonia bearing wastestreams segregated for treatment (to reduce difficult to treat metal complexes formation)? ______

Reviewed by:______ (additional comments on back)

Date:______ (Design info on pp. 4 - 11 of Appendix)

Continuous Chemical Precipitation Process Flow Diagram



CONTINUOUS TREATMENT PROCESS FOR RINSE WATER

1. Equalization of flows and concentrations of influent in first step.
2. Pump transfers equalized raw waste to subsequent treatment at uniform rate.
3. Adjust pH by adding alkali or acid to precipitate heavy metals using rapid mixing for 5 to 7 minutes.
4. During gravity transfer to Floc Tank, polymer is added to improve flocculation.
5. Slow mixing in Floc Tank to promote growth of large settleable floc for 5 to 7 minutes.
6. Gravity settling of suspended solids in Clarifier during 1 to 3 hr retention period. (Dilute sludge is periodically removed from bottom of tank.)
7. Final pH adjustment (if required) by controlled addition of acid and/or alkali for 5 to 7 minutes, prior to discharge of treated effluent.

Fig. 5 Continuous treatment units for common metal removal by hydroxide precipitation and sedimentation for rinse water by Joe Shockcor

taken from <u>Treatment of Metal Wastestreams</u>, p. 23

Conventional Chemical Treatment Methods

TABLE 4 SUMMARY OF CONVENTIONAL CHEMICAL TREATMENT METHODS[a]

Treatment Method	Treatment Chemical	Usage Ratio	Optimum pH	Minimum Reaction Time (min)	Comments
I. Hexavalent chromium reduction					
Acid method	Sodium metabisulfite	1.5:1	pH = 3.0-3.5	5	Reaction time dependent on pH.
	Sulfur dioxide	1:1	pH = 3.0-3.5	5	Reaction time dependent on pH.
	Ferrous sulfate	8:1	pH = 3.0-3.5	5	Reaction time dependent on pH.
II. Cyanide oxidation					
A. Cyanide to cyanate	Chlorine gas	3.5:1	pH > 11.0	10	pH > 11.0 critical to prevent toxic gas.
	15% sodium hypochlorite		pH > 11.0	10	pH > 11.0 critical to prevent toxic gas.
	Calcium hypochlorite		pH > 11.0	10	pH > 11.0 critical to prevent toxic gas.
B. Cyanate to CO_2 and N_2	Chlorine gas	5:1	pH = 8.5	20	Reaction time dependent on pH.
	15% sodium hypochlorite		pH = 8.5	20	Reaction time dependent on pH.
	Calcium hypochlorite		pH = 8.5	20	Reaction time dependent on pH.
III. Metals precipitation					
A. Hydroxide	Hydrated lime	Variable	pH = 7.0-10.0	20	Optimum pH varies depending on metal to be removed.
	Caustic soda	Variable	pH = 7.0-10.0	20	Optimum pH varies depending on metal to be removed.
B. Sulfide	Ferrous sulfide/ sodium sulfide	5:1	pH = 8.0-9.0	15	Polishing after hydroxide precipitation when complexing agents present.
C. Carbonate	Sodium bicarbonate	Variable	Variable	15	Advantageous for lead, cadmium, nickel removal.
D. Insoluble starch xanthate	Cross linked starches	5-10:1	pH > 7.0	Instantaneous	Polishing after hydroxide precipitation when complexing agents present.
IV. Oily waste demulsification					
Acidification/hydrolysis/ adsorption	Sulfuric acid	Variable	pH < 3.0	10-20	Removal efficiencies related to type of emulsifying agent used and nature of oil (i.e., mineral based or synthetic type). Addition of heat may also be needed for certain applications.
	Polyelectrolyte	Variable	pH = 3.0-5.0	10-20	
	Alum	Variable	pH < 3.0	10-20	
	Calcium chloride	Variable	pH < 3.0	10-20	

[a] *Reproduced by permission of TMSI Contractors from METAL FINISHING PLATING BUYERS GUIDE.*

taken from <u>Treatment of Metal Wastestreams</u>, p. 20

Chemical Coagulant Applications

TABLE 4.1
Chemical coagulant applications

Chemical process	Dosage range, mg/l	pH	Comments
Lime	150–500	9.0–11.0	For colloid coagulation and P removal Wastewater with low alkalinity, and high and variable P Basic reactions: $Ca(OH)_2 + Ca(HCO_3)_2 \rightarrow 2CaCO_3 + 2H_2O$ $MgCO_3 + Ca(OH)_2 \rightarrow Mg(OH)_2 + CaCO_3$
Alum	75–250	4.5–7.0	For colloid coagulation and P removal Wastewater with high alkalinity and low and stable P Basic reactions: $Al_2(SO_4)_3 + 6H_2O \rightarrow 2Al(OH)_3 + 3H_2SO_4$
$FeCl_3$, $FeCl_2$	35–150	4.0–7.0	For colloid coagulation and P removal
$FeSO_4 \cdot 7H_2O$	70–200	4.0–7.0	Wastewater with high alkalinity and low and stable P Where leaching of iron in the effluent is allowable or can be controlled Where economical source of waste iron is available (steel mills, etc.) Basic reactions: $FeCl_3 + 3H_2O \rightarrow Fe(OH)_3 + 3HCl$
Cationic polymers	2–5	No change	For colloid coagulation or to aid coagulation with a metal Where the buildup of an inert chemical is to be avoided
Anionic and some nonionic polymers	0.25–1.0	No change	Use as a flocculation aid to speed flocculation and settling and to toughen floc for filtration
Weighting aids and clays	3–20	No change	Used for very dilute colloidal suspensions for weighting

taken from <u>Industrial Water Pollution Control</u>, p. 92

Chemical Resistance for Construx. Materials

1. Good for 200°F (93°C)
2. Good for 185°F (85°C)
3. Good for 140°F (60°C)
4. Good for 70°F (21°C)
Q. Questionable
NR. Not recommended

Chemical	Plastics								Metals					Rings, Liners and Seals			Elastomers					Fibers			
	Kynar	Tefzel	Epoxy	PVC	CPVC	Polypropylene	Polysulfone	Ryton	Aluminum	SS 316	Hastelloy B	Hastelloy C	Titanium	Ceramic	Graphite-Ni	Glass-Teflon	Buna N	Viton A	Ethyl/Prop.	Hypalon	Neoprene	Teflon	Cotton	Mod. Acrylic	Polypropylene
Acetaldehyde	–	4	3	NR	NR	4	NR	1	Q	1	3	1	1	1	1	1	NR	Q	3	NR	NR	1	1	NR	Q
Acetic Acid, 20%	1	1	4	4	4	2	3	1	Q	1	1	1	1	1	1	1	2	NR	2	1	Q	1	NR	1	2
Acetic Acid, Glacial	4	4	Q	NR	NR	4	Q	1	4	1	3	1	1	1	Q	1	4	NR	2	Q	NR	1	NR	NR	Q
Acetic Anhydride	NR	4	Q	NR	NR	4	NR	1	NR	1	1	1	1	1	Q	1	NR	NR	2	1	NR	1	NR	NR	4
Acetone	NR	Q	NR	NR	NR	4	NR	1	1	1	1	1	1	1	1	1	NR	NR	4	Q	Q	1	1	Q	4
Aluminum Chloride	1	1	1	3	1	2	1	1	Q	Q	1	1	1	1	NR	1	1	1	1	1	1	1	NR	1	1
Aluminum Fluoride	1	1	2	3	1	2	1	1	Q	Q	3	3	Q	NR	NR	1	1	1	1	1	1	1	NR	1	1
Aluminum Sulfate	1	1	1	3	1	2	1	1	NR	Q	2	1	1	1	1	1	1	1	1	1	1	1	NR	1	1
Ammonia, Aqueous	1	Q	4	4	3	2	1	4	Q	1	1	1	1	1	1	1	4	NR	1	1	1	1	4	1	1
Ammonium Carbonate	1	1	3	3	1	2	1	1	Q	1	2	2	1	1	1	1	NR	4	1	1	1	1	Q	1	1
Ammonium Chloride	1	1	3	3	1	2	1	1	NR	Q	2	2	3	1	NR	1	2	1	1	1	1	1	Q	1	1
Ammonium Hydroxide	1	1	4	4	1	2	1	1	Q	1	4	1	1	1	1	1	4	NR	1	1	1	1	Q	1	1
Ammonium Nitrate	1	1	3	3	1	2	1	1	Q	4	Q	3	1	1	1	1	1	NR	1	1	1	1	Q	1	1
Ammonium Phosphate	1	1	4	3	1	2	1	1	Q	Q	–	1	1	1	Q	1	1	Q	1	1	1	1	Q	1	1
Ammonium Sulfate	1	1	2	3	1	2	1	1	Q	Q	Q	1	1	4	Q	1	1	Q	1	1	1	1	Q	1	1
Amyl Acetate	NR	Q	4	NR	NR	NR	NR	1	1	1	1	1	1	1	1	1	NR	NR	Q	NR	NR	1	1	NR	NR
Amyl Alcohol	1	1	3	4	3	2	4	1	Q	1	1	1	1	1	1	1	4	NR	4	2	3	1	1	1	4
Aniline	3	4	4	NR	NR	2	NR	1	Q	1	2	1	Q	1	1	1	NR	2	2	Q	NR	1	NR	NR	NR
Aqua Regia	NR	4	NR	NR	Q	Q	NR	NR	NR	NR	NR	NR	Q	1	1	1	NR	2	NR	4	Q	1	NR	Q	Q
Arsenic Acid	1	1	3	3	1	2	1	1	1	Q	–	1	1	1	1	1	1	1	1	1	1	1	MR	4	2

taken from Plating Waste Treatment, pp. 241 - 247

1. Good for 200°F (93°C)
2. Good for 185°F (85°C)
3. Good for 140°F (60°C)
4. Good for 70°F (21°C)
Q. Questionable
NR. Not recommended

	Plastics								Metals					Rings, Liners and Seals			Elastomers					Fibers			
Chemical	Kynar	Tefzel	Epoxy	PVC	CPVC	Polypropylene	Polysulfone	Ryton	Aluminum	SS 316	Hastelloy B	Hastelloy C	Titanium	Ceramic	Graphite-Ni	Glass-Teflon	Buna N	Viton A	Ethyl/Prop.	Hypalon	Neoprene	Teflon	Cotton	.rylic	P...opylene
Barium Hydroxide	1	1	3	3	1	2	1	1	NR	1	3	3	1	1	1	1	1	1	1	1	1	1	4	1	1
Barium Chloride	1	1	2	3	1	2	1	1	Q	4	1	1	1	1	Q	1	NR	1	1	1	1	1	Q	1	1
Barium Sulfate	1	1	3	3	1	2	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	Q	1	1
Benzaldehyde	–	4	3	NR	NR	4	NR	3	1	1	1	1	1	1	1	1	NR	NR	Q	NR	NR	1	1	NR	Q
Benzene (Benzol)	2	2	3	NR	NR	NR	NR	1	1	1	1	1	1	1	1	1	NR	3	NR	NR	NR	1	1	NR	NR
Benzenesulfonic Acid	3	4	3	NR	NR	Q	NR	1	NR	1	1	1	1	1	1	1	NR	2	NR	NR	NR	1	NR	NR	Q
Benzoic Acid	1	1	2	3	1	2	Q	1	NR	3	1	1	1	1	1	1	NR	2	NR	NR	NR	1	NR	2	2
Borax (Sodium Borate)	1	1	2	3	1	2	1	1	Q	1	1	1	1	1	4	1	4	3	1	3	4	1	1	1	1
Boric Acid	1	1	2	3	1	2	1	1	Q	2	1	1	1	1	1	1	2	2	1	2	1	1	1	1	1
Bromide Water	2	1	4	3	4	NR	4	Q	NR	NR	1	1	1	1	4	1	NR	1	Q	NR	Q	1	NR	4	NR
Butyl Acetate	NR	4	4	NR	Q	NR	NR	1	1	1	1	1	1	1	Q	1	NR	NR	Q	NR	NR	1	1	4	2
Butyl Alcohol	1	1	4	4	3	2	4	1	Q	1	1	1	1	1	1	1	Q	Q	3	3	3	1	1	1	4
Butyl Amine	NR	4	3	NR	Q	3	NR	4	1	1	1	1	1	1	1	1	NR	Q	4	4	NR	1	3	4	4
Butyl Phthalate	3	3	3	NR	NR	NR	2	4	1	1	1	1	1	1	1	1	NR	Q	4	NR	NR	1	1	4	2
Butyric Acid	1	1	3	4	NR	2	Q	1	NR	3	2	1	1	1	Q	1	NR	4	3	NR	NR	1	NR	NR	4
Cadmium Cyanide	1	1	2	3	1	2	1	1	1	1	1	[illegible]	1	1	1	1	1	1	1	1	1	1	1	1	1
Calcium Bisulfite	1	1	2	3	1	2	1	1	NR	3	2	1	4	1	1	Q	1	1	4	1	1	1	NR	1	1
Calcium Chloride	1	1	2	3	1	2	1	1	NR	Q	1	1	1	1	Q	1	1	1	1	1	1	1	NR	1	1
Calcium Hypochlorite	1	1	2	3	1	3	1	1	Q	NR	4	2	1	1	1	1	4	1	Q	1	NR	1	NR	1	3
Calcium Nitrate	1	1	2	3	1	2	1	1	Q	3	1	1	1	1	1	1	1	1	1	1	1	1	NR	1	1

Calcium Phosphate	1	1	2	3	1	2	1	1	Q	3	1	1	1	1	1	1	1	1	1	1	1	1	Q	1	2
Calcium Sulfate	1	1	2	3	1	2	1	1	Q	3	1	1	1	1	1	1	1	1	NR	1	1	1	Q	1	Q
Carbon Disulfide	1	4	3	NR	NR	NR	NR	2	1	1	2	1	1	1	1	1	NR	1	NR	NR	NR	1	1	1	NR
Carbon Tetrachloride	1	Q	3	Q	4	NR	NR	3	NR	1	1	1	1	1	1	1	Q	3	NR	NR	NR	1	1	1	NR
Carbonic Acid	1	1	2	2	1	2	1	1	1	1	1	1	1	1	1	1	4	1	1	1	1	1	4	4	4
Cellosolve	1	4	3	NR	Q	NR	NR	1	1	1	1	1	1	1	1	1	NR	NR	Q	Q	2	1	1	Q	3
Chloracetic Acid	1	4	4	4	4	Q	NR	1	NR	NR	Q	1	1	1	1	1	NR	NR	Q	1	Q	1	NR	NR	4
Chlorine Water	1	1	4	4	2	4	4	Q	NR	Q	1	3	1	1	4	1	NR	1	1	NR	NR	1	NR	1	1
Chlorobenzene	2	4	3	NR	NR	4	NR	1	1	1	1	1	1	1	1	1	NR	4	NR	NR	NR	1	1	Q	Q
Chloroform	1	Q	3	NR	NR	NR	NR	4	Q	1	1	1	1	1	1	1	NR	3	NR	NR	NR	1	1	1	4
Chlorosulfonic Acid	NR	4	Q	4	4	NR	NR	NR	NR	NR	2	1	1	NR	NR	1	NR	NR	NR	NR	NR	1	NR	2	4
Chromic Acid up to 30%	2	4	Q	4	3	2	Q	2	NR	NR	1	1	1	1	3	1	NR	1	Q	2	NR	1	NR	3	3
Chromic Acid 50%	2	4	NR	NR	4	3	NR	Q	NR	NR	NR	1	1	1	NR	1	NR	1	Q	3	NR	1	NR	4	4
Citric Acid	1	1	2	3	2	2	1	1	1	2	1	1	1	1	1	1	2	1	1	1	1	1	3	1	1
Copper Chloride	1	1	2	3	1	2	1	1	NR	NR	Q	1	1	1	1	1	2	2	1	2	1	1	Q	1	1
Copper Cyanide	1	1	2	3	1	2	1	1	NR	1	3	1	1	1	1	1	2	2	1	2	1	1	4	1	1
Copper Nitrate	1	1	2	3	1	2	1	1	NR	1	1	1	1	1	1	1	1	1	1	1	1	1	Q	1	1
Copper Sulfate	1	1	2	3	1	2	1	1	NR	1	1	1	1	1	1	1	1	1	1	1	1	1	Q	1	1
Cresol	2	1	3	NR	Q	Q	NR	1	1	1	1	1	1	1	1	1	Q	1	NR	NR	NR	1	1	4	NR
Cyclohexane	1	1	3	NR	NR	NR	1	1	1	1	1	1	1	1	1	1	1	1	NR	NR	NR	1	1	Q	NR
Decalin	–	1	3	NR	Q	NR	4	1	1	1	1	1	1	1	1	1	NR	1	NR	NR	Q	1	1	Q	NR
Detergents	2	1	2	3	1	2	3	1	Q	1	1	1	1	1	1	1	1	1	1	1	1	1	1	[illegible]	
Diesel Fuel	1	4	2	3	1	4	1	1	1	1	1	1	1	1	1	1	1	1	NR	2	Q	1	1		
Dowtherm	2	4	1	NR	1	NR	NR	1	1	1	1	1	1	1	1	1	NR	1	NR	4	Q	1	1		
Ethanolamine	NR	1	2	3	3	3	2	1	Q	1	1	1	1	1	1	1	Q	Q	Q	1	1	1	1		4
Ether	3	4	3	NR	4	NR	NR	1	1	1	1	1	1	1	1	1	NR	NR	NR	NR	Q	1	1	4	4
Ethyl Acetate	NR	4	3	NR	Q	Q	NR	1	1	1	1	1	1	1	1	1	NR	NR	4	NR	NR	1	1	NR	NR
Ethyl Alcohol (Ethanol)	–	1	3	4	3	3	Q	1	Q	1	1	1	1	1	1	1	2	NR	4	1	3	1	1	1	1

1. Good for 200°F (93°C)
2. Good for 185°F (85°C)
3. Good for 140°F (60°C)
4. Good for 70°F (21°C)
Q. Questionable
NR. Not recommended

Chemical	Plastics								Metals					Rings, Liners and Seals			Elastomers						Fibers		
	Kynar	Tefzel	Epoxy	PVC	CPVC	Polysulfone	Polysulfone	Ryton	Aluminum	SS 316	Hastelloy B	Hastelloy C	Titanium	Ceramic	Graphite-Ni	Glass-Teflon	Buna N	Viton A	Ethyl/Prop.	Hypalon	Neoprene	Teflon	Cotton	Mod. Acrylic	Polypropylene
Ethylene Dichloride	1	Q	3	NR	NR	4	NR	3	Q	1	1	1	1	1	1	1	NR	3	NR	NR	NR	1	1	1	NR
Ethylene Gylcol	1	1	2	4	1	3	1	1	Q	1	1	1	1	1	1	1	1	1	1	1	3	1	1	1	1
Ferric Chloride	1	1	2	3	1	2	1	1	NR	NR	NR	Q	1	1	NR	1	1	1	Q	1	3	1	NR	4	1
Ferric Hydroxide	1	1	2	3	1	2	1	1	NR	3	3	2	1	1	1	1	1	1	1	1	1	1	NR	4	1
Ferric Nitrate	1	1	2	3	1	2	1	1	NR	3	1	3	1	1	1	1	1	1	1	1	1	1	NR	4	1
Ferric Sulfate	1	1	2	3	1	2	1	1	4	Q	1	1	1	1	1	1	1	1	1	1	1	1	NR	4	1
Ferrous Chloride	1	1	2	3	1	2	1	1	NR	NR	1	1	1	1	1	1	1	1	1	1	1	1	NR	4	1
Ferrous Sulfate	1	1	2	3	1	2	1	1	NR	Q	1	1	1	1	1	1	1	1	1	1	1	1	NR	4	1
Fluoboric Acid	1	1	2	3	3	2	1	1	NR	Q	1	1	NR	NR	1	1	2	2	3	3	1	1	NR	2	1
Fluosilicic Acid	1	1	2	3	3	2	1	1	NR	Q	1	1	NR	NR	1	1	3	4	Q	1	1	1	NR	1	1
Formaldehyde	3	1	2	4	3	2	1	1	Q	Q	2	1	1	1	1	1	NR	NR	Q	4	4	1	4	1	2
Formic Acid	1	4	Q	NR	4	2	1	1	NR	1	2	1	1	1	3	Q	NR	Q	1	1	1	1	NR	1	2
Freons (Fluorocarbons)	1	4	2	Q	3	Q	Q	1	4	Q	1	1	1	1	1	1	Q	Q	Q	1	1	1	1	1	NR
Fuel Oils	1	4	2	Q	4	4	3	1	1	1	1	1	1	1	1	1	1	1	NR	4	1	1	1	1	Q
Furfural	-	4	2	NR	NR	Q	NR	1	1	3	1	1	1	1	1	1	NR	NR	Q	Q	Q	1	1	NR	Q
Gasoline	1	4	3	Q	4	NR	2	1	1	1	1	1	1	1	1	1	4	1	NR	Q	Q	1	1	1	Q
Glycerine	1	4	3	4	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1	1	1	1
Heptane	1	3	3	4	2	4	1	1	1	1	1	1	1	1	1	1	1	1	NR	1	4	1	1	1	Q
Hexane	1	3	3	4	2	4	1	1	1	1	1	1	1	1	1	1	1	1	NR	1	4	1	1	1	Q
Hydrobromic Acid, 20%	1	1	Q	4	2	2	2	3	NR	NR	1	4	4	4	Q	1	NR	4	1	1	NR	1	NR	1	1
Hydrochloric Acid, 0-25%	1	1	2	4	2	2	2	3	NR	Q	1	4	Q	4	4	1	Q	1	1	1	1	1	NR	1	1
Hydrochloric Acid, 25-37%	1	1	2	4	2	4	4	3	NR	NR	1	4	Q	Q	Q	1	NR	Q	Q	3	4	1	NR	1	2
Hydrofluoric Acid, 10%	1	1	4	3	4	2	4	3	NR	NR	1	2	NR	NR	2	NR	4	2	2	2	2	1	4	2	2
Hydrofluoric Acid, 30%	1	1	Q	3	4	3	4	3	NR	NR	1	3	NR	NR	4	NR	NR	3	3	2	3	1	NR	2	3
Hydrofluoric Acid, 50%	1	1	Q	Q	4	Q	4	3	NR	NR	1	3	NR	NR	4	NR	NR	4	4	Q	NR	1	NR	3	4
Hydrogen Peroxide, 30%	1	4	4	4	3	2	2	Q	1	Q	1	1	3	Q	1	1	NR	1	NR	1	Q	1	NR	4	Q
Hydrogen Peroxide, 50%	-	4	3	Q	3	Q	4	NR	1	Q	1	1	Q	Q	NR	NR	NR	1	NR	1	NR	1	NR	4	Q
Kerosene	1	4	3	4	2	4	1	1	1	1	1	1	1	1	1	1	4	3	NR	NR	NR	1	1	1	NR
Ketones	NR	4	4	NR	NR	Q	NR	1	1	1	1	1	1	1	1	1	NR	NR	2	NR	NR	1	1	Q	NR
Lactic Acid	-	3	3	NR	Q	4	1	1	Q	4	2	2	4	1	1	4	4	3	1	1	4	1	NR	1	1
Lead Acetate	1	1	2	3	1	2	1	1	1	1	1	1	1	1	1	1	4	NR	1	NR	NR	1	1	1	1
Lubricants	1	2	2	3	1	2	1	1	1	1	1	1	1	1	1	1	1	1	NR	3	Q	1	1	1	1
Magnesium Chloride	1	1	2	3	1	2	1	1	NR	Q	1	1	1	1	1	1	1	1	1	1	1	1	NR	1	1
Magnesium Hydroxide	1	1	2	3	1	2	1	1	NR	1	1	1	1	1	1	1	3	1	1	1	1	1	NR	1	1
Magnesium Nitrate	1	1	2	3	1	2	1	1	NR	1	1	1	1	1	1	1	1	1	1	1	1	1	NR	1	1
Magnesium Sulfate	1	1	2	3	1	2	1	1	4	1	1	1	1	1	1	1	1	1	1	1	1	1	NR	1	1
Methyl Alcohol (Methanol)	3	1	3	NR	3	4	Q	1	NR	1	1	1	1	1	1	1	4	NR	Q	1	1	1	1	1	1
Methyl Chloride	-	Q	4	NR	NR	NR	NR	4	Q	1	1	1	1	1	1	1	NR	Q	NR	NR	NR	1	1	4	NR
Methyl Ethyl Ketone	NR	4	4	NR	NR	4	NR	4	1	1	1	1	1	1	1	1	NR	NR	1	NR	NR	1	1	4	NR
Methylene Chloride	-	Q	4	NR	NR	NR	NR	4	NR	1	1	1	1	1	1	1	NR	Q	Q	NR	NR	1	1	4	NR
Naphtha	1	4	2	4	3	4	4	1	1	1	1	1	1	1	1	1	4	3	NR	NR	NR	1	1	1	NR
Nickel Chloride	1	1	2	3	2	2	1	1	NR	Q	1	1	1	1	1	1	2	2	2	2	Q	1	Q	1	1
Nickel Sulfate	1	1	2	3	2	2	1	1	NR	1	1	1	1	1	1	1	1	1	1	1	1	1	4	1	1
Nitric Acid, 10%	2	1	Q	3	2	4	Q	3	NR	1	NR	2	1	Q	4	1	NR	1	Q	1	4	1	4	1	4
Nitric Acid, 20%	3	2	4	3	2	4	Q	Q	NR	2	NR	3	1	Q	4	1	NR	1	Q	3	Q	1	NR	2	Q
Nitric Acid, 50%	3	3	NR	Q	2	4	NR	Q	NR	3	NR	4	1	Q	Q	1	NR	NR	NR	Q	Q	1	NR	3	NR
Nitric Acid (Conc.)	NR	4	NR	NR	NR	NR	NR	Q	4	3	NR	4	1	Q	NR	1	NR	NR	NR	NR	NR	1	NR	4	NR
Nitrobenzene	3	4	4	NR	NR	4	NR	1	1	1	1	1	1	1	1	1	NR	Q	4	NR	NR	1	NR	NR	4
Oil, Vegetable	1	1	3	3	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3
Oil, Sour Crude	1	1	3	3	1	4	Q	1	Q	1	1	1	1	1	1	1	4	1	1	Q	Q	1	3	1	Q
Oleic Acid	1	1	2	4	1	4	1	1	1	3	4	3	1	1	1	1	Q	4	Q	Q	Q	1	4	1	NR
Oxalic Acid	3	1	2	4	1	3	Q	1	NR	4	4	3	4	1	1	1	4	1	2	2	4	1	NR	1	Q

1. Good for 200°F (93°C)
2. Good for 185°F (85°C)
3. Good for 140°F (60°C)
4. Good for 70°F (21°C)
Q. Questionable
NR. Not recommended
Q. Questionable

	Plastics								Metals				Rings, Liners and Seals			Elastomers						Fibers		
	Kynar	Tefzel	Epoxy	PVC	CPVC	Polypropylene	Polysulfone	Ryton	Aluminum	SS 316	Hastelloy B	Hastelloy C	Titanium	Ceramic	Graphite-Ni	Glass-Teflon	Buna N	Viton A	Ethyl/Prop.	Hypalon	Neoprene	Teflon	Cotton	Mod. Acr.	Polypro
Perchloroethylene	1	Q	NR	NR	NR	NR	NR	1	1	1	1	1	1	1	1	1	Q	1	NR	NR	NR	1	1	[illegible]	NR
Phenol	3	4	Q	NR	3	Q	NR	1	1	2	1	1	1	1	1	1	NR	1	Q	NR	NR	1	1	NR	4
Phosphoric Acid, 0-50%	1	1	2	4	2	2	1	1	NR	3	3	1	4	1	1	1	Q	2	1	1	1	1	4	1	1
Phosphoric Acid, 50-100%	1	1	Q	4	2	2	1	1	NR	Q	3	3	Q	1	1	1	NR	2	1	1	Q	1	NR	1	1
Potassium Bromide	1	1	2	3	1	2	1	1	2	3	2	1	1	1	1	1	1	1	1	1	1	1	NR	1	1
Potassium Carbonate	1	1	2	3	1	2	1	1	Q	3	2	3	1	Q	1	1	1	1	1	1	1	1	Q	1	1
Potassium Chlorate	1	1	2	3	1	2	1	1	Q	3	1	3	1	1	1	1	Q	1	1	1	1	1	NR	1	1
Potassium Chloride	1	1	2	3	1	2	1	1	NR	Q	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1
Potassium Cyanide	1	1	2	3	1	2	1	1	Q	1	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1
Potassium Dichromate	1	1	Q	3	1	2	1	1	NR	1	2	3	1	1	1	1	Q	1	Q	1	1	1	NR	1	1
Potassium Hydroxide	3	1	2	2	1	2	1	1	NR	2	2	2	Q	NR	1	1	4	NR	4	1	4	1	NR	4	1
Potassium Nitrate	1	1	2	3	1	2	1	1	Q	3	2	3	1	1	1	1	1	2	2	2	1	1	NR	1	1
Potassium Permanganate	1	2	Q	3	1	3	1	1	Q	2	1	1	1	1	1	1	4	3	3	3	1	1	Q	1	1
Potassium Sulfate	1	1	2	3	1	2	1	1	Q	2	2	3	1	1	1	1	1	1	1	1	1	1	4	1	1
Propyl Alcohol	–	1	2	3	2	4	4	1	Q	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Silver Nitrate	1	1	2	3	1	2	1	1	Q	1	1	1	1	1	1	1	4	1	1	1	1	1	1	1	1
Soaps	1	1	2	3	1	2	1	1	Q	1	1	1	1	1	1	1	1	1	4	1	1	1	1	1	1
Sodium Acetate	1	1	2	3	1	2	1	1	Q	1	2	3	1	1	1	1	Q	Q	1	1	Q	1	1	1	1
Sodium Bicarbonate	1	1	2	3	1	2	1	1	Q	1	2	3	1	1	1	1	1	1	1	1	1	1	1	1	1
Sodium Bisulfate	1	1	2	3	1	2	1	1	Q	1	1	3	1	1	1	1	1	1	1	1	1	1	Q	1	1
Sodium Carbonate	1	1	2	3	1	2	1	1	NR	1	1	3	1	Q	1	1	1	1	1	1	1	1	1	1	1
	1	1	2	3	1	2	1	1	Q	3	1	3	1	1	1	1	NR	1	1	1	1	1	NR	1	1
Sodium Chloride	1	1	2	3	1	2	1	1	NR	Q	4	3	1	1	1	1	1	1	1	1	1	1	1	1	1
	1	1	2	3	1	2	1	1	NR	1	1	1	1	1	4	1	1	1	1	1	1	1	1	1	1
Sodium Hydroxide, 20%	2	1	2	4	1	2	1	1	NR	1	1	1	1	NR	1	1	4	1	1	1	1	1	NR	1	1
Sodium Hydroxide, 50%	3	1	2	Q	1	2	Q	3	NR	3	1	1	1	NR	1	1	4	4	Q	1	1	1	NR	4	1
Sodium Hypochlorite	1	2	Q	3	1	3	1	1	NR	NR	3	3	1	1	Q	1	Q	2	1	1	Q	1	NR	1	3
Sodium Nitrate	1	1	2	3	1	2	1	1	Q	1	1	3	1	1	1	1	4	4	1	1	1	1	Q	1	1
Sodium Silicate	1	1	2	3	1	2	1	1	Q	2	2	3	1	1	1	1	1	1	1	1	1	1	1	1	1
Sodium Sulfate	1	1	2	3	1	2	1	1	Q	1	1	1	1	1	1	1	1	1	1	1	1	1	4	1	1
Sodium Sulfide	1	1	2	3	1	2	1	1	Q	2	1	2	1	1	1	1	1	1	1	1	1	1	Q	1	1
Stannic Chloride	1	1	2	3	1	2	1	1	Q	NR	2	2	1	1	NR	1	1	1	Q	1	1	1	4		1
Sulfuric Acid, 0-10%	1	1	2	4	3	2	1	1	NR	Q	1	1	4	1	1	1	4	1	1	1	Q	1	4	3	2
Sulfuric Acid, 10-75%	1	1	4	Q	3	3	2	4	NR	NR	1	3	Q	2	2	2	NR	1	NR	4	NR	1	NR	3	3
Sulfuric Acid, Conc.	Q	2	NR	NR	4	Q	NR	Q	NR	Q	3	3	NR	3	4	1	NR	2	NR	Q	NR	1	NR	NR	NR
Sulfurous Acid	1	1	2	4	2	2	1	1	NR	3	3	3	2	1	1	1	Q	1	NR	4	NR	1	NR	1	1
Tannic Acid	1	1	2	3	1	2	1	1	Q	2	2	2	1	1	1	1	NR	1	1	1	1	1	3	1	1
Tartaric Acid	1	1	2	3	1	2	1	1	Q	1	1	1	1	1	1	1	NR	1	4	1	1	1	1	NR	1
Tetrahydrofurane	–	2	4	NR	NR	NR	NR	1	1	1	1	1	1	1	1	1	NR	4	NR	NR	Q	1	1	NR	NR
Toluene (Toluol)	2	2	3	NR	NR	Q	NR	1	1	1	1	1	1	1	1	1	NR	3	NR	NR	NR	1	1	NR	NR
Trichloroethylene	1	Q	3	NR	NR	Q	NR	NR	Q	Q	1	1	1	1	1	1	NR	1	NR	NR	NR	1	1	NR	NR
Triethanolamine	NR	2	3	3	3	2	NR	1	Q	1	1	1	1	1	1	1	Q	NR	Q	2	2	1			2
Turpentine	–	3	4	4	4	4	NR	1	1	1	1	1	1	1	1	1	3	1	NR	3	NR	1	1	4	NR
Urea	–	1	3	3	1	2	Q	1	Q	1	2	1	1	1	1	1	NR	1	1	1	Q	1	1		4
Vinegar	1	1	3	3	1	2	1	1	Q	1	1	1	1	1	1	1	4	1	1	1	1	1	4	1	[illegible]
Water, Deionized	1	1	1	3	2	2	1	1	Q	1	1	1	1	1	1	1	1	1	1	1	1	1	1	NR	[illegible]
Water, Sea (Salt)	1	1	1	3	2	2	1	1	Q	Q	1	1	1	1	1	1	1	1	1	1	1	1	1	[illegible]	[illegible]
Xylene (Xylol)	2	1	3	NR	NR	Q	NR	1	1	1	1	1	1	1	1	1	NR	1	NR	NR	NR	1	1	NR	[illegible]
Zinc Chloride	1	1	2	3	1	2	1	1	NR	Q	2	2	1	1	NR	1	1	1	1	1	1	1	Q	1	1
Zinc Sulfate	1	1	2	3	1	2	1	1	Q	1	4	2	1	1	1	1	1	1	1	1	1	1	Q	1	1

ULTRAFILTRATION TREATMENT FACILITY
AUTHORIZATION TO CONSTRUCT REVIEW CHECKLIST

Industry Name:____

Project Identifier:____

1. Equipment List:

Equalization Tank	Yes/No	Capacity:
Prefilter/Strainer	Yes/No	Type:
Oil & Grease Separator	Yes/No	Type:
Surfactant/Chemical StorageTank	Yes / No	Chemical:
	ID:	Capacity:
		Construx Material:
		Mixer: Yes/No
		Overflow Control: Yes /No
pH Adjustment Chemical Storage Tank	Yes / No	Chemical:
	ID:	Capacity:
		Construx Material:
		Mixer: Yes/No
		pH Probe: Yes/No
		Overflow Control: Yes /No
Batch/Retentate Tank	Yes/No	Capacity:
(Retentate is the concentrate)		Precipitate Removal: Yes / No
		Chemicals Added:
		Construx Material:
		Mixer: Yes/No
		pH Probe: Yes/No
		Chemical Addition Control: Yes/No
		Overflow Control: Yes /No
Ultrafiltration Unit	Yes / No	Module Manufacturer:
		Module Designation
		Installed Number of Modules
		Installed Membrane Surface Area:
		Maximum Number of Modules:
		Maximum Membrane Surface Area:
		Inlet Pressure Gauge: Yes / No
		Outlet Pressure Gauge: Yes / No

Final pH Adjustment or Holding Tank	Yes / No	Chemicals added:
	ID:	Capacity:
		Construx Material:
		Mixer: Yes/No
		pH Probe: Yes/No
		Chemical Addition Control: Yes / No
		Overflow Control: Yes /No
Flow Measurement Device	Yes/No	Type:(influent, effluent)
Sampling Equipment	Yes/No	Type:
Retentate Holding Tank	Yes/No	Capacity:
Retentate Handling Equipment	Yes/No	Type:
		Capacity:
Cleaning Chemical Storage Tank	Yes / No	Chemical Stored:
	ID:	Capacity:
		Construx Material:
		Overflow Control: Yes / No

2. Design Review

a. Is Equipment Design Flow ≥ Permitted Flow? __________

b. Is predicted effluent discharge ≤ permitted effluent limits? __________

c. Were jar test or pilot plant data provided to justify predicted effluent discharge concentration? __________

d. Are retentate, precipitate and any cleaning residuals disposal methods provided? __________

e. Do all pumps have influent and effluent valves, so that pumps may be rapidly changed out? __________

f. Are pumps sized appropriately? __________

g. Are there bypass lines around the processes? __________

h. If there are bypass lines, are the valves locked? __________

i. Is the process within containment dike? __________

j. Are all process tanks made of material to withstand the pH expected? __________

k. Are all pipes and valves made of material to withstand pH expected? __________

l. Are facilities protected from the 100 year flood? __________

m. Are all pumps made of material to withstand pH expected? __________

n. Do all automatic control valves have secondary manual control valves? ____________________

o. What excess treatment chemicals are possibly discharged with the effluent? (i.e. Surfactants, cleaning chemicals) ____________________

p. Are the discharged treatment chemicals in "safe" amounts? ____________________

q. Was an Alternatives Analysis completed? ____________________

q. Ultrafiltration Review

- Hydraulic Loading
  - Membrane Nominal Flux Rate (Volume/Area/Day) =____________
  - Hydraulic Loading =

    = (Membrane Nominal Flux Rate)(Installed Membrane Surface Area)

    = ______________________________
  - Is the Hydraulic Loading greater than the permitted flow? Yes / No
- Pollutant Removal
  - Nominal Molecular Weight Cutoff (MWCO) =____________

    (For removal of oil & grease to 10 - 100 mg/l, then 20, 000 to 50,000 MWCO generally recommended)
  - Pilot test with exact membrane completed with checks for fouling, and cleaning technique? Yes / No
- Membrane Operating Limits
  - Temperature =__________
  - pH =__________
  - Pressure =__________

  Are Temperature and pH within expected discharge range? Yes / No
- Membrane Cleaning
  - How is the membrane to be cleaned?____________________

    ____

    ____

    ____
  - Is the cleaning a CIP (clean-in-place) automatic operation? Yes / No

Comments:______________________________

____

____

____

____

____

Reviewed by:____________________

Date:____________________

AIR STRIPPING & ACTIVATED CARBON
AUTHORIZATION TO CONSTRUCT REVIEW CHECKLIST

Industry Name:____

Project Identifier:____

1. GENERAL DESIGN: (Typical Schematic on Page 4)

	Yes/No	Size	Units	NOTES
Is predicted effluent conc. less than permitted effluent conc.	Yes/No			
Is the equipment design flow greater than the permitted flow	Yes/No			
Do all pumps have influent and effluent valves, so that pumps may be rapidly changed out?	Yes/No			
Are there back flow prevention valves where needed?	Yes/No			
Is flow meter provided?	Yes/No			
Sampling points provided?	Yes/No			
Freeze Protection provided?	Yes/No			
Are Iron and Manganese Potential Problems addressed?	Yes/No			
Is the facility in the 100 year flood plain?	Yes/No			

OTHER COMMENTS:____

2. OIL WATER SEPARATOR:

	Yes/No, or Size	Units	NOTES
Size		gal	
Detention time		min.	
Free product storage tank			
Auto shut off when full			
Inside or Outside building ?			
Sludge Disposal Plan			

OTHER COMMENTS:____

3. AIR STRIPPER:

	Yes/No, or Size	Units	NOTES
Storage tank before stripper			
Low Profile or Tower:			
Stripper Tower height		feet	
Stripper Tower diameter		inches	
Water distributor at top & type			
Packing material			
Air Flow Rate		cfm	
Water Flow Rate		gpm	
Air / Water Ratio			7.48 gal/cf
Flexibility to Recycle water flow			
De-mister for exit air			
Other treatment for exit air			
Air intake separated from air exit		ft	
Storage Tank post stripper			
Water seal on discharge line?			
Clean out procedures/access port?			
>40 #/day VOC air permit?			
Are removal rates listed and sufficient for each pollutant?			

OTHER COMMENTS:____

4. PARTICLE FILTER:

	Yes/No, or Size	Units	NOTES
Paper Filters			
Bag Filters			
Aluminum silicate			
Other media			

OTHER COMMENTS:____

5. ACTIVATED CARBON UNITS:

	Yes/No, or Size	Units	NOTES
Column Layout:			
Downflow in series			
Downflow in parallel			
Upflow expanded in series			
Moving bed			
Other			
Total carbon contact time		min	
Total lbs. carbon		lbs	
Virgin or Re-Activated Carbon			
Back wash provided			
Breakthrough Detection?			
Expected days to Breakthrough		days	
Carbon replacement procedures specified			
Carbon replacement period?			

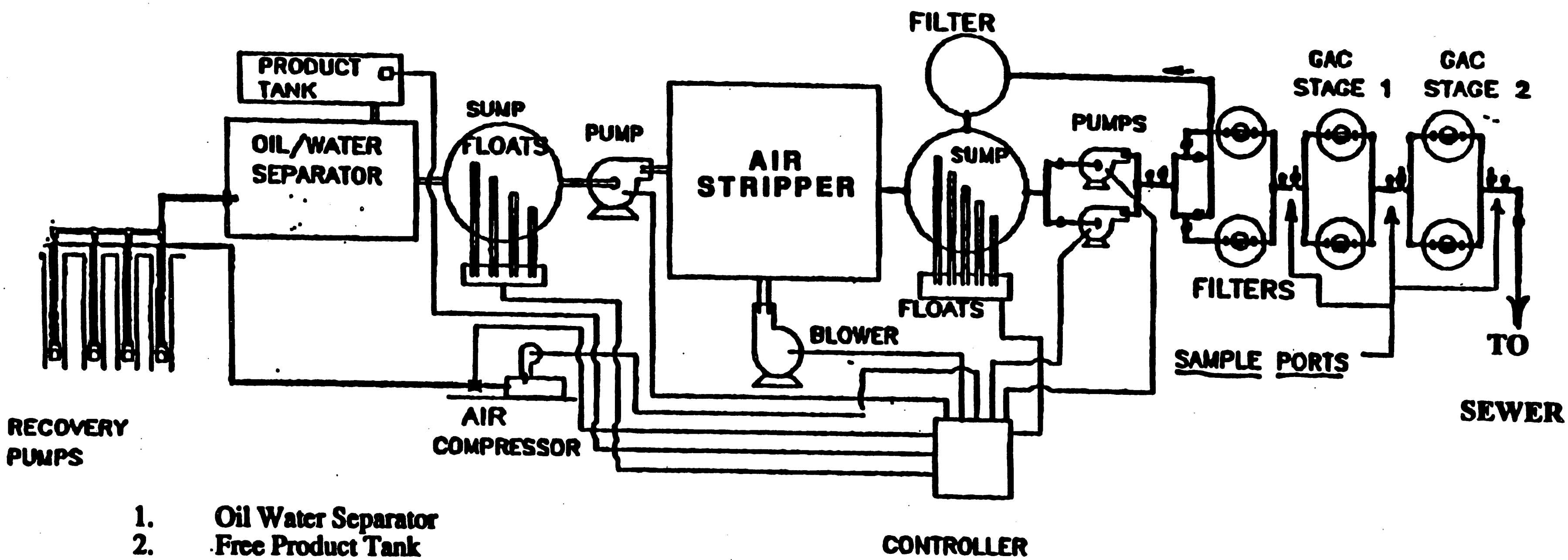
OTHER COMMENTS:____________________

6. General Comments:

Reviewed by:____________________

Date:____________________

Schematic of Typical Ground Water Remediation Treatment Facility



1. Oil Water Separator
2. Free Product Tank
3. Equalization Tank
4. Air Stripper
5. Equalization Tank
6. Filters & Backwash Tank
7. Primary Activated Carbon Cylinders
8. Secondary Activated Carbon Cylinders
9. Sample Ports, Gauges, Valves, etc.