

Cromaglass®

**WASTEWATER
TREATMENT
SYSTEMS**

OPERATIONS & MAINTENANCE MANUAL

CROMAGLASS CORPORATION
Williamsport, Pennsylvania

Note from Water Authority-Cayman:

The following information is for quick reference. It consists of excerpted pages from a multi-section Cromaglass manual for models CA 50& CA60.

A complete manual shall be provided for each system sold.

SECTION I

INTRODUCTION

A. Operations Manual User Guide

1. This manual was written to provide technical guidance for the owners/operators of the Cromaglass Sequencing Batch Reactor (SBR) models CA-50/60.
2. Information presented is necessary to operate and maintain the Cromaglass SBR system.

B. Operator Responsibility

1. The Operations & Maintenance Manual can be used either as a guide for an individual familiar with operations of a sewage treatment facility, or as a valuable tool to supplement the training of an inexperienced person. The material contained in this manual is presented to promote normal operating conditions. In the course of time, operating personnel will be called upon to exercise their skill and judgment when unusual operating conditions are encountered. Experienced and inexperienced persons can take advantage of the information offered concerning sewage treatment plant operations.
2. The operator should maintain accurate and legible operational maintenance records.
 - a. An operator logbook is essential to good record keeping. This enables the operator to track process control strategies. The type of information recommended should include but not be limited to:
 - (1) Date, weather
 - (2) Operator on staff and signature
 - (3) Current average daily flow
 - (4) Current number of cycles per day
 - (5) Dissolved oxygen content
 - (6) Microscopic examination
 - (7) Equipment breakdown, report on repair status
 - (8) Current phase times for aeration, anoxic, settle, discharge
 - (9) Any and all changes to time clocks
 - (10) Volume of sludge wasted in gallons per day.
 - b. The information should be entered daily, as necessary, into the logbook. This should be standard operating procedure for all personnel.

C. Purpose of Operations & Maintenance Manual

1. The purpose of this manual is to act as a training tool for new operators and a guide for experienced operators.
2. The format of this manual is to provide the operator with detailed instructions on the operation of each piece of equipment.

D. General Type of Treatment and Treatment Requirements/ Effluent Limitations

Influent

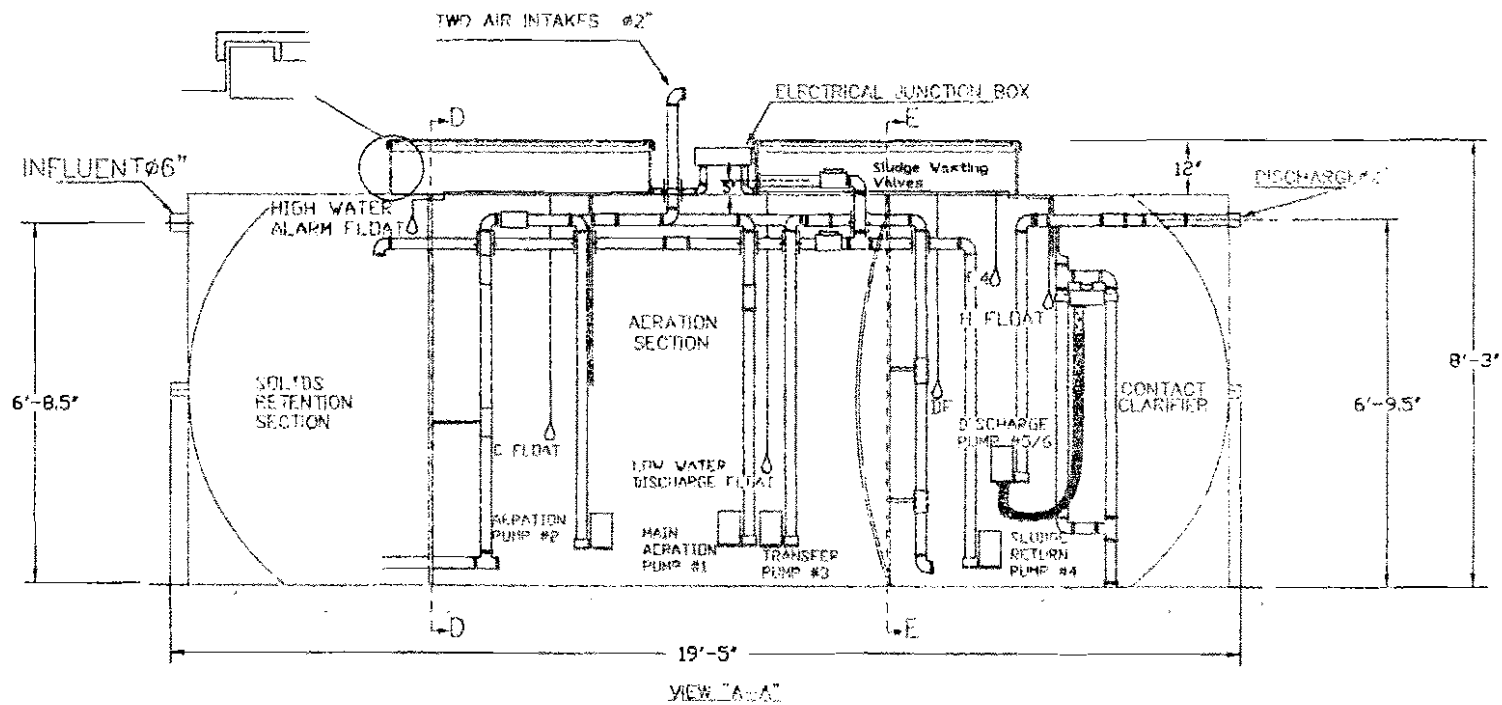
Rated treatment capacity:	5,000 gpd (CA-50) w/ Denitrification	3,750 gpd
Rated treatment capacity:	6,000 gpd (CA-60) w/ Denitrification	3,750 gpd
BOD (5 day)	300 mg/l (CA-50)	227 w/Denitrification
BOD (5 day)	250 mg/l (CA-60)	227 w/Denitrification
Total Suspended Solids (TSS)	270 mg/l/	227mg/l w/Denitrification
Nitrogen (Ammonia)	35 mg/l	
TKN	55 mg/l	

Effluent

BOD-C (Carbonaceous)	≤ 25 mg/l
Total Suspended Solids	≤ 30 mg/l
Total Nitrogen	≤ 10 mg/l (with denitrification capability)
TKN	≤ 20 mg/l (with nitrification)

E. Description Of System Components

1. The Cromaglass CA-50/60 consists of the following components:
 - a. Tank 1 of 1:
 - ◆ Solids Retention Section
 - (1) High Water Alarm
 - ◆ Aeration Section
 - (1) Aeration Pumps P1 & P2
 - (2) Aeration/Transfer Pump P3
 - (3) Dual Aeration Float (C)
 - (4) Low Water Discharge Float (LWDF)
 - ◆ Contact Clarifier
 - (1) Sludge Return Pump P4
 - (2) Sludge Return Shutoff Float (F4)
 - (3) Redundant Discharge Pumps P5 & P6
 - (4) Discharge Pump Failure Alarm Float (H)
 - (5) Discharge Pump Shutoff Float (DF)
3. Section view diagrams of these components are located in this manual Section II.



CROMAGLASS® CORPORATION WILLIAMSPORT, PA	DRAWN BY: JBG	DATE: 3/1/01
TITLE: CA-50/60 TANK SECTION VIEW	APPROVED BY:	SCALE: NTS
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SECTION III

PROCESS SUMMARY

Effective reduction of organic material entering the Cromaglass Sequencing Batch Reactor (SBR) is accomplished biologically through millions of microorganisms (bacteria). These bacteria degrade wastewater through the addition of atmospheric oxygen and biochemical reactions. Through the operation of automatic time clocks, the Cromaglass SBR maintains a controlled environment. This enables various process control strategies to be achieved.

The Cromaglass SBR process descriptions are as follows:

- A. Screening/Pre-Aeration** - Raw wastewater enters the solids retention section for a separation process of organic biochemical oxygen demand (BOD)/ inorganic materials (e.g., toilet paper, feminine hygiene products, etc.). This reduces the potential for any of the above to become lodged in any of the pumps and prevent normal operations.
- B. Aeration** – This is the phase for biological degradation of organic material thereby reducing pollutants. At pre-programmed times, submersible pumps are activated to provide adequate mixing to allow BOD and bacteria (workers) to come in contact with one another. The dissolved oxygen is supplied via pumps when the wastewater is directed through a unique air induction device. As wastewater is being pumped, atmospheric oxygen is drawn into the intakes provided. This supplies the aerobic bacteria with an energy source for growth and reproduction. As the microorganisms consume the organic waste, additional waste is created.

This is the whole basis of the activated sludge process:
organic material as the food source
placed into an aerobic environment
with microorganisms serving as the workers
in the absence of other extraneous conditions
(e.g., pH, toxicity, low levels of alkalinity, low dissolved oxygen).
All of this working together with adequate retention time for the
biological/chemical reactions occurring should produce a quality
effluent (treated sewage).

- C. Anoxic/Denitrification** – This phase refers to the degradation of inorganic byproducts of Ammonia Nitrogen ($\text{NH}_3\text{-N}$) to gaseous nitrogen and CO_2 in the absence of dissolved oxygen. This process becomes important in selected geographical areas due to high concentrations of nitrates found in drinking water. High levels of nitrates sometimes found in soils have been linked to a disease known as methomoglobinemia or BLUE BABY SYNDROME. The Cromaglass SBR has the capability to create an environment, which can ultimately reduce these concentrations to a safe level for human consumption. This is accomplished via control valve placed in line with an existing air pipe. Following the aeration cycle, most of the Ammonia Nitrogen levels have been reduced to nitrates (NO_3). Automatically controlled air valves close, thus creating an environment with little or no free oxygen present. Specific bacteria already contained in the system begin to utilize available NO_3 as an oxygen source for energy. Through careful monitoring, these NO_3 levels are eliminated or reduced to levels that pose no threat to human consumption.
- D. Settling**- The specific intent for this phase is to provide a quiescent environment (i.e., in the absence of air and mixing) such that solid/liquid separation occurs. The aerobic bacteria, through the introduction of oxygen, mixing, and food, begin to secrete mucoproteins and polysaccharides that provide a sticky surface for sludge particles to adhere to. As a result, the sludge particles coagulate to form a mass (floc) which has a high specific gravity. The dense floc is now permitted to settle to the bottom of the clarifier and the clear effluent (supernate) remains above. This effluent is high quality; virtually free from BOD and total suspended solids.
- E. Decant** – All processes thus far have been biological in nature. The microorganisms have provided the tools necessary to degrade the waste to an environmentally safe product. Submersible decant pumps, located in the clarifier compartment, are activated automatically through the remote control panel. Once running, a floatable discharge suction line begins to remove the supernatant and dispose to the pre-designated source (e.g., sub-surface drain field, surface water supply, etc.).

SECTION IV

CROMAGLASS TREATMENT PROCESS DESCRIPTION

The Cromaglass Sequencing Batch Reactor stabilizes wastewater and reduces organics through aerobic treatment. Utilizing the stages previously listed, the environment is manipulated in order to allow the enzyme systems for selected bacteria to operate more efficiently. By understanding these enzyme mechanisms, we can utilize the batch mode of treatment to achieve very specific goals (i.e., final effluent treatment objectives).

The Cromaglass SBR uses this biological tool to achieve the following results:

- ◆ Reduction of Carbonaceous BOD (i.e., particulate and soluble BOD).
- ◆ Reduction of Nitrogenous BOD (i.e., ammonia, proteins, etc.).

BOD removal involves the addition of oxygen to create an environment, which allows these bacteria to perform their duties. Once a specific concentration of oxygen becomes dissolved in the wastewater, organic pollutants are broken down into simpler components for bacterial assimilation. This represents **Step 1** for biological treatment. **Step 2** involves reduction NBOD. This is the required environment for the heterotrophic bacteria, in the absence of oxygen, to utilize their enzyme systems capable of reducing oxidized nitrogen (i.e., denitrification).

The Cromaglass treatment process involves the following phases:

- Step 1: Aerobic/Aeration
- Step 2: Anoxic/Denitrification
- Step 3: Settling
- Step 4: Discharge

Step 1: Aerobic/Aeration

Addition of air is accomplished via submersible pumps identified as P1, 2, & 3 located in aeration compartment. (Refer to diagrams Section II). As well as supplying oxygen to the system, these pumps also provide adequate mixing to allow the wastewater and bacteria to come in contact. This is of utmost importance to facilitate the waste degradation process. Biological reduction of Ammonia Nitrogen ($\text{NH}_3\text{-N}$) proceeds once BOD levels fall below inhibition thresholds - typically 5–80 mg/l low molecular weight soluble BOD. During this process, alkalinity is destroyed via production of nitrous acid. Since nitrifying bacteria utilize bicarbonate alkalinity as a source for structural growth and reproduction, it becomes very important to monitor alkalinity levels within the aeration basin for process control.

It must be noted that pH and alkalinity should **not** be considered synonymous.

Nitrifying bacteria will be inhibited if sufficient alkalinity is not present, regardless of pH. Approximately 7.14 mg of alkalinity is destroyed to convert 1 mg of Ammonia Nitrogen to nitrite. The second biochemical reaction involves the conversion of nitrite to nitrate also under aerobic conditions. Three pumps are designated to mix/aerate for a pre-programmed time dependent upon treatment objectives.

Step 2: Anoxic/Denitrification

Denitrification is the biological conversion of nitrate-nitrogen to more reduced forms, ultimately di-nitrogen gas. Nitrogen removal occurs when the nitrogen gas is allowed to escape into the atmosphere. Denitrification is brought about by a variety of facultative bacteria that utilize nitrate instead of oxygen for respiration. Alkalinity is produced during this process due to the de-animation of organic compounds. Approximately $\frac{1}{2}$ of the alkalinity destroyed during nitrification is replaced during denitrification resulting in a slight increase in pH. The organic source available and its relative concentration dictate the rate of denitrification. Rates are highest with a readily biodegradable source, such as methanol. Rates also increase with increasing temperature and with decreasing oxygen concentrations.

At pre-programmed times, aeration pumps P1 & 2 along with aeration/transfer pump P3 continue to run without the introduction of air. This can occur via electrically operated solenoid valves which close the air supply to the system. The programmed time is to allow the facultative bacteria to consume all available dissolved oxygen and nitrate. The duration of the cycle is determined via the analysis of the mixed liquor suspended solids filtrate for dissolved NO_3 . At completion, the air valve will automatically re-open and the aeration process will resume for another batch.

Step 3: Settling

Following BOD oxidation, nitrogen removal, and subsequent nitrate removal, the Cromaglass SBR process will enter into a quiescent period for solid/liquid separation. This is accomplished by the deactivation of pump P3 via pre-programmed time clock. The unique attribute of a Cromaglass SBR versus a conventional flow through system is found in the clarifier compartment. During settle phase, no additional flow is allowed to enter this compartment, thus minimizing short circuiting or solids washout. This process control allows the bacteria to efficiently utilize the space provided, and polish the effluent.

Following 30 minutes of settling, concentrated sludge is either returned back to the pre-aeration chamber for additional treatment or wasted to an optional sludge holding tank through the operation of P4. This represents the primary control tool available to the operator for maintaining a specific food to microorganism (F/M) ratio. By controlling the biomass inventory in the treatment process relative to the amount of food contained in wastewater, a healthy population of heterotrophic and autotrophic bacteria can be maintained for treating additional wastewater. This is the primary objective behind activated sludge.

Step 4: Discharge

In order to complete the SBR batch process, a known volume of clear settled supernatant is discharged following an additional settling period of 30 minutes. A 30-minute pump cycle is designated to remove approximately 625 gallons from the clarifier compartment. Pumps P5 & 6 are allocated for this task. The clear supernatant is pumped via floatable suction line and is designed to shut off before entering the settled sludge blanket. The pump shut-off is controlled via float switch (DF) suspended in the clarifier.

An important item to note: In order for a discharge cycle to occur, both the clarifier discharge shut-off float (DF) and the low water discharge float (LWDF) must be activated. Both **must** be either on their side or inverted. This prevents the pumps from operating out of water, and retains a quantity of activated sludge for treating additional waste. Should the level fail to drop below the H-Float in seven minutes, the discharge pump failure alarm will be activated.

F. IMPORTANT PRECAUTIONS

1. Do not allow water softener backwash into the treatment plant. The high concentration of sodium ions will adversely affect the treatment and discharge efficiency
2. If restaurant waste is included in the sewage flow, a grease removal unit must be utilized before the sewage enters the plant. This grease removal unit must be properly maintained.
3. Laundry waste should not comprise more than 15-20% of the total daily waste flow.
4. Do not attach any groundwater, storm water, or condensate drains into the sewage treatment system.
5. Non-biodegradable materials (sanitary napkins, applicators, diapers, plastic or rubber goods, cigarettes, hair, etc.) should be placed in the garbage, not introduced into the sewage flow. They can interrupt the treatment process and cause unnecessary service expense.
6. Chemicals such as acid, caustic cleaners, gasoline, oil, turpentine, photo developing fluids, etc. should not be introduced into the sewage treatment plant. Disposal of cleaning disinfectants and chlorine bleaches should be kept to normal domestic use. Excessive amounts of these materials can do serious harm to the biological treatment process.
7. The use of low-suds, biodegradable detergents are recommended. Excessive use of detergents, or the use of high-suds detergents can cause foaming and odor problems.

SECTION VIII

HOW IT WORKS

A. OPERATING INSTRUCTIONS - PLC CONTROLS

Models CA-50/60

Cromaglass Systems are designed to operate most efficiently if installed, operated, and serviced by a contractor experienced in the field of sewage disposal systems. This operational information should enable the operator of the treatment system to understand the batch-treat process and sequence of events that take place.

CONTENTS

The PLC

1. Tank Components
2. Denite Operation (optional)
3. Air Flow
4. Powering
5. On-Demand Aeration
6. Discharge
7. Go-Fast Sequence
8. Reset Push Button
9. High Water Alarm
10. Surge Cycle
11. Low Aeration Section Alarm
12. Low Clarifier Section Alarm

THE PROGRAMMABLE LOGIC CONTROLLER (PLC)

The PLC is the control center for all system operations. With necessary equipment the system operator can fine-tune the operating parameters to optimize the performance of the treatment system dependent on influent characteristics. The standard factory setting of the PLC is for 8 or 10 batch cycles per day for non-denitrification systems. All denite installations are programmed for "6 batch" cycles per day. Operator can adjust these factory settings if necessary.

1. TANK COMPONENTS

Contains the Solids Retention Chamber and the first section of the Aeration Chamber. Pump #1 (P1) and Pump #2 (P2) are the main aeration pumps. They are energized when PLC output relays close (see input/output list). The standard factory setting is to operate P1 and P2 alternately each cycle or both pumps are energized by the "C" float level sensor as the liquid level in the tank increases.

Pumps #3 (P3) aerates and transfers the mixed liquor from the aeration section into the clarifier. P3 is energized by its corresponding PLC relay output during the aeration/transfer

phase. It is de-energized by the PLC after the aeration/transfer preset phase time has elapsed.

Pump #4 (P4) is the sludge return pump located at the bottom of the clarifier. Thirty (30) minutes after transfer into the clarifier stops P4 is energized by the PLC which closes its relay output. P4 then returns sludge that has settled to the bottom of the Clarifier. P4 is wired through the "F4" float level sensor which will stop P4 after a set amount of sludge has been returned to the front of the system, or wasted to a Sludge Processing Tank, as determined by the operator.

Pumps #5 (P5) and #6 (P6) are the discharge pumps. Sixty (60) minutes after transfer stops and the clarifier settles and returns sludge, the PLC energizes either P5 or P6 through relay outputs to discharge 600-625 gallons of treated effluent. P5 and P6 alternate each cycle.

2. DENITE OPERATION (OPTIONAL)

To accomplish denitrification the PLC is programmed to periodically interrupt the aeration cycle by closing the electrically operated air intake valve. The aeration pump(s) continues to circulate the liquid throughout the tanks and with no oxygen available the dissolved oxygen (DO) levels in the mixed liquor drop and denitrifying bacteria then convert nitrate to nitrogen gas and water. All of these functions are controlled by the PLC. A typical treatment sequence is as follows:

- | | |
|-----------|---------|
| 1. Aerate | 1.0 hr |
| 2. Anoxic | 1.5 hr |
| 3. Settle | 1.0 hr |
| 4. Decant | 0.5 hr |
| | 4.0 hrs |

During the Settle and Decant periods the Clarifier is isolated from the other sections and is quiescent while aeration continues in the Aeration and Solids Retention Sections.

3. AIR FLOW

To assure that the electronic valve in the airline is functioning properly it should be checked during the anoxic cycle. During this period no air should enter the system through the air intake pipe. This can be confirmed by placing your hand over the intake opening; no suction force indicates the valve is closed. When the anoxic period ends air should again enter the system. This can be confirmed by detecting suction forces at the intake opening. If the electronic valve is not working properly, repair or replacement is necessary.

4. POWERING

The PLC is programmed to start pumps sequentially with a two second delay before the next pump starts. This feature will reduce the initial incoming current load commonly associated with system startup. This delayed starting of pumps may reduce the requirements for a backup generator (Engineer of Record must approve). Note this power-up feature is not applicable when aeration pumps are left in the "Hand" position.

Each PLC comes with an in-line surge protector. The surge protector should be checked periodically to ensure proper protection (see surge protector specification sheets for further details).

5. ON-DEMAND AERATION

The Cromaglass system is designed for aeration "On-Demand." Through the use of float switches, aeration and mixing pumps are turned on or off according to water level.

The float used in the on-demand aeration sequence is the "C" float. The C float is located in manway #1 and set slightly above the Low Water Discharge Float. The C float will turn on both aeration pumps P1 and P2 continuously. If the C float is not engaged, either P1 or P2 will run alternating each cycle (P1 on during odd cycles, P2 on during even cycles).

6. DISCHARGE

The first float switch in the discharge circuit is the Low-Water Discharge Float (LWDF). It is located in the Aeration Section of the second tank. The purpose of this float is to prevent a discharge if the water level is too low in the aeration section. This is necessary to maintain sufficient mixed liquor during periods of low flow.

Both the LWDF float and the Discharge Float (DF) located in the clarifier must be engaged to complete the discharge circuit. If both floats are engaged, they will signal an input on the PLC.

There is an additional control which will alternate power to the other discharge pump should the first pump fail to operate. When the PLC energizes a discharge pump it also energizes the "H" float level sensor in the clarifier. After seven minutes elapsed time if the liquid level did not drop enough to open the float switch (H), the PLC will energize the other discharge pump, activate a steady alarm light, and signal a remote dialer output.

7. GO-FAST SEQUENCE

The PLC can operate under a shortened cycle to confirm proper sequence of operations. A "GO-FAST" toggle switch in the control panel when activated will signal an input and cause the PLC to begin a shortened cycle. During the GO-FAST mode, the cycle minutes equate to seconds. For example, a 240-minute cycle will sequence through in only 240 seconds while in GO-FAST.

The operator can confirm proper operations of pumps and floats by noting the inputs and outputs on the PLC or by observing the Timeline menu of the HMI and the treatment system.

After turning GO-FAST off, use the Reset button in the control panel or the HMI to return to the preset cycle-time. Note the PLC will automatically turn GO-FAST off when four consecutive GO-FAST cycles have been completed.

8. RESET PUSH BUTTON

Resetting the PLC will return the system to the proper cycle time according to the PLC's real time clock and the system settings. The Reset feature is accomplished with either the Reset push button located in the control panel next to the Go-Fast toggle switch or via the HMI. It is recommended to use the HMI due to the "Are You Sure" prompt (see HMI instructions).

9. HIGH WATER ALARM

The high water alarm circuit consists of the "AL" float level sensor in the Solids Retention Chamber. When the liquid level raises the alarm float switch, an input on the PLC is signaled and turns on a relay output for a remote dialer and a pulsing alarm light. Additionally, a surge cycle begins if the AL float is engaged for more than one minute (see Surge Cycle for additional details).

10. SURGE CYCLE

The PLC is programmed to automatically assume a Surge Cycle, or shortened cycle, when a High Water Alarm occurs. The PLC assumes the following settings when in surge mode:

Transfer	=15 min.
Settle 1	= 20 min.
Sludge Return	= 5 min.
Settle 2	= 5 min.
Discharge	=15 min.

The surge cycle settings are automatic and not adjustable via the HMI. The PLC will also advance within the surge cycle according to the following rules:

- Rule 1.0 If the Sludge Return Float or H Float is on, start at min. 15 of surge cycle.
- Rule 2.0 If in Discharge, Settle 2, or Sludge Return phase, start at min. 45 of surge cycle.
- Rule 3.0 If neither Rule 1.0 nor 2.0 are satisfied, begin surge cycle at min. 0.

The PLC is programmed to revert to initial settings after the surge cycle is completed and the High Water Alarm has cleared. The PLC will continue to operate in surge mode until the surge cycle is completed and the High Water Alarm has cleared.

It is important to note the PLC will return to minute zero of a normal cycle after the surge cycle. The PLC will now be out of sync with the real time clock. The system must be Reset to synchronize the cycle time with the real time clock (see Reset instructions).

11. LOW AERATION SECTION ALARM

The Low Aeration Section alarm is signaled to the PLC via the Normally Closed "LA" float located in manway #2. Note all other floats with the exception of LA, LC, and EQ-DF (if an EQ tank precedes system) are Normally Open.

The LA float is suspended slightly below the LWDF float. If the water level drops below the LA float, a signal is sent to the PLC, all aeration/transfer pumps are turned off, an output is signaled for a remote dialer, and a steady alarm lamp is illuminated. The alarm lamp will remain on to inform the operator the system has undergone a Low Aeration Section alarm. To clear the alarm, simply reset the system.

The pumps will start when the water level rises sufficiently in the aeration chamber. If a Low Aeration Section alarm has occurred the LWDF float should be checked to ensure it is operational.

12. LOW CLARIFIER SECTION ALARM

The Low Clarifier Section Alarm is signaled to the PLC via the Normally Closed "LC" float located in manway #2. Note all other floats with the exception of LA, LC, and EQ-DF (if an EQ tank precedes system) are Normally Open.

The LC float is suspended slightly below the DF float. If the water level drops below the LC float, a signal is sent to the PLC, all clarifier pumps are turned off, an output is signaled for a remote dialer, and a steady alarm lamp is illuminated. The alarm lamp will remain on to inform the operator the system has undergone a Low Clarifier Section alarm. To clear the alarm, simply reset the system.

The pumps will start when the water level rises sufficiently in the clarifier chamber. If a Low Clarifier Section alarm has occurred the DF float should be checked to ensure it is operational.

Cromaglass CA-50/60 Siemens S7-226 Micro PLC Version 1.02

Bottom Row LED's

INPUT	SOURCE	FUNCTION
I0.0	AL Float	Signal High Level Alarm
I0.1	GO-FAST toggle switch	Engage Shortened Diagnostic Cycle
I0.2	RESET Push Button	Re-initialize PLC/HMI
I0.3	C Float	Activate Pump #1 and #2 Simultaneously
I0.4	DF Float	Enable discharge
I0.5	H Float	Signal Discharge Pump Failure Alarm
I0.6	F4 Float	Enable Sludge Return Pump
I1.1	LA Float	Low Water Shutoff for Aeration/Transfer Pump(s)
I1.2	LC Float	Low Water Shutoff for Clarifier Pump(s)
I2.5	Address Bit	Address the PLC to Train C
I2.6	Address Bit	Address the PLC to Train B
I2.7	Clock Set	Resets the PLC Timeclock to 12 A.M.

Top Row LED's

OUTPUT	DESTINATION	FUNCTION
Q0.0	Dialer	High Water Alarm
Q0.1	Dialer	Discharge Pump Failure Alarm ¹
Q0.2	Dialer	Low Aeration Section Alarm ²
Q0.3	Dialer	Low Clarifier Section Alarm ²
Q0.4	Pump #1	Aeration
Q0.5	Pump #2	Aeration
Q0.6	Pump #3	Aeration/Transfer
Q0.7	Pump #4	Sludge Return/Waste
Q1.0	Pump #5	Discharge
Q1.1	Pump #6	Discharge
Q1.5	Denite Valve	Close Denite Valve
Q1.6	Denite Valve	Open Denite Valve
Q1.7	Alarm Lamp/Buzzer ¹	Visual/Audible Alarm Indicator(s)

¹Blinking for High Water Alarm; Steady for Pump Failure or Low Water Alarms

²RESET to clear

B. OPERATING INSTRUCTIONS - Mechanical Controls Models CA-50/60

CONTROL PANEL

Electrical service to control panel – 230 v, single phase, 4 wires

P1 and P2 pumps operate from Tork timer TC1. This timer is set to run 24 hours a day. The timing can be changed to alternate pumps P1 and P2 if the application warrants.

P3 transfers mixed liquor to clarifier and is controlled by Tork timer TC2. This timer is factory set depending upon which model is sold. Cycles may be adjusted to optimum performance.

EACH CYCLE CONSISTS OF:

1 hour 30 minute transfer (CA-50) 54 minute transfer (CA-60), after which TC2 microswitch drops off toggling on timers TC3 and 4 and allows clarifier to settle. Timer TC3 is set for 30 minutes. At the end of the 30 minutes, the sludge return pump will be energized and return the sludge to the aeration chamber. Level sensor de-activates this pump. TC4 is set 60 minutes or an additional 30 minutes following the sludge return event. At completion of 60 minutes of settling, discharge pump P5 or P6 will be energized to decant the clarified effluent. Discharge volume is controlled by level sensor.

NOTE: In order for the system to go into a discharge, there must be enough liquid in aeration chamber to activate the (LWDF) level sensor that is hanging nearest transfer pump in aeration chamber (even though the clarifier is full).

DO NOT SET TIMERS WITH POWER ON

AERATION SECTION

Pumps P1, P2 create an optimum amount of aeration within the main aeration chamber and comminution chamber. Although these pumps are heavy-duty sewage pumps, they should be checked periodically to assure that they have not become clogged from stringy articles.

Should the alarm system be activated and there is no noticeable excess of clogging materials in the comminution chamber, there is a possibility that P3 pump is malfunctioning. (P3 pump provides all the water transfer to the clarifying chamber, and if malfunctioning would cause water level in the entire main chamber and comminution chamber to rise and signal through the "AL" float level device.)

AIR FLOW

It is important that a programmed quantity of air flows to the entire system. A check should be made occasionally for proper aeration by first visually estimating amount of turbulence within the main aeration chamber or (if proper sequence) the settling chamber. Also aeration can be determined by placing a hand against the air intake, wherever it may be located. Adequate suction would indicate proper amount of aeration.

OVERLOAD

There may be an occasion when an extraordinary overload of incoming wastewater cannot be adequately handled through the programmed cycle. In such a situation, it may be necessary for the operator to temporarily speed up the process by limiting the aeration cycle of P3 pump. This is accomplished by changing the setting on time clock TC2 for additional discharge cycles. Due to a continuous operation of the two aeration pumps this should not affect the total aeration capabilities or effluent quality. Note that if heavy surges have caused a frequent changing of the aeration and transfer period, there is undoubtedly an indication of an overload on the system as originally sized and provisions should be made for increasing the total capacity.

Should the operator be unable to correct conditions for which these instructions can help, a phone call should be made to the nearest Cromaglass® Distributor or the **Cromaglass®** factory.

SECTION IX

INITIAL MONITORING PHASE

Operators must keep in mind that this is a living, breathing biological community that requires attention. During initial operations, it is recommended to inspect daily. The following **Checklist** was developed to assist the owner/operator with initial start-up procedures.

- a. At minimum, one complete cycle should be observed to confirm normal operations of all systems: aeration, transfer, anoxic, settle, sludge return, and discharge would be considered a complete cycle.
- b. Observe float switch operations. Be sure to observe tank levels associated with current settings.
- c. Collect/observe final effluent clarity documenting any unusual characteristics (e.g., turbidity, odor, suspended solids, etc.).
- d. Note any unusual odors associated with treatment process while in aeration mode. A musty, woody odor is indicative of good operations.
- e. Loud noises are **not normal** and must be recorded.
- f. All air intakes should be checked for proper vacuum. This can be accomplished by holding a hand over PVC intake pipes.
- g. Observe initial aeration cycle and monitor dissolved oxygen (D.O.) levels. It is very important that the D.O. meets or exceeds 2 mg/l near the end of this cycle. This will ensure the microorganisms are provided a satisfactory environment necessary for biological oxidation of organic waste. If the D.O. is below 1.5 mg/l, inspect manual PVC ball valves to assure they are fully open. Fully open valves will allow more oxygen to enter the system. Over-aerating can also have a negative impact on the system. This can create a floc that is dispersed resulting in a poor-settling sludge. Partially closing the same valve will reduce the oxygen supplied. Minor adjustments should only occur **once per day**. Time must be allowed for the microorganisms to acclimate to changes and reach steady state.

Note: Manufacturer recommends this test conducted weekly.

SECTION XI

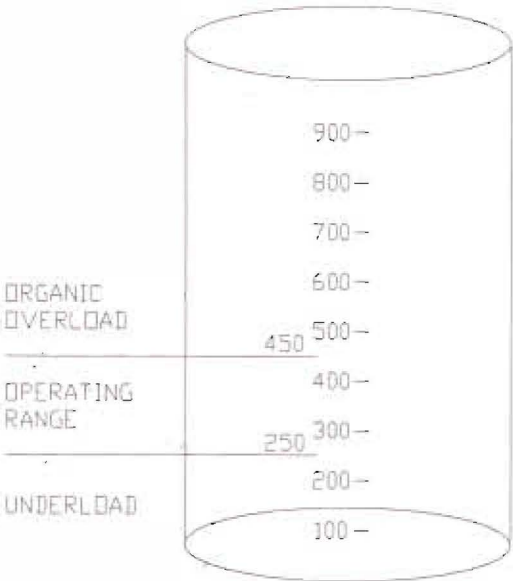
SLUDGE WASTING & SETTLOMETER TEST

A key operational tool the operator has available is the ability to increase or decrease sludge wasting. An appropriate amount of mixed liquor must be maintained in order to optimize the biological process. This is called controlling the food to microorganism ratio (F/M). The volume of wasted sludge is determined by the 30-minute Settrometer Test. No more than 10% MLSS should be wasted in a 24-hr period. Sudden process control changes must be avoided to reduce stressing the microorganisms. If a sludge holding tank was provided, a quantity of **settled sludge** can be pumped to this location. By closing the PVC sludge return valve to the head of the plant and opening the sludge wasting valve during a normal sludge return event, the appropriate biological inventory is maintained in the system. Increased organic loadings will require more supplied oxygen and reduced sludge wasting. This will result in a lower F/M ratio, resulting in more bacteria on site for degradation of substrate. Conversely, reduced loadings will result in a lower oxygen demand thus minimizing the need for more bugs (higher F/M).

The Settrometer test is very useful in determining when to waste sludge from the system. (Refer to Settrometer Graph Section 11-2).

To perform:

- Obtain a one-liter graduated cylinder that is properly marked.
- Fill the container to the 1000-ml mark with well mixed activated sludge. This sample should be obtained from the aeration compartment near the **end of the aeration/transfer cycle**.
- Place the cylinder out of direct sunlight to eliminate denitrification during the settling process.
- Begin to time settling and record percent of sludge/liquid interface volume every 5 minutes for the first 30 minutes, followed by 10-minute recordings for the next 30 minutes. Be sure to observe sludge coloration, floc-settling characteristics (e.g., fast or slow settling, fine pin floc in supernate, etc.).



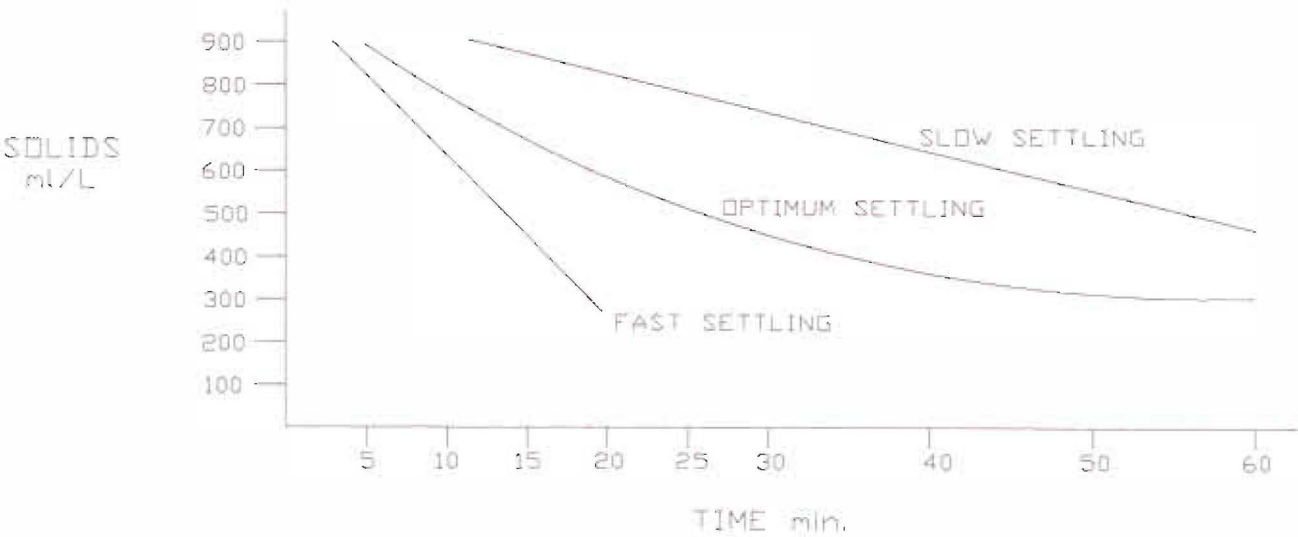
Optimum settling should yield a 30-minute test ranging between 250 ml/l and 450 ml/l. Results greater than 450 ml/l indicate organic overloading is occurring and sludge wasting should be **increased**. Tests yielding less than 250 ml/l indicate under-loading and wasting must be **reduced**. No more than 10% of inventory should be wasted per day.

Sludge should be wasted during normal sludge return cycle, if possible. This will assure a higher concentration of bacteria. To waste, close valve in the sludge return line (which returns sludge from the clarifier to the aeration chamber) and open valve in line leading to the sludge holding tank. For systems that do not have a supplied tank, secure a septic hauler to remove sludge from system. Hauler should place suction hose in aeration compartment with both P1 and P2 pumps running to maximize mixing.

Caution: Do not remove excessive amounts of sludge resulting in a settlometer test of less than 250 ml/l. In doing so, the process will be deprived of a sufficient quantity of bacteria to provide adequate treatment and ultimately result in degrading effluent quality. Should this occur, no further wasting of biological solids should take place in order to rebuild biomass inventory.

Following the sludge-wasting event, return sludge valves to normal factory settings.

SETTLOMETER GRAPH



SECTION XVIII

TROUBLESHOOTING GUIDE

<u>PROBLEM</u>	<u>CAUSE</u>	<u>SOLUTION</u>
1. White, billowing foam on surface in aeration section.	Overloaded aeration tank, low Mixed Liquor Suspended Solids (MLSS) due to start-up. Will resolve itself.	Do not waste sludge during start-up period.
	Excessive sludge wasting from process tanks.	Restrict sludge wasting so the settleable solids test confirms a minimum of 250 ml sludge level.
	Toxic waste introduced into process, severe temperature change in influent, or large change in influent pH.	Establish new activated sludge after eliminating toxicity. Eliminate sources of toxicity, temperature and pH changes. Use pH adjustment equipment.
2. Thick, scummy, dark foam in aeration section	MLSS too high	Waste sludge
	DO too low	Test for DO, if <2 mg/l increase air.
	Change in influent strength or pH.	Increase air. Check for source of problem, eliminate if possible.

<u>PROBLEM</u>	<u>CAUSE</u>	<u>SOLUTION</u>
3. Dark brown, black sudsy foam or mixed liquor color. Septic or sour odor.	Anaerobic conditions in aeration section, due to toxic influent or aeration equipment failure.	Check influent for cause of toxicity. Check for pump failure or clogged venturi(s)
4. Clouds of fluffy sludge rising in areas of clarifier. Mixed liquor settles until process is back to	Improper organic loading or change in DO level.	Check DO, reduce if too high. Decrease or eliminate sludge wasting slowly. optimum parameters
	Filamentous organisms cause such as fats, grease,	Check influent for likely ground water infiltration, etc. and eliminate cause. Check for low DO To remove, lightly chlorinate influent with caution.
	Wastewater nutrient deficiencies.	Check nutrient level in influent wastewater. Nutrient addition may be required.
	Low DO in aeration section.	Increase air to raise DO to at least 2mg/l.
	pH in aeration section is <6.5.	Eliminate cause of low pH if possible. If not, add an alkaline agent such as caustic soda or lime, with care, to influent.
5. Solids in effluent	MLSS too high, high solids level in clarifier.	Do settleable solids test. If high, waste sludge to reduce solids to 250-300 ml
	Poor settling in clarifier	MLSS too low due to start-up or toxic kill. Do not waste sludge, increase MLSS. Check liquid in aeration section for high acidic, grease, or alkaline levels.

<u>PROBLEM</u>	<u>CAUSE</u>	<u>SOLUTION</u>
5. (continued)		Eliminate at source if possible.
	High solids level in clarifier.	Check sludge return pump operation. If OK check sludge return float in clarifier. Lower if necessary to remove more sludge (factory setting at 20" top of float to tank top. check and replace TC-3 if necessary.
	Light colored pin floc on clarifier surface	Check DO in aeration section, reduce to <4.0mg/l if high.
	Discharge pumps operate too long, discharge solids	Check discharge float, replace if necessary.
	Mixed liquor becoming septic.	Check aeration pump operation. Adjust floats to provide constant aeration until DO rises to acceptable parameters.
6. High water alarm	Low water float failure	Replace float
	Hydraulic overload	Correct overload cause; or install equalization tank; or increase system capacity.
	Discharge pump failure	Repair/replace discharge pump.
	Transfer pumps not operating	Check operation of TC-2 for proper functioning. Repair/replace transfer pump.
7. Discharge pump(s) not operating	Improper signal from low water float	Check and replace if necessary.
	Timer malfunction	Check operation of TC-2 for energizing TC-3 and TC-4 timers. If OK, check and replace TC-4 if necessary.
	Pump failure	If energized – repair/replace pump.