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Appendix A. Secondary Treatment Alternatives Evaluation

Screening of Biological Treatment Technologies for the Point Loma Plant

			Criteria					
Biological Treatment Option[1] (Secondary processes oxidize BOD in primary effluent. Processes differ in the manner in which organisms are kept in the reactor & how oxygen is supplied to organisms)	**Process Description**	**Vendor (if applicable)**	**Footprint**[2]	**Proven Effectiveness**[3] (Operational at >30mgd) In U.S. / Worldwide	**Experience (Years technology in use [>20 yr])**	**Performance (Meets BOD:TSS of 30:30 mg/L)**	**Cost (Life Cycle Basis)**	
			Suggested Weighting of Criteria (percent)[4]					
			30	**25**	**15**	**15**	**15**	**Tot score /100**
Land Treatment -Wetlands -Slow Rate -Overland flow	Controlled application of wastewater to land surface. Treatment occurs in soil-water matrix.	Not proprietary	Very high 0	No / Yes 10	50 15	Not for TSS 7	High: funct of land cost, availability 0	32
Aquaculture	Controlled application of wastewater to a mixture of grasses and higher level plants. Treatment occurs in soil-water matrix.	Not proprietary	Very high 0	No / No 0	15 0	Not for TSS although could be met with filters 7	High: funct of land cost, availability 0	7
Lagoon Systems -Anaerobic -Facultative -Aerobic	Lagoons simulate biological stabilization processes occurring in lakes but at higher loading rates.	Not proprietary	Very high 0	No / Yes 10	45 15	Not for TSS 7	High: funct of land cost, availability 0	32
Suspended Growth Systems -Conventional or air activated sludge (AAS)	Biological stabilization occurs at much higher rates than in lagoons because of higher organism concentration & controlled environ-ment. Sec clarifier used to return sludge.	Not proprietary	Will not fit location 0	Yes / Yes 25	100 15	Yes 15	 10	65
-High purity oxygen AS (OAS)	Same as AAS except that oxygen used in place of air. Higher rate system with smaller footprint.	M2T Technologies (previously UNOX, Lotepro)	Will not fit location 0	Yes / Yes 20	30 15	Yes 15	Similar to AAS except requires O_2 & explosion 10	60
-Powdered activated carbon AS (PAC)	PAC added to AAS to improve toxics removal. Improves settleability, allows higher ML conc & smaller footprint.	Zimpro / US Filter	Will not fit location 0	Yes / No 10	30 15	Yes 15	High: cost of carbon recovery 5	45
-Sequencing batch reactor (SBR)	AAS & clarifier functions carried out in a single tank. Some reduction in footprint. Focus on small systems.	JetTech, Fluidyne, Aqua Aerobics, Austen Biojet	Will not fit location 0	No / No 0	80 15	Yes 15	Need 2 or more tanks, + equaln 10	40
-Deep shaft	Variation on AAS where 300 ft shaft serves as aeration tank: hydrostatic head increases oxygen transfer. Need large clarifiers or DAFs[6]	Noram, Vost	Will fit with DAFs 30	No / No 0	20 15	Not for TSS 7	High cost of shaft , large clarifiers 5	57
-Oxidation ditch	Variation on AAS where the aeration tank is in the shape of a racetrack; sometimes 2 or 3 tracks are used. Clarifier required.	Orbal by US Filter, Biodenitro, Biodenipho by Kruger / US Filter	Will not fit location 0	No / Yes 10	45 15	Yes 15	Need more land, high energy cost 5	45
Fixed Film (Biofilm) Systems -Trickling filters	Wastewater distributed over bed of plastic media that supports biofilm growth. Clarifier required.	Not proprietary	Will not fit location 0	Yes / Yes 20	80 15	Not for TSS 7	Similar to AAS 10	52
-Biological fluidized bed	Wastewater flows upward through fluidized bed of sand or carbon, which supports fixed film growth.	Envirex / US Filter No longer sold for BOD removal	Low 30	No / No 0	20 15	Not for TSS 7	Equipment expensive 5	57
-Biological aerated filters (BAF)	Passes primary effluent through bed of fired clay or polystyrene media that supports fixed film growth. Need enhanced primary clarifier but no secondary clarifier.	Biofor by IDI / Ondeo Biostyr by Kruger / US Filter	Low 30	No / Yes 15	25 15	Yes 15	Higher sludge costs than AAS 7	82

Screening of Biological Treatment Technologies for the Point Loma Plant

			Criteria					
Biological Treatment Option[1] (Secondary processes oxidize BOD in primary effluent. Processes differ in the manner in which organisms are kept in the reactor & how oxygen is supplied to organisms)	**Process Description**	**Vendor (if applicable)**	**Footprint**[2]	**Proven Effectiveness**[3] (Operational at >30mgd) In U.S. / Worldwide	**Experience** (Years technology in use [>20 yr])	**Performance** (Meets BOD:TSS of 30:30 mg/L)	**Cost** (Life Cycle Basis)	
			Suggested Weighting of Criteria (percent)[4]					
			30	**25**	**15**	**15**	**15**	**Tot score /100**
-Rotating biological contactor (RBC)	Partially (40%) submerged discs rotating in tanks of wastewater support biofilm growth. Clarifier required.	Not sold for large plants now.	Will not fit location 0	Yes / No 10	35 15	Yes 15	Higher energy cost than AAS 7	47
-Submerged biological contactor (SBC)	RBC almost completely (90%) submerged in wastewater.	Envirex / US Filter	Will not fit location 0	No / Yes 5	10 0	Yes 15	Higher energy cost than AAS 7	27
Hybrid Systems	Promote fixed film growth in a suspended growth activated sludge process. This increases the biomass concentration per reactor unit volume & reduces footprint of aeration tank. Clarifier required.							
-Trickling filter-solids contact (TF / SC)	Couples TF with suspended growth contact tank to improve mixed liquor settleability.	Not proprietary	Will not fit location 0	Yes / Yes 15	25 15	Yes 15	Comparable to AAS 10	55
-Integrated fixed film activated sludge system (IFAS)	Processes use plastic media and sponges of of various shapes to support fixed film growth in a AAS process.	Ringlace, Bionet, Hydroxyl Biomatrix Technologies Captor, Linpor, Kaldness	Will not fit location 0	No / No 0	15 0	Yes 15	Comparable to AAS 10	25
-Moving bed biofilm reactor (MBBR)	Process uses random fill media to support fixed film growth in a suspended growth system.	Kaldness, Hydroxyl	Will not fit location 0	No / No 0	10 0	Yes 15	Costly media 5	20
Membrane Bioreactors	A modification of the AAS process in which membranes are used in place of a secondary clarifier	Zenon, US Filter, Kubota, Mitsubishi	Low 30	No / No 0	20 15	Yes 15	Costly membranes, high O&M[5] 5	65

Footnotes

1. Wastewater may be treated with physical-chemical or biological treatment technologies. Significant physical-chemical technologies that would be applicable and have been used in the past for the treatment of municipal sewage include adsorption with carbon and other media, ozonation, chemical oxidation (with say hydrogen peroxide), coagulation, precipitation, and electrolysis. These technologies were evaluated during the 1970s and 1980s under the U.S. EPA alternative technology program and several were built at full scale. In general, physical-chemical plants are more expensive both in terms of capital and operations and maintenance costs than biological treatment systems. Also, almost all have been abandoned because of poor performance or high operating costs. Consequently, this screening has been focused on biological treatment technologies.
2. Based on requirements for a 240-mgd AADF plant. 1990 reports are available that show conventional technologies for a 150 mgd flow will fit on the site based on land availability at the time of the work.
3. The scoring for plant effectiveness is a graduated scale in which larger scores reflect increased levels of operation at larger plants and for increasing numbers of plants as given below. The 30 mgd plant size was selected for the reason that any scale effects would manifest themselves at this plant size.

Score	Criteria
5	At least one plant @ > 30 mgd in successful operation for a minimum of 1 year
10	At least 2 plants @ > 30 mgd in successful operation for a minimum of 10 years
15	At least 5 plants @ > 30 mgd in successful operation for a minimum of 3 years
20	At least 10 plants @ > 30 mgd in successful operation for a minimum of 5 years
25	At least 20 plants @ > 30 mgd in successful operation for a minimum of 10 years

4. The weighting of the scores has been assigned according to Footprint (30%), Proven Effectiveness (25%), Experience (15%), Performance (15%), and Life Cycle Cost (15%). This weighting is to be verified.
5. MBRs can be competitive with other technologies if used in concert with chemically enhanced primaries. In this approach, the MBR is based loaded with a constant flow and flows greater than the base flow are treated in the enhanced primaries. This concept is being applied in the Brightwater WA design.
6. If DAFs were to be used for effluent solids removal, they would likely fit on the site but not achieve the effluent TSS limit of 30 mg/L. If secondary clarifiers were used instead, together with preaeration for desaturation, the effluent TSS limits would be met but the larger footprint of the clarifiers would not fit on the site.

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Appendix B. Vendor Proposals

Infilco Degremont, Inc.

Krüger

PROPOSAL FOR

THE BIOSTYR® PROCESS

FOR

POINT LOMA WWTP, SAN DIEGO, CA
CARBON REMOVAL BIOSTYR

(Revision 1)

PREPARED FOR

Brown & Caldwell Engineers
9665 Chesapeake Drive
Suite 201
San Diego, CA 92123

PREPARED BY

Kruger, Inc.
Project #42050312

November 21, 2003

TABLE OF CONTENTS

ATTACHMENTS

1) APPLICATION SUMMARY

Kruger, Inc. (Kruger) is pleased to present this revised BIOSTYR proposal for the City of San Diego/MWWD, CA project. This revision is to reflect the following changes in design basis:

- Max. Month Flow Rate: Decrease from 360 MGD to 264 MGD
- Effluent Limitations: Increase from 20 mg/L to 30 mg/L for both BOD and TSS and CBOD of 25 mg/L; all limitations are on 30-day average basis.

Source water for the proposed BIOSTYR system will still be the effluent from advanced primary treatment works (Lamella Plate Type with Chemical Addition). The waste backwash water generated from the BIOSTYR system will be recycled back to the primary clarifiers.

For this application, we have proposed a total of 40 cells of 2,582 ft^2 each. The 40 cells are divided into four batteries. Each battery consists of 10 cells and a dedicated waste backwash storage tank. As shown in the attached layout drawing, the four batteries occupy a total area of 822 ft by 250 ft including a 30 ft wide access road.

This revised design has been reviewed and approved by Kim Sorensen of Violia Water System at France. The budget price for our BIOSTYR scope of supply for this preliminary design is $33,000,000 $\pm$ 20%.

2) GENERAL PROCESS DESCRIPTION

The BIOSTYR system is an up-flow submerged fixed-film filter that biologically treats carbonaceous and nitrogenous wastes (CBOD, NH_4-N, NO_3-N) and removes insoluble pollutants (TSS) through the filtering mechanism of the process. One distinguishing characteristic of the BIOSTYR process is that a complete treatment facility is composed of individual filter units. Adding BIOSTYR filters to an existing facility allows for incremental expansion.

The BIOSTYR process can be designed to accomplish BOD removal, nitrification, and/or denitrification. As shown in Figure 1, the influent wastewater is first pumped to a common inlet feed channel above the BIOSTYR cells where it flows down to the individual cells by gravity. Upon entering the BIOSTYR cells, the wastewater is forced upwards through the filter media. The media contained in the cells is composed of specially manufactured high-density polystyrene beads covered by active biomass. This active biomass provides biological treatment to the wastewater as it flows through the cells. Ceiling plates with regularly spaced nozzles are used to retain the filter media. The nozzles allow the treated water to enter a common water reservoir above the filters, which in turn is used to provide water during backwash sequences.

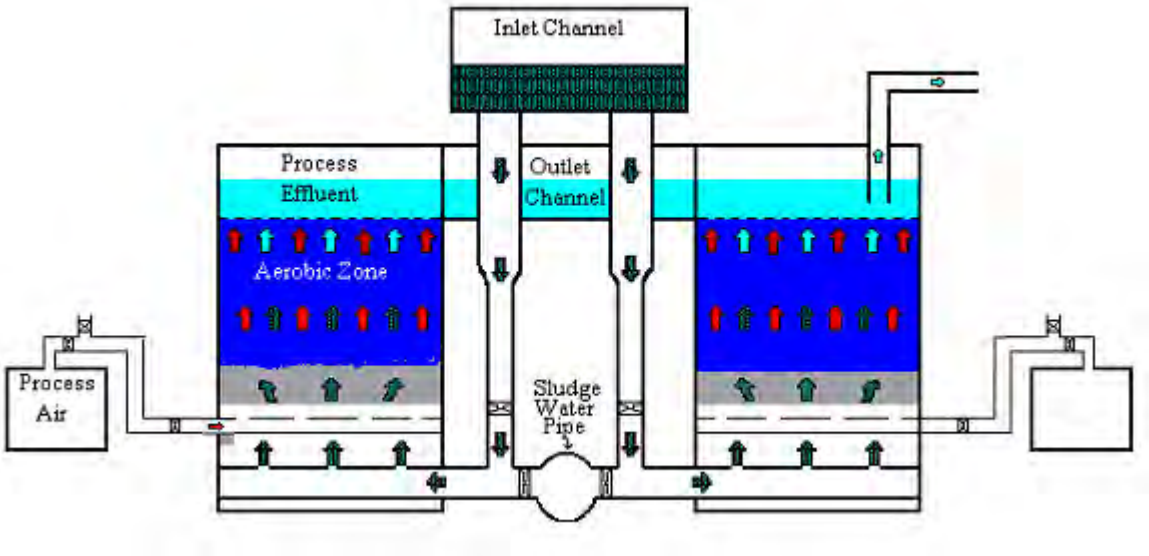
In a system designed for carbon removal and/or nitrification only, a process air grid is placed below the filter media so that the whole filter bed is aerobic. BOD is oxidized by the biomass in the lower section of the filter. As the wastewater continues up the filter,

additional BOD is consumed. When the BOD:TKN ratio falls below a certain limiting level, nitrification occurs, thereby converting the ammonia to nitrate.

Growth of biomass and the retention of suspended solids in the filter media make periodic backwashing necessary. The BIOSTYR process is designed for a backwash interval of 24 hours or more. The backwash sequence is performed automatically and is triggered either when a preset time limit has expired or when the head loss across the filter exceeds a pre-determined setpoint. Water from the common treated water reservoir flows down through the filter by gravity, thereby expanding the media bed. The air grid located below the media is used to supply scouring air during the backwash sequence. This grid is composed of perforated stainless steel piping that allows air to be injected into the filters.

Like other bio-filtration processes, high TSS and BOD concentrations in the influent waste stream can increase the rate of clogging. If the influent waste stream contains high levels of TSS or BOD, it is desirable to install clarification to partially treat the wastewater.

Figure 1 - BIOSTYR System for BOD Removal, Nitrification and Denitrification



The BIOSTYR process provides several significant improvements over other fixed film systems. First, using a floating media bed in conjunction with an up-flow system ensures that the nozzles used to retain the media are only in contact with treated water. This prevents the nozzles from clogging and provides easy access for nozzle maintenance or replacement.

Second, the counter-current backwashing sequence ensures efficient removal of accumulated solids. During backwashing sequences, the downward flow expands the filter media and utilizes gravity to aid in flushing solids from the bottom of the filter. Additionally, the backwash water is supplied from a common reservoir above the filter cells, eliminating the costs associated with backwash pumping. Finally, used backwash water is collected in drainpipes at the bottom of the filters. It is not exposed to the atmosphere, so the potential for odor problems is dramatically reduced.

3) BIOSTYR PROCESS DESIGN SUMMARY

Influent to the BIOSTYR system requires 10 mm fine screening, bar or mesh screens, which could occur somewhere upstream of the filters, for instance at the plant headworks. Kruger understands that the effluent from the primary treatment works will feed the BIOSTYR system by pumping.

The BIOSTYR influent design basis is summarized in Table 1. The target effluent criteria are listed in Table 2. The process design is summarized in Table 3. This revised design has been reviewed and approved by Kim Sorensen of Violia Water System at France.

Table 1: BIOSTYR Influent Design Basis

			Revision 1 Design Basis
Flow, Peak	MGD	432	432
Flow, Max. Month	MGD	360	264
BOD, Max. Month	mg/l	116	116
TSS, Max. Month	mg/l	52	52
Min. Temperature	^{o}C	22	22

Table 2: BIOSTYR Effluent Criteria – 30 Day Average

			Revision 1 Limitations
BOD or CBOD	mg/l mg/l	$\leq$ 20 NA	$\leq$ 30 $\leq$ 25
TSS	mg/l	$\leq$ 20	$\leq$ 30

Table 3: BIOSTYR Process Design Summary

		Values
Size of Cells	ft^2	2,582
Number of Cells	-	40
Size of Media	mm	5.0
Height of Media	ft	11.48
Hydraulic, Peak (All cells from all batteries in filtration)	$m^3/m^2/hr$ gpm/ft^2	7.1 2.9
Hydraulic, Peak (1 Cell in backwash for each battery)	$m^3/m^2/hr$ gpm/ft^2	7.9 3.2
BOD, Max. Month	$kg/m^3/d$ $lb/1000ft^3/d$	3.5* 218*
TSS, Max. Month	$kg/m^3/d$ $lb/1000ft^3/d$	1.6* 99.7*
Sludge Production, Max. Month	lb/d	104,000*
Process Air / Cell, Max. Month	Scfm	2,200
Backwash Air / Cell, Max. Month	Scfm	1,700

*Biostyr backwash water recycle stream (31 MGD) is considered in the design. However, the values shown are calculated without including backwash flow and loads.

Pollutant loading rates for the design are calculated based on the maximum month conditions provided. The BOD loading, or be more precisely, soluble BOD loading dictates the design of the Biostyr system.

A total of 40 cells are divided into four batteries. Each battery consists of 10 cells and a dedicated waste backwash storage tank and occupies an area of 250 ft by 200 ft. A plant layout is included at the end of the proposal. As shown in the layout, the entire system occupies a total area of 820 ft by 250 ft including a 30 ft wide access road between.

4) OPERATING FACTORS

The main operating costs for the BIOSTYR system will be for aeration and feed pumping.

BIOSTYR feed pumping energy will depend on the discharge head on the pump station. Although we do not have information about the site to detail pumping head, we can state that the elevation difference from the bottom of a cell to the feed channel is roughly 30-35 ft.

Maximum month total air demand is approximately 94,800 scfm, which includes 88,000 scfm for maximum process air requirement and 6,800 scfm for backwash air requirement for four cells. Air may be supplied with a centralized blower system with flow monitoring and control at each cell. The discharge pressure will typically range from 11.0 to 13.0 psig, but will depend on the final design.

Carbon removal cells will typically backwash on a 24-hour interval. Treated water is collected in an effluent channel for use during backwash. A typical backwash for this filter will produce around 776,000 gallons per backwash. For design purposes we estimate that 31.0 MGD of waste backwash water will be generated per day during maximum month conditions.

During backwash, the used backwash water is detained in a waste backwash storage tank and then pumped to a facility where it will be treated. For this application a storage tank with a capacity of 887,000 gallons is proposed.

The water from each backwash would need to be pumped from the waste backwash storage tank over a period of about 60 to 90 minutes. The used backwash water will be handled by recycling it to the primary treatment works. The sludge production will be roughly 104,000 lb/d under the maximum month conditions provided.

There is no annual media replacement cost. The media will compress slightly (5-10%), mostly during the first year of operation. During media installation, additional media is installed to compensate for this initial compression.

5) BIOSTYR O&M COST

Based on our understanding of the scope of the job, the significant operating costs for the proposed full-scale Biostyr system are outlined in the table below. The calculations are based on annual average flow and loads; and 30 of 40 cells will be in filtration.

The present worth costs were calculated for a life cycle of 20 years and with an interest rate of 4.69%. The present worth factor was estimated to be 12.8 and the cost of electricity was assumed to be 0.12 $/KWhr.

				Present Worth Cost
Process Air Blowers	4745	18,400,000	$2,210,000	$28,000,000
Backwash Air Scour Blowers	730	1,700,000	$207,000	$2,650,000
Feed Pumping	8,760	14,300,000	$1,710,000	$21,900,000

Total Annual Operating Cost: $4,124,000
Total Present Worth Cost: $52,800,000

Assumptions for Blower HP Calculations:

1) Relative Humidity = 90%
2) Air Temperature = 30°C
3) Blower Efficiency = 75%

6) SCOPE OF SUPPLY

Kruger's Scope of Supply for the BIOSTYR System.

The scope is specific to the forty (40) cells of 2,582 ft^2 designed for the San Diego, CA project.

- One-thousand two-hundred eighty (1,280) precast reinforced concrete nozzle slabs, 32 per cell.
- Two (2) nozzle slab manways per cell.
- Nozzles and gaskets for all cells . Installed by others.
- Two (2) stainless steel pipe gallery manway per cell.
- One (1) stainless steel sight glass per cell. Sight glasses are cast in the concrete pipe gallery wall of the BIOSTYR cells.
- Pressure port inserts, two (2) per cell.
- Sample ports for profile sampling, eight (8) cells (2 cell per battery) equipped with 3 ports each.
- 5 mm media to fill forty (40) 2,582 ft^2 cells to the indicated depth of 11.48 ft (3.5 m). Media installation is included.
- One (1) process/backwash aeration grid per cell, including inlet header, purge header, lateral distribution lines, couplings, wall brackets, floor stand support structure, and wall inserts. Piping is 316 stainless. Anchor bolts provided by others.
- Four (4) aeration blower packages.
- One (1) set of feed/backwash pipes per cell. Anchor bolts provided by others.
- Sludge pumps to transfer backwash water from the backwash storage tanks to primary treatment facility, including necessary check and isolation valves.
- Four (4) instrument air systems to provide compressed air for pneumatic actuators. System includes backup/duplex compressor, receiving tank, refrigerated air dryer, controller, regulator, and necessary filters.
- Process instrumentation. Includes DO meter, on-line phosphate analyzer, pressure instruments, pH instrument, temperature instrument, and level instruments.
- PLC based control system. Includes control cabinet, programming, and customized SCADA system.
- All automatic process valves for the BIOSTYR system. Process valves are primarily wafer-style butterfly valves. Actuators are primarily dual acting pneumatic.

A minimum of 30 man-days field support during the construction and start-up of the facility. Included in this period is time for training Owner's staff in the proper operation and maintenance of the BIOSTYR facility.

Contractor's Scope of Supply

The contractor's scope of supply for the BIOSTYR system should include, but is not limited to, the following items:

- Concrete construction of the BIOSTYR cells, including assembly of the nozzle decks using the prefabricated, modular slabs supplied by Kruger.
- Aluminum slide gates in the BIOSTYR cell effluent.
- All piping, up to the walls of the BIOSTYR cells.
- Anchor bolts for all equipment installation.
- Installation, adjustment, and verification of operation on all equipment.
- Installation of nozzles in the nozzle slabs.
- Mechanical structures such as handrails, stairways, and platforms.
- Motor control centers (MCC's).
- All electrical and mechanical hardware with the exception of the equipment that is identified above.
- HVAC for the building pipe gallery, equipment rooms, and control room.
- System check out and piping tests.
- All installation labor and construction management.

7) ASSUMPTIONS and CLARIFICATIONS

Some of the assumptions made to compile this proposal are listed below.

- None of the equipment provided would be used in a classified area (e.g. Class 1, Division 1 or Class 1, Division 2).
- The water has no prohibitive characteristics that would affect the biological processes.
- Process design and effluent guarantee are based on the stated or assumed influent and site conditions.
- Sales tax is not included in pricing.

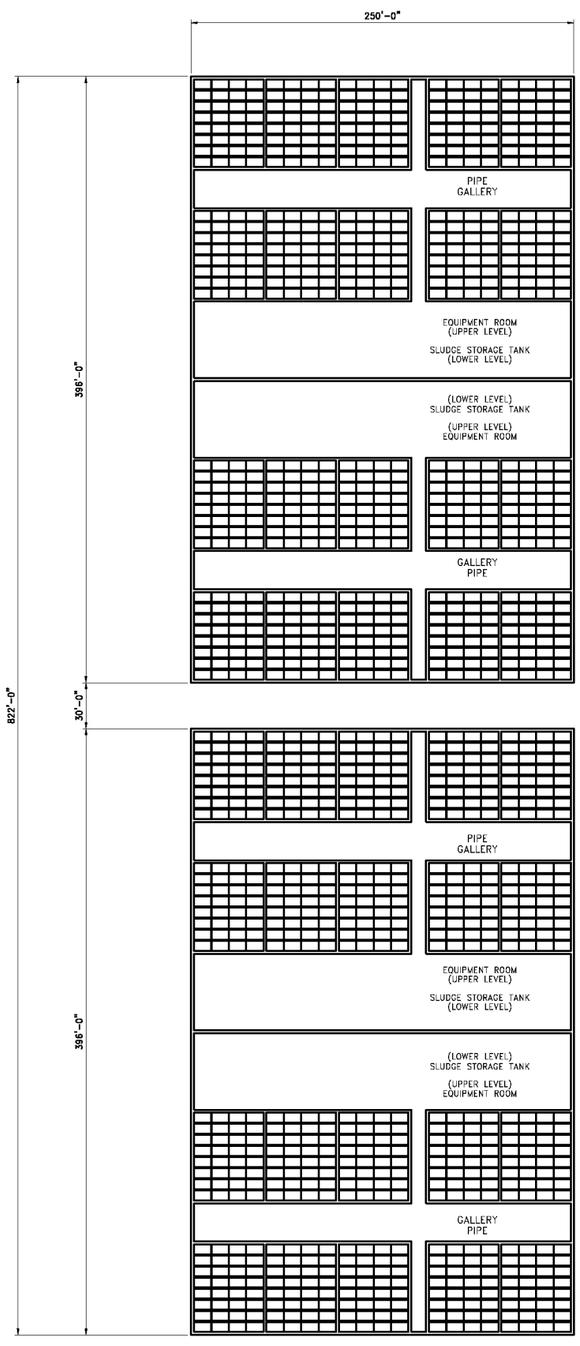
8) BIOSTYR SYSTEM COST

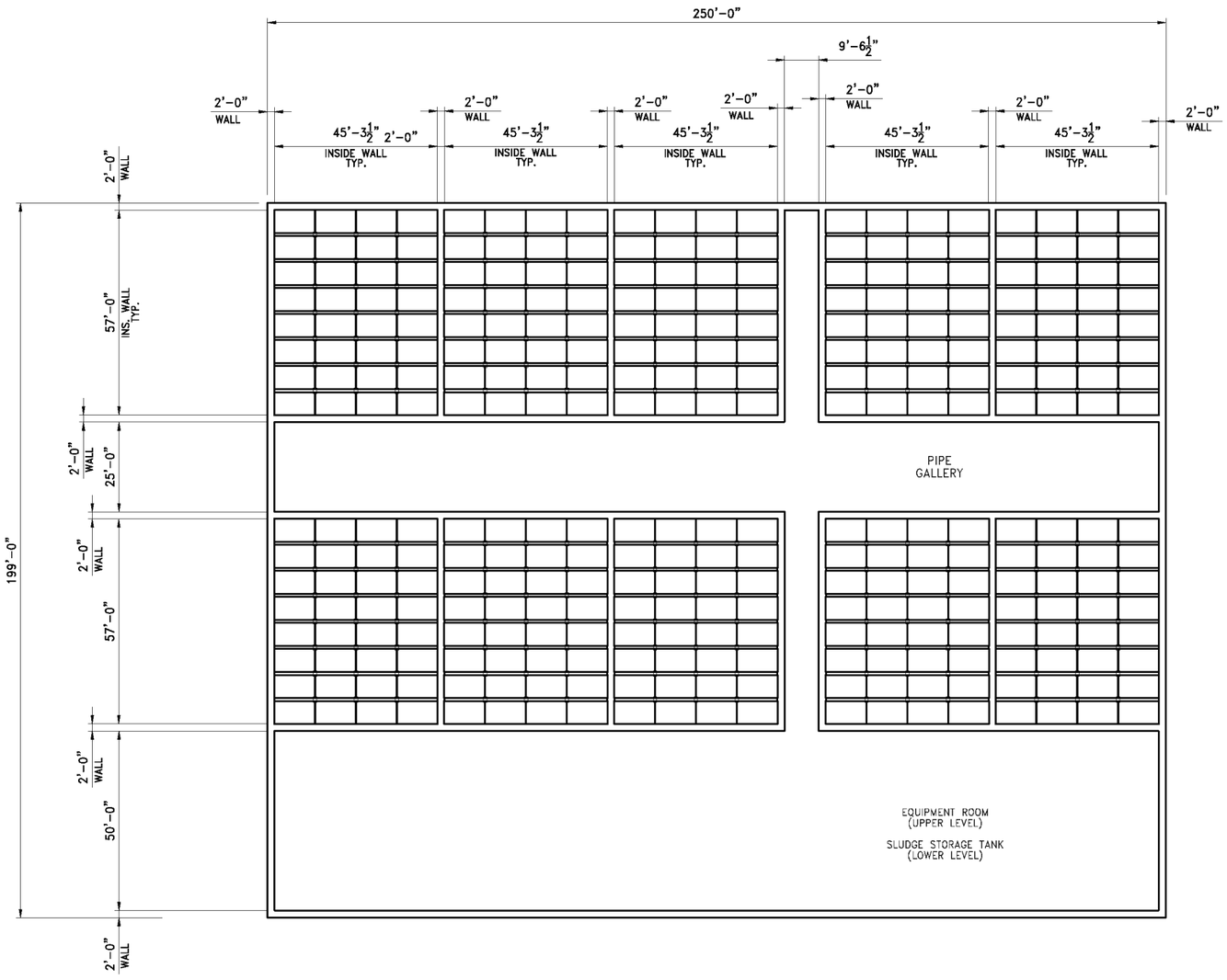
The following table summarizes the cost for the proposed BIOSTYR system. This estimate is based on our understanding of the scope of the job at this time.

	Cost
BIOSTYR System Cost	$33,000,000±20%

ATTACHMENT

PRELIMINARY LAYOUT OF FULL-SCALE PLANT





THE PRESENCE OF A PROFESSIONAL ENGINEERS SEAL ON THIS DRAWING INDICATES THAT A SIGNED AND SEALED ORIGINAL IS ON FILE.

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GRAPHICAL SCALE 0 300 600 1200 1800 3600

DESIGNER	SPR	DATE 11.19.03
CHECKER	.	DATE .
ENGINEER	.	DATE .
MANAGER	GAT	DATE 11.19.03
FILE:	.	
SCALE:	:	

TITLE
BIOSTYR PROCESS
40 – 2585 SQ. FT. CELLS
PRELIMINARY DESIGN

CLIENT
CITY OF SAN DIEGO, CA

USFilter
KRUGER PRODUCTS
401 HARRISON OAKS BLVD CARY, NC 27513
(919) 677-8310 FAX (919) 677-0082

CLASSIFICATION	PROJECT No.	DRAWING	SHEET	REV
.	42050312	385P04	1 OF 1	0

INTERNAL REF NO:

IF BAR IS NOT 1", ADJUST SCALE ACCORDINGLY

ONDEO Degrémont

Proposal No: 512-3999 **December 12, 2003**

POINT LOMA WWTP

BIOFOR™-"C"
SUBMERGED BIOLOGICAL AERATED FILTER SYSTEM

BUDGET PROPOSAL PREPARED FOR:
BROWN & CALDWELL

SUEZ

Ondeo Degremont, Inc.
PO Box 71390
Richmond, VA 23255-1390
2924 Emerywood Parkway
Richmond, VA 23294
Tel: (804) 756-7600
Fax: (804) 756-7643
info@ondeo-degremont-usa.com
www.ondeo-degremont-usa.com

December 12, 2003

Brown & Caldwell
Attn: Mr. Victor Occiano
9665 Chesapeake Drive, Suite 201
San Diego, CA 92123

Re: Point Loma WWTP
BIOFOR™ C Biological Aerated Filtration System
Inquiry No. 512-3999

Dear Mr. Occiano:

I am pleased to submit our revised proposal for a one stage BIOFOR™ biological aerated filtration system. The design described in this proposal is for 64 (64) 1612 ft^2 filters that can treat a maximum month flow of 264 MGD and a peak flow of 432 MGD. This design can meet an effluent CBOD limit of ≤ 25 mg/L and a TSS limit of ≤ 25 mg/L, both 30 day running averages. The layout of 64 filters, including clearwell and backwash tanks, can fit into the area of the existing PSB, see attached drawing.

If you have any questions regarding this budget proposal don't hesitate to contact me.

Sincerely,

Troy C. Holst
Senior Project Engineer
Biological Systems Group

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1. BIOFOR™- GENERAL DESCRIPTION

The BIOFOR is a biological, submerged filter containing a fixed, dense granular bed with influent wastewater flowing in the upward direction. The BIOFOR Process is applied individually or in separate stages for carbonaceous BOD_5 reduction (BIOFOR-"C"), nitrification (BIOFOR-"N"), and denitrification (BIOFOR-"Pre-DN", BIOFOR-"Post-DN"). In aerated systems ("C" and "N"), process air is introduced at the bottom of the media bed and flows co-currently with the influent wastewater.

The BIOFOR is based on the following basic principles:

- a single layer of granular BIOLITE media for biomass attachment and retention of suspended solids.
- a discrete process air distribution system (for aerated systems only)
- upflow, co-current distribution of air and water
- backwash sequence automated and optimized per application requirements

BIOLITE™ Media

BIOLITE media is an expanded clay material with a high specific surface area, low density, and good resistance to attrition. The porosity of the material ensures biomass attachment. Different particle sizes ranging from 1mm to 5mm are available depending on the application.

OXAZUR® Air Diffusers

OXAZUR air diffusers, present in all aerated BIOFOR units, are aerating devices with elastic rubber membranes enclosed in a polypropylene casing. The diffusers are installed on a series of process air distribution pipes located at the bottom of the media bed, directly above the plenum. The combination of diffused air and media retention produces a highly efficient aeration system with fine bubble diffusion characteristics. In order to assure homogeneous distribution over long-term operation, a pressurized cleaning water system is provided and operated approximately once per month to flush the diffusers.

Upflow Distribution of Air and Water

Distribution of process air and influent wastewater is upward through the BIOLITE media. This co-current, upward flow ensures an even distribution of water and air. It enables the media to retain solids and biomass throughout the entire bed depth and prevents short-circuiting and gas entrapment. In anoxic, denitrifying systems, nitrogen gas bubbles are continuously and effectively released from the media to atmosphere. The media operates in slight expansion, thereby ensuring full use of the available media volume and allowing high hydraulic loading rates.

MONOFLOR® Underdrain

Concrete BIOFOR installations have the distribution nozzles located in the poured-in-place filter floor. To ensure an accurate, grout-free installation, the MONOFLOR underdrain is used. This underdrain is simple to install, leak-proof, and has been widely used on filter systems for many years.

Backwash Sequence

Backwash sequences for biological aerated filters must comply with several requirements:

- The filter bed must be cleaned of retained solids and excess biomass
- Sufficient biomass must remain in the reactor following a backwash
- Air and water flows must not cause filter media to be lost
- Water and energy consumption must be minimized
- The backwash sequence must be initiated and carried out automatically.

The standard BIOFOR backwash sequence has been developed specifically to meet the requirements listed above. The backwash sequence may be optimized during start-up and can be modified based on operating experience.

The sequence may be initiated manually, on operating time, or upon reaching a pre-set terminal headloss. The main steps of the sequence are :

- quick drain to backflush the influent distribution nozzles
- air scour
- a series of simultaneous air/water washes
- water rinse

The water used for backwashing is typically BIOFOR effluent which is stored in a separate clean water tank. Backwash wastewater is normally stored in a

separate holding tank and pumped over time back to the head of the treatment plant.

2. DESIGN CONDITIONS

The Submerged Biological Filter BIOFOR™-"C" described herein is a wastewater treatment system designed for the removal of organic carbon and suspended solids.

The single-stage biofilter system will be furnished and installed as described herein. The system will have a maximum monthly average flow capacity of **264 MGD** and a peak flow (10 hour) capacity of **432 MGD,** and is based on treating municipal wastewater secondary effluent with the following characteristics:

Influent	mg/l	Given	Assumed
Biological Oxygen Demand (BOD_{5t})	116	X	
Total Suspended Solids (TSS)	52	X	
Minimum Water Temperature	21.8	X	

The single-stage BIOFOR™-"C" system described herein is designed to achieve the following effluent quality:

Effluent Requirements	Type of Running Average	mg/l
Carbonaceous Biological Oxygen Demand ($CBOD_{5t}$)	30 day	25
	7 day	40
Total Suspended Solids (TSS)	30 day	25
	7 day	40

3. BIOLOGICAL REACTORS

Ondeo Degremont, Inc. will provide **64** upflow, biological, submerged fixed-film aerobic reactors as shown on the plans; with BIOLITE™ media for biomass support. Each reactor with an effective filter surface area of **1612.54 sq.ft**.

Each reactor will consist of concrete tank with monolithic underdrain (MONOFLOR®), bottom influent and air/water backwash distribution system, process air distribution system, granular expanded clay media, influent channel, effluent and backwash waste channels with stilling baffle. Process air blowers, air distribution system, cleaning pump, air scour blowers, backwash pumps, controls and instrumentation and all associated valves and skid piping will be furnished by ODI. One flat, static screen fabricated of 316 stainless steel with 2.5 mm perforations will be provided for each pair of filters.

The media will be periodically washed by a sequence of air scour, combination air scour/backwash water, and water only rinse steps. Water used to backwash the biofilter will be pumped from a separate storage tank supplied by others. The air scour blower capacity is based on a maximum air scour rate of 4.8 scfm/sq.ft. of filter media. The backwash pump will be sized for a maximum backwash water rate of 12.2 gpm/sq.ft. of filter media.

4. SCOPE OF SUPPLY

Complete ODI Scope of Supply:

4.1. Biofilter Modules

64 - BIOFOR™ Reactors, 1612.54 ft² effective filtration area, 38.17' x 42.25' approximate inside dimensions, with internals and required wall pieces. Each reactor will include of the following:

- Equipment for MONOFLOR® underdrain including forms, polyethylene nozzles and accessories.
- 1 - Tranquilizer (stilling baffle) consisting of staggered vertical aluminum slats extending across the width of the reactor. Installation of the tranquilizer baffle is by others.
- Process air distribution system in 316 stainless steel with OXAZUR air diffusers∗

∗ The air distribution laterals, headers and downcomers are shipped to site loose for field assembly by the Contractor. Couplings, supplied by ODI are used for process air connections. The OXAZUR® air diffusers are shop installed on the laterals.

4.2. Media

1,373,630 ft³ BIOLITE-"L" media, 2.7mm, to 12.1 ft. depth in the BIOFOR reactor (includes 10% extra). BIOLITE will be shipped to site in bulk.

180,966 ft^3 Gravel, to 20" depth, in each BIOFOR unit (includes 5% extra). Gravel will be shipped to site.

4.3. Centrifugal Pumps

20 - Backwash supply pumps, horizontal centrifugal type rated for 6,594 gpm at 60' TDH (16 x 50% duty, plus 4 spares).

4 - Air distribution system cleaning pumps, horizontal centrifugal type rated for 4,946 gpm at 120' TDH.

Pumps will be skidded on a structural steel base with required piping, valves, flange fittings and accessories fully assembled.

4.4. Blowers and Appurtenances

20 - Process air blowers, rotary lobe type, rated for 3,350 scfm at 11.5 psig (16 x 50% duty, plus 4 spares).

12 - Air scour blowers, rotary lobe type, rated for 8,626 scfm at 10.5 psig (8 x 50% duty, plus 4 spares).

Each blower provided with:

- Motor
- V-belt drive
- Inlet filter/silencer and outlet silencer
- check valve
- manual valve for outlet isolation
- relief valve
- flexible connections
- discharge pressure gauge
- acoustic enclosure, to meet 85 dBA free field noise requirements.

Blowers shipped to site skidded on separate structural steel bases, assembled with piping, silencers, valves and fittings.

An automatic by-pass flow control valve is included with each air scour blower.

4.5. Compressed Air for Automatic Valves

4 - Compressed Air System, comprising:

- 1 - dual-head reciprocating type compressor rated for 7.5 scfm at 100 psig
- 1 - standby head
- 1 - 80 gallon carbon steel receiver
- Air dryer
- Required relief, exit, and blowdown valves
- pressure gauges

System shipped to site pre-piped and skidded on a structural steel base.

Pneumatic tubing, valves, and appurtenances for air feed to automatic valves is by others.

4.6. Automatic and Manual Valves

Lot automatic valves including:

64 - 18" diameter influent open/close
8 - 36" diameter backwash water inlet flow control
64 - 36" diameter backwash water inlet open/close
64 - 20" diameter backwash air inlet open/close
64 - 14" diameter process air inlet open/close
64 - 4" diameter air cushion vent open/close
64 - 42" diameter backwash waste open/close
64 - 30" diameter quick drain open/close

All automatic valves are butterfly type equipped with double-acting pneumatic cylinder actuators. Solenoids are mounted directly on actuators. Positioners are pneumatic. Valves include open and close limit switches.

4.7. Strainers

8- Backwash inlet strainer in-line Y type, 36" diameter, 2 mm stainless steel mesh, carbon steel body with flanged ends.

8- Air distributor cleaning header strainer, in-line Y type, 12" diameter, 2 mm stainless steel mesh, carbon steel body with flanged ends.

4.8. Miscellaneous Equipment

Lot - bolts, gaskets, etc., associated with equipment within ODI's Scope.

4.9. Controls and Instrumentation

1 -PLC/PC control system, mounted in a free-standing NEMA 12 enclosure.

Lot -Field instruments including:

- 64 - level transmitters, ultrasonic-type
- 64- pressure transmitters (cell pressure)
- 64 - pressure transmitters (plenum pressure)
- 1 - inlet flow meter/transmitter, magnetic type
- 8 - backwash flow meter/transmitter, 24" diameter, magnetic type
- 8 - air scour flow meter/transmitter, thermal mass type for 16" line
- 64 - process air flow meter/transmitters, thermal mass type for 6" line
- 16 - differential pressure gauges across strainers
- 6 - pH/temperature sensors/transmitters, in inlet and outlet channels
- Lot - pressure gauges, local indication only

4.10. Field Service

15 - days total service time by a qualified, factory-trained service engineer to inspect the BIOFOR equipment installation, provide start-up assistance and training of operations personnel.

5. BUDGET PRICING

The budget price for the equipment and services described above is **$19,120,000**. This price will be valid for one (1) year; payment terms will be as below, and commercial terms and conditions are given on the following page. The price is in accordance with the Scope of Supply and terms of this proposal and any changes may require the price to be adjusted.

Payment Terms:

10% Net Cash, Payable in thirty (30) days from date of submittal of initial drawings for approval;

85% Net Cash, Payable in progress payments thirty (30) days from dates of respective shipments of the Products;

5% Net Cash, Payable in thirty (30) days from Product installation and acceptance or Ninety (90) days after date of final Product delivery, whichever occurs first.

6. TERMS & CONDITIONS

1. TERMS AND CONDITIONS OF SALE. The Terms and Conditions of Sale set forth herein, and any supplements which may be attached hereto, constitute the full and final expression of the contract for the sale of products or services (hereinafter referred to as Products or Services) to Purchaser, and supersedes all prior quotations, purchase orders, correspondence or communications whether written or oral between the Purchaser and Ondeo. Notwithstanding any contrary language in Purchaser's purchase order, correspondence or other form of acknowledgement, Purchaser shall be bound by these Terms and Conditions when it sends a purchase order or otherwise indicates acceptance of this Contract, or when it accepts delivery from Ondeo of the Products or Services. The contract for sale of the Products and Services is expressly limited to the terms and conditions of sale stated herein. Any additional or different terms proposed by Purchaser are rejected, unless expressly agreed to in writing by Ondeo. No contract shall exist except as herein provided.

2. COMPLETE AGREEMENT. No amendment or modification hereto nor any statement, representation or warranty not contained herein shall be binding on Ondeo unless made in writing by an authorized representative of Ondeo. Prior dealings, usage of the trade or a course of performance shall not be relevant to determine the meaning of this Contract even though the accepting or acquiescing party had knowledge of the nature of the performance and the opportunity for objection.

3. ADEQUATE ASSURANCES. If, in the judgment of Ondeo, the financial condition of the Purchaser, at any time during the period of the contract, does not justify the terms of payment specified, Ondeo may require full or partial payment in advance, or an acceptable form of payment guarantee such as a bank letter of credit, or other modifications to the terms of payment.

4. DELAYED PAYMENT. If payment are not made in accordance with the terms contained herein, a service charge may, without prejudice to the right of Ondeo to immediate payment, be added in an amount equal to the lower of 1.5% per month or fraction thereof or the highest legal rate on the unpaid balance.

5. TAXES. The Purchase Price does not include any taxes. Purchaser shall be responsible for the payment of all taxes applicable to, or arising from the transaction, the Products, its sale, value or use, or any Services performed in connection therewith regardless of the person or entity actually taxed.

6. RISK OF LOSS. Risk of loss or damage to the Products, or any part thereof, shall pass to Purchaser upon delivery of the Products or part to Purchaser at the f.o.b. point stated herein.

7. EXCUSABLE DELAY. Ondeo shall not be liable for any delay in performance or failure to perform due to fire, flood or any other act of God, strike or other labor difficulty, act of any civil or military authority or of Purchaser, Engineer, or Owner, insurrection, riot, embargo, unavailability or delays in transportation or car shortages, or any other cause beyond Ondeo's reasonable control. In the event Ondeo's performance is delayed by any of the foregoing causes, Ondeo's schedule for performance shall be extended accordingly without penalty. If Purchaser's, Engineer's or Owner's actions delay Ondeo's performance, Purchaser shall pay Ondeo any additional costs incurred by Ondeo resulting from such delay. If Purchaser or Owner orders Ondeo to delay shipment of Products, or any part thereof, or by other actions refuses to permit Ondeo to deliver Products, or any part thereof, to Owner's Premises, in addition to paying Ondeo for costs of storage and insurance, Purchaser shall also pay Ondeo's invoice for such stored Products, or any part thereof, as if they had been delivered to Owner's Premises on the date such Products, or any part thereof, were produced and ready for shipment.

8. PROPRIETARY INFORMATION. All information, plans, drawings, tracings, specifications, programs, reports, models, mock-ups, designs, calculations, schedules, technical information, data, manuals, proposals, CADD documents and other materials, including those in electronic form (collectively the "Documents") prepared and furnished by Ondeo are Instruments of Service for use solely with respect to this Project. Ondeo shall be deemed the author and owner of these Instruments of Service and shall retain all common law, statutory and other reserved rights, including copyrights. The Purchaser, Engineer, or Owner shall not use these Instruments of Service for future additions or alterations to this Project or for other projects, without the prior written agreement by the Ondeo. The Documents furnished by Ondeo are proprietary to Ondeo, submitted in strict confidence and shall not be reproduced, transmitted, disclosed or used in any other manner without Ondeo's written authorization.

9. INSPECTION BY PURCHASER. Purchaser may inspect the Products at the point of manufacture, provided that such inspection is arranged and conducted so as not to unreasonably interfere with Ondeo's or the manufacturer's operations. Purchaser's inspection of the Products and release for shipment shall constitute Purchaser's acceptance of the Products as conforming to the requirements of this Contract.

10. WARRANTY OF TITLE. Ondeo warrants and guarantees that title to all Products covered by any invoice submitted to Purchaser, whether incorporated into the Project or not, will pass to Purchaser no later than the time of payment free and clear of all Liens. This paragraph does not apply to any Documents covered by paragraphs above entitled "Proprietary Information."

11. WARRANTY. Ondeo warrants the Products shall conform to the description contained herein and be free from defects in material and workmanship for a period of one (1) year from date the Products are initially placed in operation or eighteen (18) months from date the Products are shipped, whichever occurs first. Upon Ondeo's receipt of written notice within thirty (30) days of discovery of any defect, and a determination by Ondeo that such defect is covered under the foregoing warranty, Ondeo's responsibility is limited to correction of the defect by, at Ondeo's option, repair or replacement of the defective part or parts, f.o.b. factory. This warranty does not cover failure or damage due to storage, installation, operation or maintenance not in conformance with Ondeo's written instructions and requirements or due to accident, misuse, abuse, neglect or corrosion. This warranty does not cover reimbursement for labor, gaining access, removal, installation, temporary power or any other expenses that may be incurred with repair or replacement. This warranty does not apply to equipment not manufactured by Ondeo. Ondeo limits itself to extending the same warranty it receives from the supplier. Ondeo shall have no responsibility for the condition of primed or finish painted surfaces after the Products leave their point of manufacture. Field touch-up of shop primed or painted surfaces are normal and shall be at Purchaser or Owner's expense. Any touch-up or repainting required to shop primed or painted surfaces, for reasons other than improper or incorrect application in the shop, shall be Purchaser or Owner's responsibility. UNLESS STATED ELSEWHERE HEREIN, ONDEO PROVIDES NO WARRANTY OF PRODUCT PERFORMANCE OR PROCESS RESULTS. THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. CORRECTION OF NON-CONFORMITIES IN THE MANNER AND FOR THE PERIOD OF TIME PROIVDED ABOVE SHALL

CONSTITUTE ONDEO'S SOLE LIABILITY AND PURCHASER'S EXCLUSIVE REMEDY FOR FAILURE OF ONDEO TO MEET ITS WARRANTY OBLIGATIONS, WHETHER CLAIMS OF PURCHASER ARE BASED IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE OR STRICT LIABILITY) OR OTHERWISE.

12. BACKCHARGES. Ondeo shall not be liable for any charges incurred by Purchaser for work, repairs, replacements or alterations to the Products, without Ondeo's prior written authorization, and any adverse consequences resulting from such unauthorized work shall be Purchaser's full responsibility.

13. LIQUIDATED DAMAGES. Contracts which include liquidated damages clause for failure to meet shipping or job completion promises are not acceptable or binding upon Ondeo, unless such clauses are specifically accepted in writing by an authorized representative of Ondeo at its headquarters office.

14. LIMITATION OF LIABILITY. THE REMEDIES OF THE PURCHASER SET FORTH IN THIS CONTRACT ARE EXCLUSIVE AND ARE ITS SOLE REMEDIES FOR FAILURE OF ONDEO TO COMPLY WITH ITS OBLIGATIONS HEREUNDER. Notwithstanding any provision in this Contract to the contrary, in no event shall Ondeo be liable for any special, incidental, indirect, statutory, exemplary, punitive or consequential damages, of any kind whatsoever, or for any lost profits, business or revenue, loss of use or goodwill, or other lost economic advantage, arising out of or related to or arising from Ondeo's obligations under this Contract or the breach hereof, whether such claims are based on breach of contract, breach of warranty, strict liability, tort, any federal or state statutory claim, or any other legal theory and even if Ondeo knew, should have known, or has been advised of the possibility of such damages. THE TOTAL CUMULATIVE LIABILITY OF ONDEO ARISING FROM OR RELATED TO THIS CONTRACT SHALL NOT EXCEED THE PRICE OF THE PRODUCT OR SERVICES ON WHICH SUCH LIABILITY IS BASED. In no circumstance will any liability under any portion of this Contract or associated contracts exceed the total Purchase Price. In the event that more than one claim is substantiated, the aggregate amount of all claims combined will not exceed the total Purchase Price. The limitation specified in this section shall survive and apply even if any limited remedy specified herein is determined to have failed of its essential purpose.

15. CANCELLATION BY PURCHASER. If Purchaser cancels this Contract or refuses to accept delivery of the Products, Purchaser shall be liable to Ondeo for reasonable cancellation charges, including loss of anticipated profits, administrative costs, commissions to sales representatives, costs incurred by Ondeo for all work performed or in process up to the time of cancellation or refusal to accept delivery, cancellation charges from Ondeo's suppliers or subcontractors, and any other expenses incurred by Ondeo in connection with Purchaser's cancellation or refusal to accept delivery.

16. DEFAULT BY PURCHASER. Without incurring any liability or waiving any claim for damages Ondeo may have against Purchaser, Ondeo may refuse to make or delay making delivery and/or withhold any service if: (a) Ondeo becomes aware of facts which, in its judgment, render Purchaser's financial condition unsatisfactory or cast doubt on Purchaser's willingness or ability to pay for the Products and/or services; (b) the Purchaser becomes insolvent, (c) the Purchaser has a petition under any chapter of the bankruptcy laws filed by or against it, (d) the Purchaser makes a general assignment for the benefit of its creditors, (e) the Purchaser has a receiver requested for or appointed for it, (f) the Purchaser fails to comply with any of its material obligations under its Contract with Ondeo, its contract with Owner or any other contract with Ondeo, or (g) the Purchaser should fail to make prompt payment to Ondeo in accordance with the terms of this Contract, then Ondeo may, after first giving Purchaser ten (10) days written notice to cure such default, if Purchaser fails to cure or initiate satisfactory cure during such ten-day period, either (i) stop all work until such default has been cured and recover from Purchaser all reasonable costs and expenses incurred by Ondeo resulting from Purchaser's default or (ii) terminate this Contract and recover from Purchaser as cancellation charges all costs and expenses incurred by Ondeo up to time of and in connection with such termination including reasonable allowance for Ondeo's overhead, administration expenses and profits, such reasonable allowance to be based on prevailing industry practice. If Purchaser is late in paying the Purchase Price or any partial payment due under this Contract, or otherwise breaches this Contract, Ondeo shall be entitled to the maximum interest rate allowed by law on the overdue amount, and on its damages, calculated from the date of default in payment or other breach, plus court costs, reasonable attorneys' fees and other expenses incurred in any effort to collect.

17. DEFAULT BY Ondeo. In the event of any default by Ondeo and prior to Purchaser terminating the work for default, Purchaser shall give fourteen (14) days written notice of default to Ondeo. Ondeo shall remedy the default to the reasonable satisfaction of the Purchaser within fourteen (14) days of receipt of such written notice or, if such default cannot reasonable be remedied within such fourteen (14) day period, Ondeo shall promptly begin to remedy the default within the fourteen (14) day period and thereafter diligently prosecute to conclusion all acts necessary to remedy the default, in which event such default shall be deemed to be remedied.

18. PATENT AND COPYRIGHT INFRINGEMENT.
Ondeo shall defend any action or proceeding brought against Purchaser based on any claim that the Products, or any part thereof, or the operation or use of the Products or any part thereof, constitutes infringement of any United States patent or copyright, now or hereafter issued. Purchaser shall give prompt written notice to Ondeo of any such action or proceeding and will reasonably provide authority, information and assistance (at Purchaser's expense) in the defense of same. Ondeo shall indemnify and hold harmless Purchaser from and against all damages and costs, including but not limited to attorneys' fees and expenses awarded against Purchaser or Ondeo in any such action or proceeding. Ondeo agrees to keep Purchaser informed of all developments in the defense of such actions.
If Purchaser is enjoined from the operation or use of the Products, or any part thereof, as the result of any patent or copyright suit, claim, or proceeding, Ondeo shall at its sole expense take reasonable steps to procure the right to operate or use the Products. If Ondeo cannot so procure such right within a reasonable time, Ondeo shall promptly, at Ondeo's option and at Ondeo's expense, (i) modify the Products so as to avoid infringement of any such patent or copyright, (ii) replace said Products with Products that do not infringe or violate any such patent or copyright, or (iii) as a last resort, remove the Products and refund the purchase price. In no case does Ondeo agree to pay any recovery based upon its Purchaser's savings or profit through use of Ondeo's Products whether the use be special or ordinary. The foregoing states the entire liability of Ondeo for patent or copyright infringement.
Paragraphs (a) and (b) above shall not be applicable to any suit, claim or proceeding based on infringement or violation of a patent or copyright (i) arising out of the use of Ondeo's Products in combination with non-Ondeo recommended Products; (ii) relating solely to a particular process or product of a particular manufacturer specified by Purchaser, Engineer or Owner and not offered or recommended by Ondeo to Purchaser, Engineer, or Owner or (iii) arising from modifications to the Products by Purchaser or Owner or its agents after acceptance of the Products. If the suit, claim or proceeding is based upon events set forth in the preceding sentence, Purchaser, Engineer or Owner shall defend, indemnify and hold harmless Ondeo to the same extent Ondeo is obligated to defend, indemnify and hold harmless Purchaser in Paragraph (a) above.

19. DISPUTE AVOIDANCE AND RESOLUTION. The parties are fully committed to working with each other and agree to communicate regularly with each other at all times so as to avoid or minimize disputes or disagreements. If disputes or disagreements do arise, Ondeo and Purchaser commit to resolving such disputes or disagreements in an amicable, professional and expeditious manner so as to avoid

unnecessary losses, delays and disruptions to the work. Ondeo and Purchaser will first attempt to resolve disputes or disagreements at the field level through discussions between Ondeo's Representative and Purchaser's Representative. If a dispute or disagreement cannot be resolved through Ondeo's Representative and Purchaser's Representative, upon the request of either party, Ondeo's Senior Representative and Purchaser's Senior Representative shall meet as soon as conveniently possible, but in no case later than thirty (30) days after such a request is made, to attempt to resolve such dispute or disagreement. Prior to any meetings between the Senior Representatives, the parties will exchange relevant information that will assist the parties in resolving their dispute or disagreement. If after meeting the Senior Representatives determine that the dispute or disagreement cannot be resolved on terms satisfactory to both parties, the parties shall submit the dispute or disagreement to non-binding mediation. The mediation shall be conducted by a mutually agreeable impartial mediator, or if the parties cannot so agree, a mediator designated by the American Arbitration Association ("AAA") pursuant to its Construction Industry Mediation Rules. The mediation will be governed by and conducted pursuant to a mediation agreement negotiated by the parties or, if the parties cannot so agree, by procedures established by the mediator. For purposes of any Process Performance Guarantee, the above procedures shall also apply for any dispute with the Owner.

20. ARBITRATION. Any claims, disputes or controversies between the parties arising out of or relating to this Contract, or the breach thereof, which have not been resolved in accordance with the Dispute Avoidance and Resolution procedures contained herein shall be decided by arbitration in accordance with the Construction Industry Arbitration Rules of the AAA then in effect, unless the parties mutually agree otherwise. The award of the arbitrator(s) shall be final and binding upon the parties without the right of appeal to the courts. Judgement may be entered upon it in accordance with applicable law by any court having jurisdiction thereof. Ondeo and Purchaser expressly agree that any arbitration pursuant to this provision may be joined or consolidated with any arbitration involving any other person or entity (i) necessary to resolve the claim, dispute or controversy, or (ii) substantially involved in or affected by such claim, dispute or controversy. Both Ondeo and Purchaser will include appropriate provisions in all contracts they execute with other parties in connection with the Project to require such joinder or consolidation. The prevailing party in any arbitration, or any other final, binding dispute proceeding upon which the parties may agree, shall be entitled to recover from the other party reasonable attorneys' fees and expenses incurred by the prevailing party. For purposes of any Process Performance Guarantee, the above procedures shall also apply to the Owner.

21. NOTICES. Unless otherwise provided, any notices to be given hereunder shall be given in writing and shall be deemed effectively given (i) upon personal delivery to the party to be notified, (ii) on confirmation of receipt by fax by the party to be notified, (iii) one business day after deposit with a reputable overnight courier, prepaid for overnight delivery and addressed as set forth below, or (iv) three days after deposit with the U.S Post Office, postage prepaid, registered or certified, with return receipt requested.

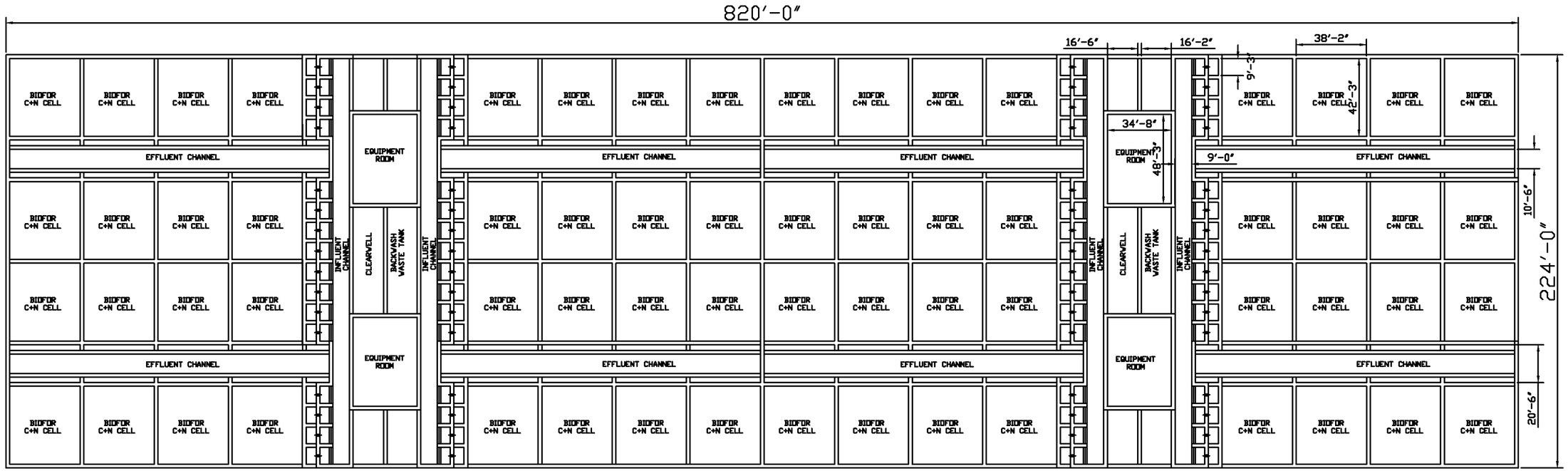
22. SUCCESSORSHIP. Ondeo and Purchaser intend that the provisions of this Contract are binding upon the parties, their employees, agents, heirs, successors and assigns.

23. ASSIGNMENT. Neither Ondeo nor Purchaser may assign this Contract without the prior written consent of the other party, which consent shall not be unreasonably withheld or delayed. Any prohibited assignment shall be null and void.

24. SEVERABILITY. If any term, condition or provision of this Contract or the application thereof to any party or circumstance shall at any time or to any extent be invalid or unenforceable, then the remainder of this Contract, or the application of such term, condition or provision to parties or circumstances other than those which it is held invalid or unenforceable, shall not be affected thereby, and each term, condition and provision of this Contract shall be valid and enforceable to the fullest extent permitted by law.

25. GOVERNING LAW; JURISDICTION. This Contract shall be governed by, interpreted and enforced in accordance with the laws of the Commonwealth of Virginia, without regard to conflicts of law principles. Each party irrevocably consents to the exclusive jurisdiction of the courts of the Commonwealth of Virginia and the federal courts situated in the Commonwealth of Virginia, in connection with any action to enforce the provisions of this Agreement, to recover damages or other relief for breach or default under this Contract, or otherwise arising under or by reason of this Contract.

26. NO WAIVER. The failure of either party to insist upon or enforce strict performance by the other party of any provision of this Contract or to exercise any right under this Contract shall not be construed as a waiver or relinquishment to any extent of such party's right to assert or rely upon any such provision or right in that or any other instance; rather, the same shall be and remain in full force and effect.



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REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE

REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE
-	ORIGINAL ISSUE				mm/yy

PROJECT INFORMATION

POINT LOMA WWTP
CITY OF SAN DIEGO, CA
ODI PROPOSAL # 512-3999

ONDEO Degremont, Inc.
Post Office Box 71390
Richmond, Virginia 23255-1390
PH: (800) 446-1150

ONDEO Degrémont

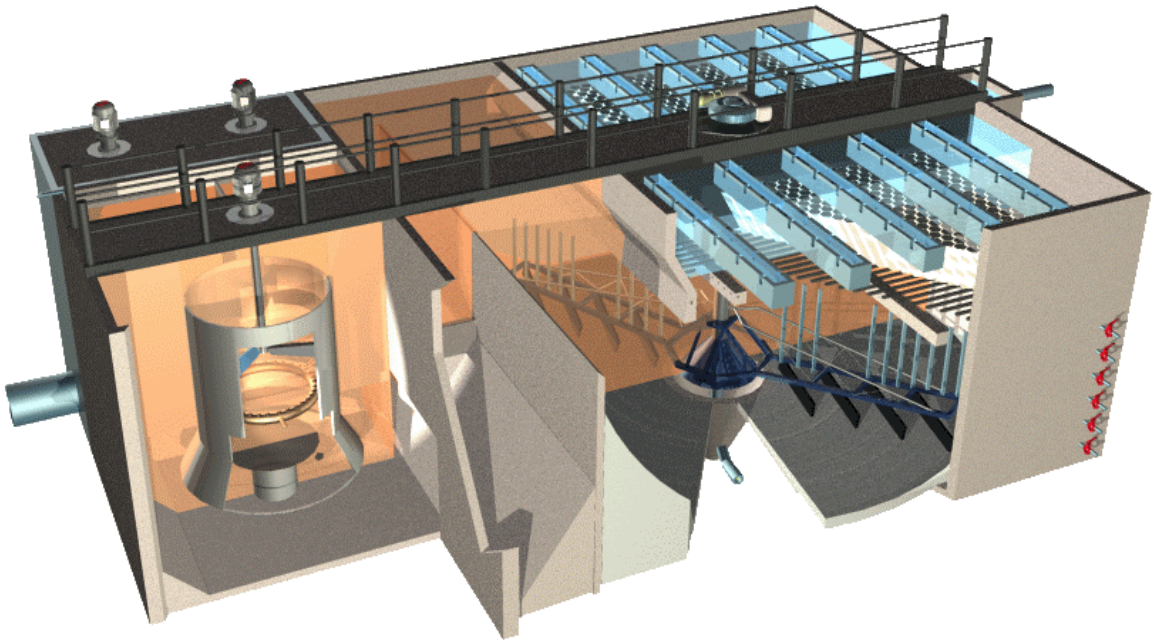
	BY	DATE
DRAWN	SMM	11/03
CHECKED	SMM	11/03
APP	TCH	11/03
REF.		
DO NOT SCALE		
SCALE NONE		

POINT LOMA WWTF
295 MGD MAX MONTH, 432 MGD PEAK
BIOFOR C-CELL LAYOUT

SIZE D | DWG. NO. 512-3999-003 | REV. -

Point Loma Wastewater Treatment Plant
Budget Proposal

DensaDeg®
High-Rate Clarifier/Thickener



ATTENTION: Mr. Joshua Newman
ENGINEER: Brown & Caldwell
DATE: April 9, 2003

ONDEO Degrémont

SUEZ

Ondeo Degremont, Inc.

PO Box 71390
Richmond, VA 23255-1390

2924 Emerywood Parkway
Richmond, VA 23294

Tel: (804) 756-7600
Fax: (804) 756-7643
info@ondeo-degremont-usa.com
www.ondeo-degremont-usa.com

April 9, 2003

Attn: Mr. Joshua Newman
Brown & Caldwell

Re: DensaDeg Budget Proposal
Proposal No. 512-3999

Dear Joshua:

In accordance with your recent request through our local sales representative, we are pleased to submit our preliminary DensaDeg proposal for the following treatment options:

- ✓ Primary Clarification - Twelve (12) 20-MGD clarifier units with auxiliaries
- ✓ Biofor Backwash Recovery - Two (2) 20-MGD clarifier units with auxiliaries

The DensaDeg is capable of thickening sludge at a 3-6% solids concentration by weight based on operating parameters. The Densadeg has the advantage of storing and thickening sludge to levels ready for dewatering processes without requiring additional thickening stages. Sludge wasting is typically on the order of hours rather than minutes. Other conventional and high rate ballasted systems produce on average 6-10 times (0.5% solids concentration) the sludge volumes.

We have endeavored to provide complete information here, but if you have any questions or do need additional information, please don't hesitate to contact our representative listed below or the writer. We look forward to further discussions with you concerning this project.

Sincerely,

Ryan J. Hess
Applications Engineer
ODI - Separations Group

TABLE OF CONTENTS

1. ABOUT ONDEO DEGREMONT, INC.

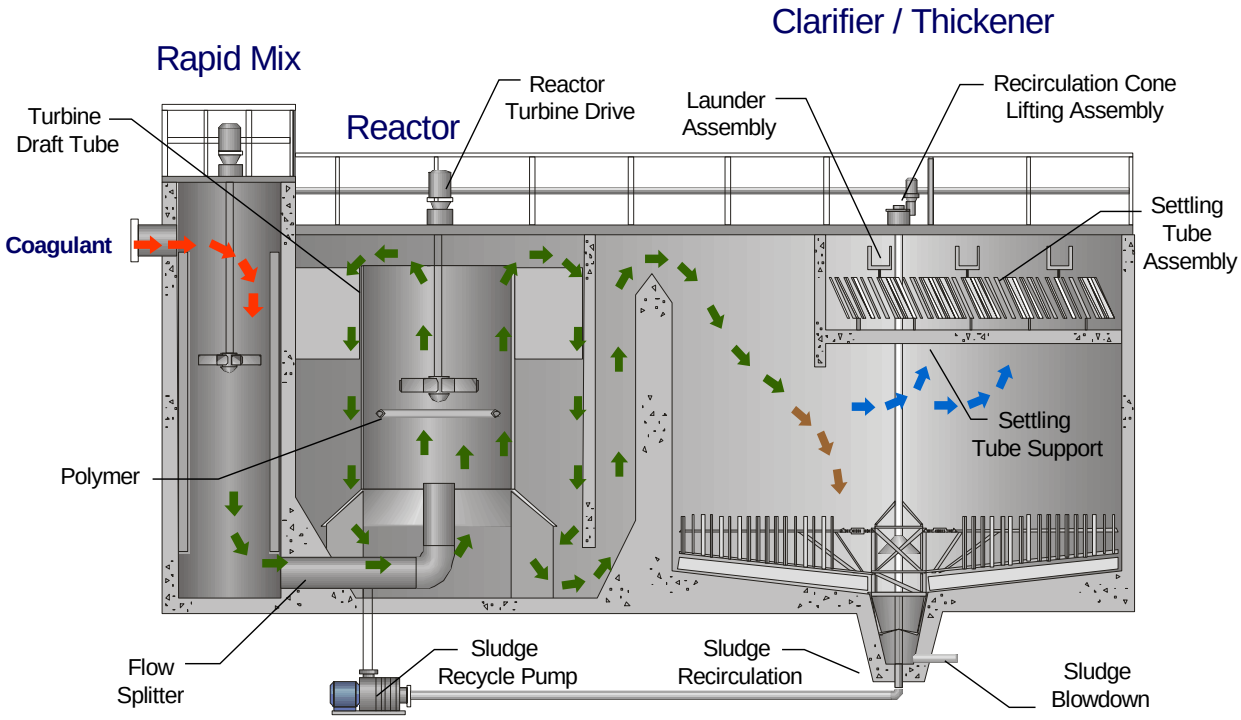
Since our start in 1894 as the International Filter Company, Ondeo Degremont, Inc. (ODI) has set the pace in water and wastewater treatment solutions. We provide equipment, systems and services that form integrated treatment solutions.

ODI is the U.S. affiliate of worldwide Ondeo Degremont, the leading specialist in water treatment plants and is present in more than 70 countries with over 3,000 employees.

Ondeo Degremont is a subsidiary of Ondeo, the water division of SUEZ. Other Ondeo subsidiaries are Ondeo Nalco, water chemical specialists; Ondeo Services, water management specialists; and Ondeo Industrial Solutions, industrial specialists. Listed on the New York Stock Exchange, SUEZ is a global services group with energy, water, and waste services businesses.

2. DENSADEG® PROCESS DESCRIPTION

Raw water enters the system and is chemically altered for coagulation in a rapid mix tank. The water is then transferred into the reaction zone and introduced through the base of the reactor basin and discharged beneath an axial flow impeller. Inside this draft tube, polymer is injected through a distribution ring to aid in the flocculation and settleability of the coagulated particles. Recycled solids are introduced in the inlet pipe to the reactor to aid in flocculation. The movement of the impeller provides sufficient energy for the mixing of the chemicals and raw water. It additionally acts as an axial flow pump by drawing previously formed solids, which settle external to the flume, into the base of the flume. This internal recycling of previously formed solids enhances the solids contact process and increases the speed of the reactions.



Next, the densely structured precipitate is transitioned from the reactor basin through a piston flocculation zone to the clarification and thickening zone. As the water flows under the baffle and upwards into the tubes, the solids downward momentum carries them to the bottom of the thickener basin. Here the solids are allowed to thicken with the aid of a slowly rotating scraper mechanism that pushes the sludge into a sludge hopper located at the bottom of the clarifier/thickener basin. This thickened sludge is periodically discharged from the hopper.

A part of the sludge inventory is recycled back to the reactor basin, thereby increasing the solids in the reactor and improving the performance of the process. Clarified water proceeds beneath the aforementioned baffle into the clarification zone. Additional solids removal is achieved by the use of tubes incorporated into the top of the clarification zone. Moving through the tubes, finished water is collected through a series of launders or laterals which discharge treated water into the effluent trough.

3. DENSADEG DESIGN BRIEF

SIZING CRITERIA

Application ..... Primary Clarification
Densadeg Model SL-118
Design Flow ..... 240 MGD
Number of Units ..... 12 N
Design Flow per Unit ..... 20 MGD
Design Loading Rate (over settling tubes) ..... 10.9 gpm/sq.ft

Application ..... Biofor Backwash Recovery
Densadeg Model SL-118
Design Flow ..... 40 MGD
Number of Units ..... 2 N
Design Flow per Unit ..... 20 MGD
Design Loading Rate (over settling tubes) ..... 10.9 gpm/sq.ft

OPERATION

Estimated Primary Power Consumption* ..... kW*hr/day

Equipment	HP	KW	Connected	Duty	Runtime/day	KW-hr/d
Rapid Mixer	15.0	11.19	12	12	24	3221
Reactor drive	25.0	18.64	12	12	24	5369
Scraper drive	3.0	2.24	12	12	24	644
Recycle pumps	30.0	22.37	18	12	24	6443
					Total Power Consumption	**15,678**

Estimated Backwash Power Consumption* ..... kW*hr/day

Equipment	HP	KW	Connected	Duty	Runtime/day	KW-hr/d
Rapid Mixer	15.0	11.19	2	2	24	537
Reactor drive	25.0	18.64	2	2	24	895
Scraper drive	3.0	2.24	2	2	24	107
Recycle pumps	30.0	22.37	3	2	24	1074
					Total Power Consumption	**2,613**

INSTALLATION

Estimated Concrete - Primary (DDeg & slabs)* ..... 5,500 cubic yards
Estimate Concrete - Backwash (DDeg & slabs)*..... 900 cubic yards

*Estimates are based on previously executed projects or preliminary data and are provided as a courtesy and are for estimating purposes only. Actual quantities may vary.

4. STANDARD SCOPE OF SUPPLY

The following will be provided for **EACH** Densadeg unit.

REACTOR

1. One (1) inner draft tube assembly - Shall be sized to promote proper recirculation and flocculation, is suspended within the walls. The draft tube and all other internal components, baffles, etc., shall be 3/16" thick carbon steel.

2. One (1) reactor turbine - Shall be provided to produce mixing, precipitation, and recirculation of solids drives the axial flow turbine. The motor shall be a minimum of 25-hp, TEFC, 230-460/60/3, severe duty. A VFD shall be provided. The turbine consists of curved blades especially designed to result in a high-efficiency, low-shear pump and is provided with a variable speed drive.

3. One (1) Sch. 80 polymer distribution ring.

4. All necessary 304 SS anchor bolts associated with the draft tube assembly.

5. Paint - The reactor components shall receive a SP-6 shop blast and one coat of Shop Primer prior to shipment to the jobsite. Finish painting shall be as specified by the Owner and is the responsibility of the Contractor.

CLARIFIER/THICKENER

6. One (1) scraper mechanism - Shall consist of a torque tube with collector arms. A center scraper shall extend below the torque tube into the sludge hopper. The collector arms and center scraper shall be fabricated of carbon steel.

7. One (1) scraper drive - The drive shall be a mechanical variable speed. The motor shall be minimum 3-hp, TEFC, 230-460/60/3, severe duty. A torque overload device and visual torque indicator gauge shall be furnished with the drive.

8. Tube settling modules - 2'-0" high settling tubes, including supports. The tubes shall be fabricated from ABS or polystyrene sheets and vacuum-formed to give a corrugated cross section. Other tube setting components shall be fabricated from carbon steel.

9. Effluent collection troughs - V-notch weir type collection laterals shall be sized and provided for effluent water collection above the tube settling. Additionally, a center outlet trough will be provided. The troughs shall be fabricated from fiberglass (FRP).

10. Sampling system - The clarifier basin is supplied with a sludge sampling system; taps, valves, piping (within the basin), and sink. A drawdown nozzle shall also be provided.

11. All necessary 304 SS anchor bolts, u-bolts, and hardware associated with the clarifier/thickener components.

12. Paint - The clarifier-thickener components shall receive a SP-6 blast, one coat of shop primer prior to shipment to site.

PUMPS

13. A total of eighteen (18) recycle pumps - Twelve (12) duty and six (6) spare progressive cavity pumps shall be furnished per unit to recycle preformed solids from the clarifier-thickener basin to the reactor inlet. The motor shall be a minimum 30-hp, TEFC, 230-460/60/3, severe duty. The pump shall be capable of recirculating a minimum of 694 gpm at 30-feet of head.

14. One (1) Sludge Discharge Pump - A progressive cavity pump shall be furnished to remove the thickened sludge from the clarifier thickener basin. The capacity of the pump shall be adequate to provide proper removal of the thickened sludge.

15. The recycle pump operation is to occur in conjunction with the sludge draw-off system furnished with the clarifier-thickener. The actual rate of recycle shall be determined during start-up testing. The capacity of the pumps herein proposed shall be adequate to provide a range of operation within which a desired recycle rate may be established.

16. The pumps shall be skid mounted and complete with suction/discharge piping and pressure gauge. All piping external to skid is by others.

VALVES

17. One (1) 6-inch diameter plug valve shall be furnished for attachment to the sludge blowdown piping. Valve body construction shall conform to General Service standards with pneumatic actuation designed for open/close service.

CONTROL PANEL

18. There shall be furnished one (1) control panel with a NEMA IV enclosure. The control panel shall contain all integrators, programmers, timers, function relays, counters, indicator lights, selector switches, wiring, etc., required to operate the treatment unit.

WALKWAYS

19. A 36"-wide (minimum) walkway and support bridge shall be fabricated of carbon steel to span the reactor and clarifier thickener basins. Aluminum handrails (1-1/2") and kickplates (4") are included. The platform shall expand at the reactor basin and thickener drive units.

SERVICE

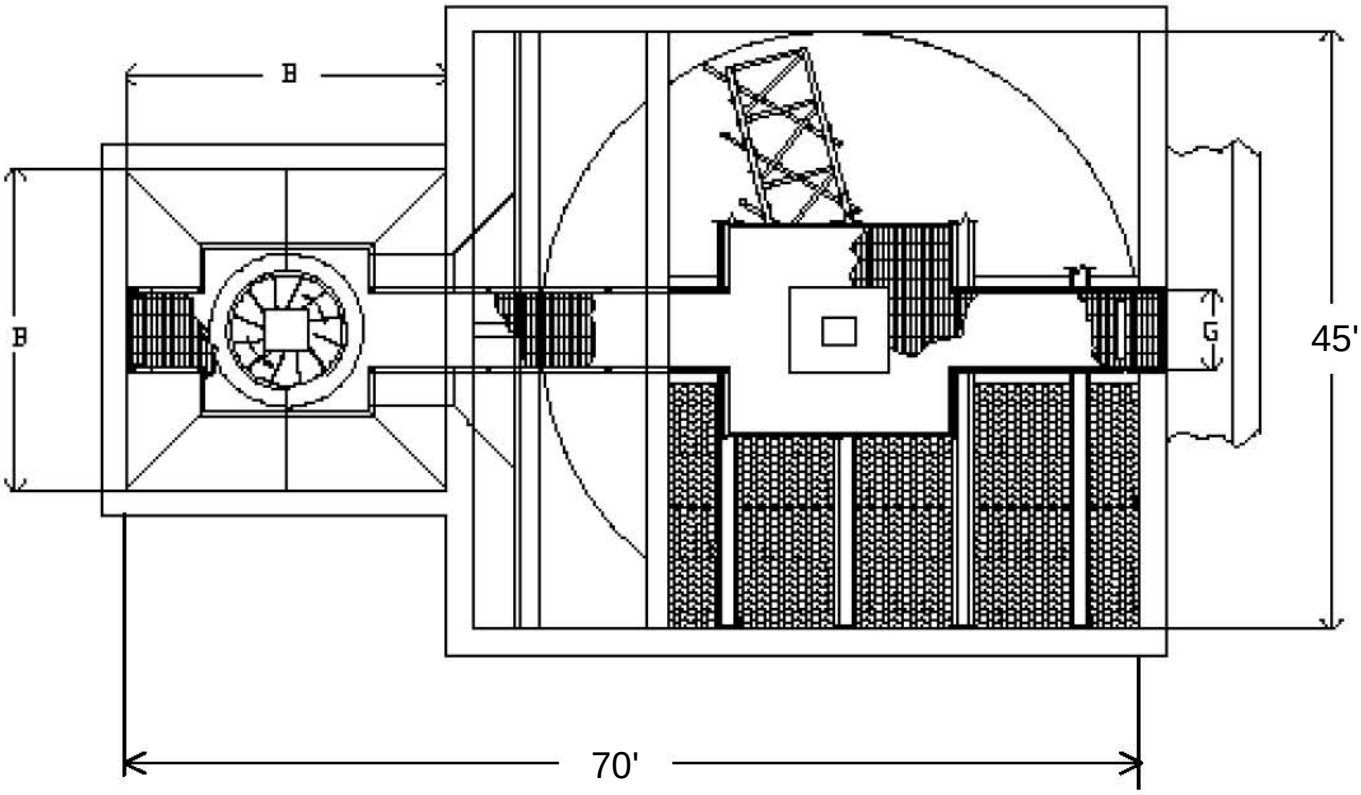
20. Ten (10) days of service - Shall be supplied for construction inspections, start-up and performance testing in no more than three (3) trips to the jobsite.

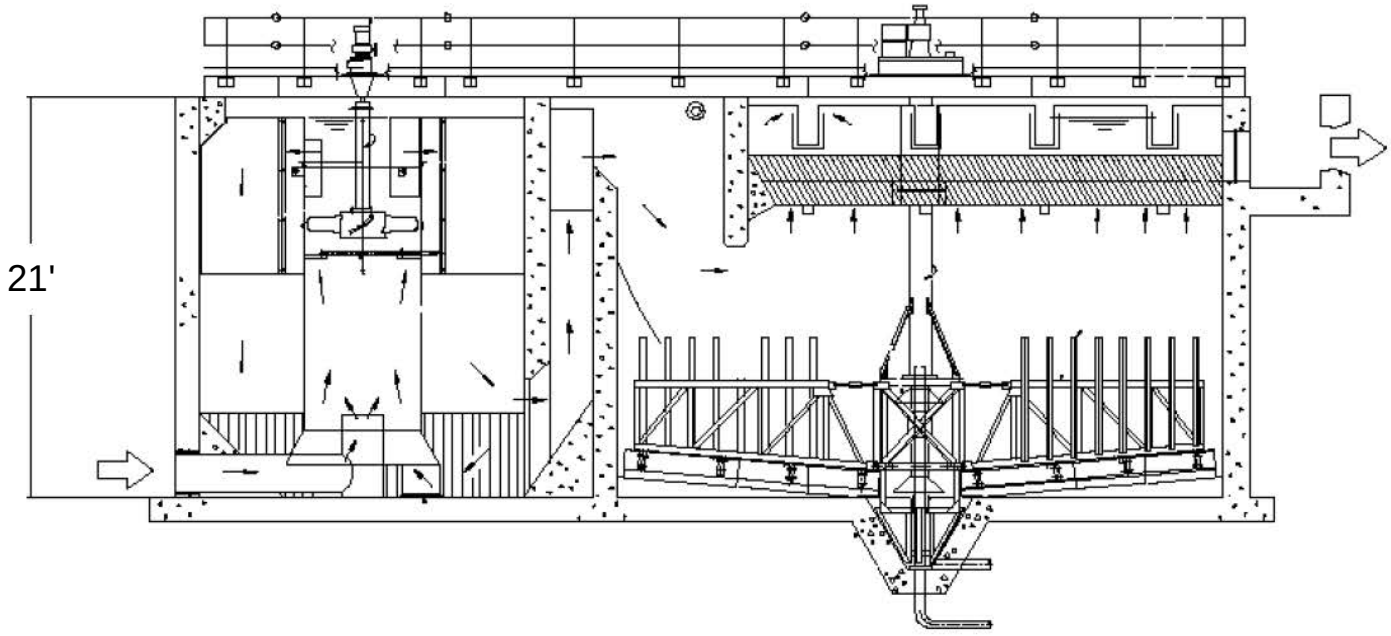
SCOPE BY OTHERS

1. All concrete basins & grout
2. Finish painting
3. All wall fittings
4. Inlet, outlet and sludge blowdown piping
5. Installation of any kind
6. Unloading & placement of equipment from delivering carrier
7. All anchor bolts and mounting hardware not specified herein
8. All piping & piping supports not specified herein
9. All chemical feed systems
10. In-line static mixer (If rapid mixer is not provided)
11. All compressed air piping
12. Building or cover
13. All basin drains and drain valves
14. Supply and installation of all electrical power and control wiring and conduit to the equipment served plus interconnections between the ODI equipment as required, including wire, cable, junction boxes, fittings, conduit, cable trays, safety disconnect switches, circuit breakers, etc.
15. Install and provide all motor control centers, motor starters, VFD's, panels, field wiring, wireways, supports and transformers
16. All embedded pipe sleeves, valves and elbows
17. All other necessary equipment and services not otherwise listed as specifically supplied by ODI

5. PRELIMINARY LAYOUT

Note: One unit shown





6. BUDGET PRICING

ODI's current budget estimating price for the complete (12) DensaDeg system described above, including freight to jobsite, is $7.9M. Price for the backwash system (2) is$1.68M. This price will be valid for one (1) year. Payment terms will be as follows and commercial terms and conditions are given on the following page.

Shipment Terms:
FOB Shipping Point, Full Freight Allowed

Payment Terms:
10% Net Cash, Payable in thirty (30) days from date of submittal of initial drawings for approval;
85% Net Cash, Payable in progress payments thirty (30) days from dates of respective shipments of the Products;
5% Net Cash, Payable in thirty (30) days from Product installation and acceptance or Ninety (90) days after date of final Product delivery, whichever occurs first.

7. COMMERCIAL TERMS & CONDITIONS

1. GENERAL: Sales by Ondeo are made solely under the conditions expressly set forth herein. Any proposed changes or exceptions to these conditions, or additional terms and conditions, included or referenced in Purchaser's order or acceptance of this offer, are hereby rejected by Ondeo, and shall be of no force or effect upon Ondeo unless expressly accepted in writing by Ondeo.

This Contract shall bind and inure to the benefit of Purchaser and Ondeo, as well as their respective successors and assigns; however, neither party may assign this Contract without the prior written consent of the other.

Neither party shall be deemed to have waived its rights by failing to enforce any particular provision of this Contract.

If a court invalidates any portion of this Contract, the rest of this Contract shall remain valid and be construed as if not containing the invalidated provision.

Virginia law shall govern the rights and obligations of the parties.

2. CREDIT APPROVAL: If at any time information available on Purchaser's financial condition or credit history, in Ondeo's judgment, does not justify the terms of payment specified herein, Ondeo may require full or partial payment in advance, or an acceptable form of payment guarantee such as a bank letter of credit, or other modifications to the terms of payment.

3. PROPRIETARY INFORMATION: All information, data, drawings, instruction and operation manuals furnished by Ondeo with this Contract are proprietary to Ondeo, submitted in strict confidence, and are to be used by Purchaser solely for the purposes of this Contract, and shall not be reproduced, transmitted, disclosed or used in any other manner without Ondeo's written authorization.

4. RISK OF LOSS: Risk of loss or damage to the Products, or any part thereof, shall pass to Purchaser upon delivery of the Products or part to Purchaser at the f.o.b. point stated herein.

5. EXCUSABLE DELAY: Ondeo shall not be liable for failure to perform or for delay in performance due to fire, flood or any other act of God, strike or other labor difficulty, act of any civil or military authority or of Purchaser, riot, embargo, delay in or shortage of transportation facilities, or any other delay beyond Ondeo's reasonable control In the event Ondeo's performance is delayed by any such cause, Ondeo's schedule for performance shall be extended accordingly. If Purchaser's actions delay Ondeo's performance, Purchaser shall pay Ondeo any additional costs incurred by Ondeo resulting from such delay. If Purchaser delays shipment of Products, or any part thereof, in addition to paying Ondeo for additional costs incurred, Purchaser shall also pay for the Products or the parts on the date Ondeo is prepared to make shipment.

6. TAXES: The Purchase Price does not include any State or local taxes of any kind applicable to the sale, use or delivery of the Products or services covered under this Contract. Purchaser shall pay direct or reimburse Ondeo for any such taxes that Ondeo or Ondeo's subcontractors or suppliers are required to pay.

7. INSPECTION BY PURCHASER: Purchaser may inspect the Products at the point of manufacture, provided that such inspection is arranged and conducted so as not to unreasonably interfere with Ondeo's or the manufacturer's operations. Purchaser's inspection of the Products and release for shipment shall constitute Purchaser's acceptance of the Products as conforming to the requirements of this Contract.

8. WARRANTY: Ondeo warrants the Products shall conform to the description contained in this Contract and be free from defects in material and workmanship for a period of one (1) year from date the Products are initially placed in operation or eighteen (18) months from date the Products are shipped, whichever occurs first, provided that the Products are stored, installed, maintained and operated in accordance with Ondeo's written instructions and not subjected to misuse, neglect or accident

Upon prompt written notice of and determination that such defect is covered under the foregoing warranty, Ondeo's responsibility is limited to correction of the defect by, at Ondeo's option, repair or replacement of the defective part or parts, f.o.b. factory. UNLESS STATED ELSEWHERE HEREIN, Ondeo PROVIDES NO WARRANTY OF PRODUCT PERFORMANCE OR PROCESS RESULTS. THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Ondeo shall have no responsibility for the condition of primed or finish painted surfaces after the Products leave their point of manufacture.

Field touch-up of shop primed or painted surfaces are normal and shall be at Purchaser's expense. Any touch-up or repainting required to shop primed or painted surfaces, for reasons other than improper or incorrect application in the shop, shall be Purchaser's responsibility.

9. BACKCHARGES: Ondeo shall not be liable for any charges incurred by Purchaser for work, repairs, replacements or alterations to the Products, without Ondeo's prior written authorization, and any adverse consequences resulting from such unauthorized work shall be Purchaser's full responsibility.

10. LIMITATION OF LIABILITY: Ondeo SHALL NOT BE LIABLE TO PURCHASER FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING FROM Ondeo's OBLIGATIONS UNDER THIS CONTRACT, WHETHER SUCH DAMAGES ARE BASED UPON BREACH OF CONTRACT, BREACH OF WARRANTY, TORT, STRICT LIABILITY OR OTHERWISE. IN ANY EVENT, Ondeo's LIABILITY TO PURCHASER SHALL NOT EXCEED THE PURCHASE PRICE OF THE PRODUCTS OR PARTS OF THE PRODUCTS ON WHICH SUCH LIABILITY IS BASED.

11. CANCELLATION BY PURCHASER: If Purchaser cancels this Contract or refuses to accept delivery of the Products, Purchaser shall be liable to Ondeo for reasonable cancellation charges, including loss of anticipated profits, administrative costs, commissions to sales representatives, costs incurred by Ondeo for all work performed or in process up to the time of cancellation or refusal to accept delivery, cancellation charges from Ondeo's suppliers or subcontractors, and any other expenses incurred by Ondeo in connection with Purchaser's cancellation or refusal to accept delivery.

12. DEFAULT BY PURCHASER: Without incurring any liability or waiving any claim for damages Ondeo may have against Purchaser, Ondeo may refuse to make or delay making delivery and/or withhold any service if (a) Purchaser breaches this or any contract with Ondeo; (b) Ondeo becomes aware of facts which, in its judgment, render Purchaser's financial condition unsatisfactory or cast doubt on Purchaser's willingness or ability to pay for the Products and/or services; or (c) Purchaser engages in or consents to liquidation, commission of any act of insolvency, appointment of a receiver of assets or assignment for the benefit of creditors, or if Purchaser becomes the subject of any bankruptcy or insolvency proceeding.

If Purchaser is late in paying the Purchase Price or any partial payment due under this Contract, or otherwise breaches this Contract, Ondeo shall be entitled to interest at the legal rate on the overdue amount, and on its damages, calculated from the date of default in payment or other breach, plus court costs, reasonable attorneys' fees and other expenses incurred in any effort to collect.

8. DENSADEG BROCHURE

DensaDeg®
High-Rate Clarifier and Thickener

Get maximum versatility with the DensaDeg Clarifier

- Lime softening
- Clarification of surface waters
- Combined clarification and softening
- Enhanced primary treatment of wastewater
- Tertiary treatment of wastewater (phosphorus removal)
- Wet weather treatment (CSO, SSO, stormwater)
- Treatment of filter or membrane backwash water

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DensaDeg®
High-Rate Clarifier and Thickener

Drinking water clarification
Tertiary phosphorus removal
CSO/SSO treatment
Enhanced primary clarification
Softening

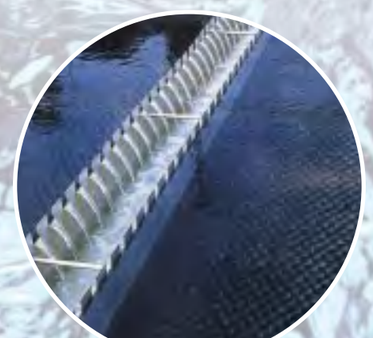
DensaDeg® High-Rate Clarifier and Thickener

The DensaDeg Clarifier is a high-rate solids contact clarifier that combines optimized flocculation, internal and external solids recirculation, and tube settling in two conjoined vessels to maximize hydraulic loading and treatment efficiencies. The proprietary blend of energy input and high volume solids recirculation reduces the waste sludge volume and results in rapid settling to optimize unit operation and treatment results.

Because it both clarifies and thickens, DensaDeg is especially effective for plants where waste sludge volumes are a problem or where there are site constraints.

DensaDeg means efficiency with real value.

- **Construction economy.** Integrated functions within a single unit require approximately 50 percent less space than conventional solids contact clarifiers.
- **Accelerated processing.** Combined internal and external sludge recirculation and high reactor solids concentration reduce startup time and increase treatment rates.
- **Excellent effluent quality.** Combined solids recirculation and high reactor concentration optimize unit operation and overall treatment results.
- **Optimal chemical efficiency.** Optimized flocculation through intense solids contact stabilizes treatment chemistry.
- **Low-cost operation.** Automatic startup, shutdown, metering, and draw-off control are based on flow rate and turbidity data, requiring minimal operator attention.
- **Reduced waste volume.** Waste sludge is very dense, which minimizes handling and storage.
- **Consistent, flexible performance.** Hydraulic loading management enables operation over a broad range of flows and raw water characteristics.
- **Long service life.** No abrasive material is added to the system so there is no wear on pumps, mixers, or scrapers.

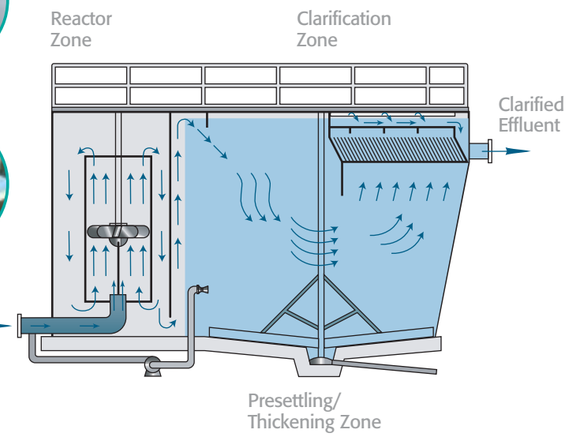


Integrated, 3-stage process

1. In the **Reactor Zone,** influent water combines with reactants and pre-formed solids from the presettling/thickening zone, flowing up through a draft tube, where a specially designed turbine initiates flocculation. As the mixture resettles, its density increases. This internal recirculation is performed at a rate of up to ten times the influent flow rate, producing optimum flocculation density for the application and selected chemistry.

Reactor Vessel

Reactor Turbine



2. The slurry enters the **Presettling/ Thickening Zone** over a submerged weir where, due to the density of the solids within the slurry, it is separated and deposited on the bottom of the vessel. Aided by a slow-moving rake, the deposited solids continue to thicken. The process maintains solids homogeneity, while facilitating further release of entrained water. Thickened sludge is periodically blown down from the bottom of the thickener, and is typically pumped directly to a final dewatering mechanism.

Rake/Scraper

3. In the **Clarification Zone,** supernatant flows upward through settling tubes and is polished. The settling tubes allow rise rates of up to 10 gpm/ft² for most metal salt coagulation processes — often higher for lime addition processes — and up to 50 gpm/ft² for most CSO/SSO applications. Clarified water is uniformly collected in effluent launders located above the tubes.

Collection

Clarification Zone

9. CONTACTS

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BROWN AND CALDWELL

Appendix C. Mechanical Problems

with Biostyr, Biofor C and Biofor N Units in Phase I

Table C.1 Biostyr Outages and Mechanical Failures

Week	Dates	Outage Description
Week 1	2/22/04 – 2/29/04	Bad solenoid on BW valve, unit not operational. Replaced.
		Feed pump variable frequency drive destroyed due to rain water in panel. Replaced.
		Air receiver tank inadequately sized for process air demand. Installed new receiver tank.
		Miscellaneous bad fuses due to rain.
Week 2	3/1/04 – 3/7/04	System out of service while problems in Week 1 were resolved.
		Air control valve damaged due to rain. Replaced.
Week 3	3/8/04 – 3/14/04	New receiver tank installed.
		New air control valve installed.
Week 4	3/15/04 – 3/21/04	Feed flow meter registering twice the flow indicated using backwash storage tank rise-rate and diameter.
		Feed pump having trouble keeping prime if level in BAF feed tank drops below certain level.
Week 5	3/22/04 – 3/28/04	Start acclimation of Biostyr.
		Still have not received new flow meter, using tank fill and draw to verify flow.
		New backwash valve installed (higher quality solenoids).
Week 6	3/29/04 – 4/3/04	Cause of meter failure found to be fouling due to buildup with iron sulfide precipitate. Piping modifications implemented to make regular cleaning of feed flow meter run possible.
		Discovered excessive frequency of mini-backwashes(1).
Week 7	4/4/04 – 4/10/04	Biostyr effluent dissolved oxygen probe not functioning.
		Water intrusion into keypad caused keypad to fail.
Week 8	4/11/04 – 4/17/04	Krüger staff determined that the Biostyr column differential pressure is not being read correctly by Supervisory Control and Data Acquisition (SCADA) system. Problem was fixed and the maximum differential pressure set-point was changed from 80 to 90 inches of water column.
		New keypad installed.
Week 9	4/18/04 – 4/24/04	Mini-backwash frequency reduced due to changes described in Week 8.
Week 10	4/25/04 – 5/2/04	Backwash pump malfunctioned. This was not discovered immediately. The discovery was based on observation of frequent mini-backwash cycling, which appeared on the Biostyr SCADA historical trend feature. It was later discovered that the backwash pump was not coming on at all.
Week 11	5/3/04 – 5/9/04	Biostyr backwash pumping fixed but backwash quality degraded substantially. Backwash observed to be black and odorous. A manual vigorous backwash was performed.
Week 12	5/10/04 – 5/16/04	Krüger staff concerned that a flow nozzle might be plugging. A second vigorous backwash was run.

(1) A mini-backwash is a short backwash sequence that is automatically initiated by the Biostyr SCADA system if the column pressure exceeds a preset trigger value.

Table C.2 Summary of Biofor-C Outages and Mechanical Failures

Week	Dates	Outage Description
Week 1	2/22/04 – 2/29/04	Biofor-C installed submersible feed pump because of insufficient head between BAF influent tank and Biofor-C inlet overflow constant head trough. However, the skid mounted influent pump (takes suction from Biofor-C perforated screen trough) screening is not able to meet the 3.0 gpm/ft^2 set point (typically able to deliver ~ 2.8 gpm/ ft^2).
Week 8	4/11/04 – 4/17/04	Biofor-C process air compressor failure. Failed on April 13, replaced on April 14.
Week 9	4/18/04 – 4/24/04	Biofor-C compressor failure, replace after 2 days.