Care and Feeding of your New Portable Digester

G. Linder
Clarkson University
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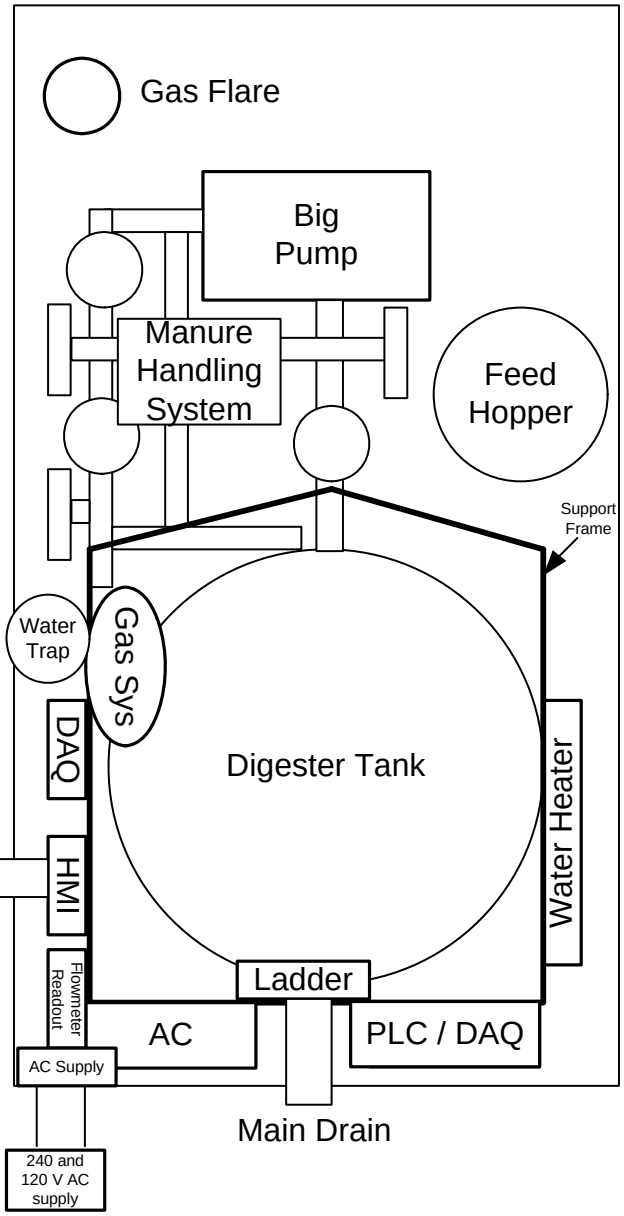
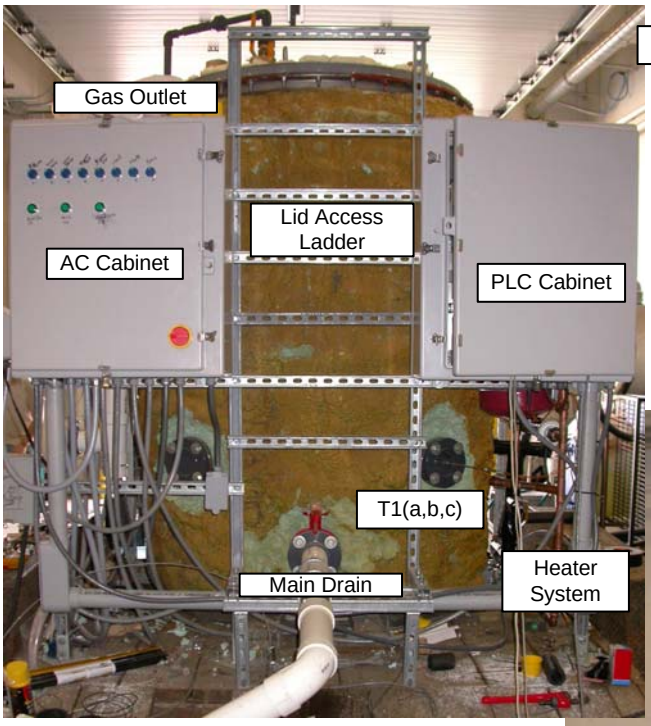
Getting to know your anaerobic digester:

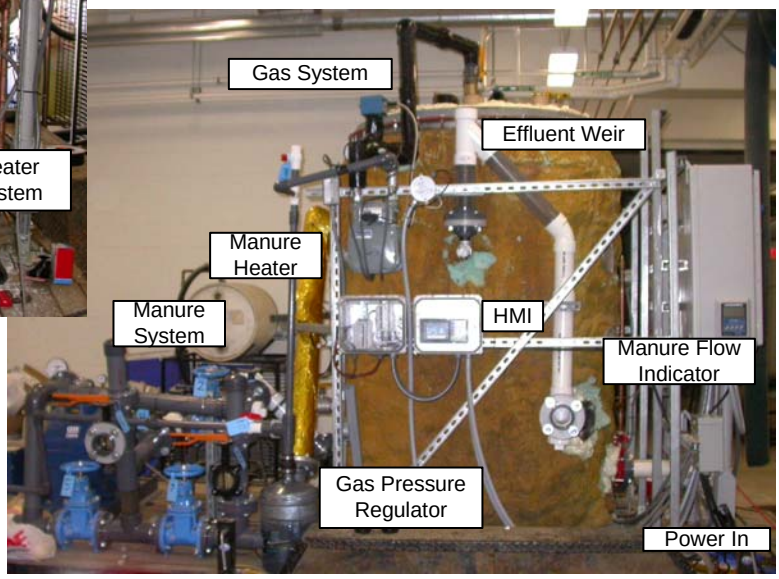
You have recently acquired the state of the art in portable manure processing and handling equipment. This document will introduce you to the basic operating procedures of your new digester.

- **Description of controls**
- **Mixing and Feeding**
- **Using the HMI (Human Machine Interface)**
- **Downloading data**
- **Inside the control cabinets: Overview**





Rear view of digester, showing location of key parts.



At right, side view of digester, showing locations of key systems.

Specifications:

Manure System:

Tank Capacity: 515 gallons to "full" mark, 470 in the tank, 45 in the pump and plumbing
Feed Rate: For 20 day residence time, 25.75 gallons per day
Tank Pressure: Operating pressure set to 8.3 inches of water (0.3 PSI), tank leak tested hydrostatically to 27.7 inches of water (1 PSI).
Main Manure Pump: 5 HP motor @ 240 V, 3" inlet and outlet chopper pump.
Manure System Flow Parameters: Max measured flow rate, 215 GPM. Bypass throttling allows for control from 0 -> 215 GPM. System equipped with pump reverser for solids re-suspension if required.
Pipe Size: All manure plumbing is 3" schedule 80 PVC, schedule 40 PVC or galvanized steel.
Valves: All valves are either 3" wafer-style butterfly valves or ductile iron gate valves
Plumbing Interface: All external ports are 3" ANSI 150 bolt flanges
Manure Flow Meter: Dynasonics ultrasonic flow meter on 4 foot galvanized pipe section
Mixing: Tank mixing controlled via a user programmable timer, "Mix for SS seconds every MM minutes"

Heater System:

Heater Element: 4 kw @ 240 V or 3 kw @ 208 V
Water Pump: 15 gpm @ 6 PSI rise
Heater System Working Pressure: 3 PSI cold, 10 PSI hot, pressure tested to 20 PSI
Heater System Fluid: Approx. 3 gallons of 50 / 50 water / propylene glycol
Heater fluid temperature: Controllable from ambient -> 49 C with +/- 1 C resolution
Tank Temperature: Design 37 C. Controllable from ambient -> 49 C with +/- 1 C resolution.
Manure Heater: 8 watt per foot self regulating heater tape, total watts 1400 when operating from cold.
Water Flow Meter: 1 ¼" turbine flow meter, outputs 64 cycles per US gallon. Frequency measurement accessible at points in PLC enclosure.

Gas System:

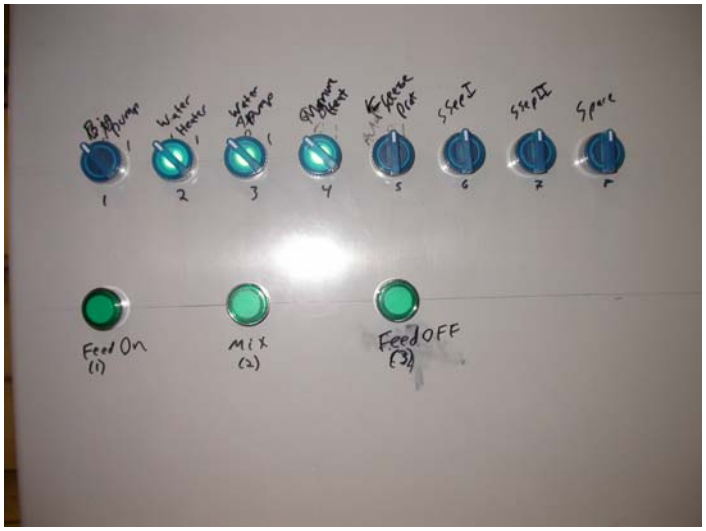
Gas Volume Flow: American Meter bellows meter with 2 foot drive and 1 foot pulser, model AC-250
Gas Methane Concentration: 0-100 % methane sensor from BlueSens GmbH
Gas System Heater: Self-regulating heater tape maintains gas metering system at ~40 C. Real-time temperature of gas meter is logged with gas volume and concentration measurements.
Gas Pressure: Adjustable fluid filled back pressure regulator / condensate trap, set to 6 inches of water

Electrical System:

Electrical Requirements: Either 240 V single phase or two phases of 208 V 3-phase rated for 30 Amps. Additionally, an optional 120 V 20 A supply for the convenience outlet
Temp Sensors: Type T-Thermocouples installed in 20 locations.
PLC: SixNET mIPM with 5 instrumentation input modules, 16 additional inputs, 16 additional outputs.
PLC Interface: On-board Ethernet cable for downloading logged data. IP Address **10.1.0.1**
Data Acquisition: 2 weeks of on-board data storage, storing all points every 10 minutes.
Control System: Automatic control of heater systems, semi-automatic feeding and mixing, manual override via front-panel selector switches.
HMI: Intuitive touch-screen LCD panel for heater and mixing set points and system visualization.

Description of Controls:

The front panel of the AC cabinet, as labeled on the diagram on the first page, is shown at right. There are eight selector switches. These are three-position selectors, which select AUTO-OFF-MANUAL for the system controlled.



Selector Switch Operation

When pointing LEFT, that contactor is under automatic control.

When pointing STRAIGHT UP, that contactor is disabled and cannot be turned on under automatic control.

When pointing RIGHT, that contactor is MANUALLY ENERGIZED and will operate until the selector is put to another position.

Currently, only the first four selector switches do anything. Labeled from left to right, they are:

1- Big Pump (Manure Pump)
2- Water Heater element
3- Water Heater pump
4- Manure Heater

Under standard conditions, these switches should always be set to the left hand position. This allows the PLC control the system to maintain the current below the 30 amps required for the digester. The selector switches are equipped with lamps, such that when that system is energized, the lamp will be turned on.

Below the selector switches are three green illuminated pushbuttons. The operation of these buttons is all that is required for basic digester operation, including initial feeding and loading.

These buttons are labeled, from left to right:

1- Feed On
2- Mix
3- Feed Off

To access these functions, hold the button down until the button illuminates. The PLC is acknowledging that the button has been pressed by turning on the light. Once the operation is done, the light will go off.

There are two operations which will be done semi-automatically. These are feeding and mixing.

Tank Mixing

The point of this button is to provide an easy way to mix the tank. This mixing both equalizes the tank temperatures and swirls around the bacteria and food, promoting good gas production. Mixing for too long could cause excessive heat loss through the external pipes, and mixing for too short a time will

not adequately stir the tank. This button turns on the big pump for the time specified on the LCD screen, if a tank mix is required out the regular timing.

To mix the tank, push and hold the MIX button until the lamp illuminates. The MIX button will flash on and off at ½ second intervals while the mixing operation is running. The MIX operation does the following:

1- Disable heater elements, wait for two seconds.
2- Turn on the large pump for the time interval set on the LCD screen.
3- Shut off the large pump and re-enable the heater.

Once the mix operation is complete, the lamp will stop flashing and the system will return to standard heating. The button will also flash while under automatic control, when the programmed time interval between mixing has elapsed. If you see this button flashing, it means that the tank is currently mixing, whether started by the user by pressing the button or started by the on board controller due to its timer settings.

Tank Feeding

Tank feeding and tank mixing perform essential the same operation. However, for tank feeding the run time of the pump is not specified. Pressing the FEED ON button will disable the heaters and turn on the big pump. The FEED ON button will illuminate while the pump is running. With the pump on, the system can be fed as described below. Upon completion of the feeding, the FEED OFF button is pressed, turning off the pump and re-activating the heaters. Feeding the tank in this manner resets the mix timers, meaning the next mix cycle will take place at the programmed time after the feeding is complete.

To feed the tank, do the following:

1- Make sure your manure sample is prepared and either dumped in the feed hopper or has the pump suction hose immersed in the sample to be fed.
2- Press and hold the FEED ON button until the button illuminates.
3- The pump will start running. You can now go operate the valves to load the system.
4- Once the feeding is complete, press and hold the FEED OFF button until it illuminates. When the buttons lamp goes off, the process is complete.

The image at right shows the valve lineup behind the feed hopper, which has been removed from this photo. Straight ahead is the pump suction valve, which is a butterfly valve. To the left is the pump inlet throttle, the large blue valve on the stand in the air.

When in step 3 above, with the pump running, slowly close the blue pump inlet throttle valve. Listen to the pump. The valve takes about 8 turns to fully close, and by turn 6 you will hear the

pump start to change pitch. This is because the pump is now pulling harder against the inlet, and is starting to cavitate. Once the pump has changed sound, slowly open the butterfly valve. The fluid level in the feed hopper or bucket will immediately start to go down. If using a hose in a bucket, make sure that the hose is not stuck to the bottom of the bucket. If you see a hose start to collapse, shut the butterfly valve and open the blue valve. A collapsing hose on a suction line means the hose is either clogged or against the bottom of the bucket. Figure out the blockage, and repeat the procedure once it has been cleared.

Once the bucket or feed hopper has been drained, immediately close the butterfly valve. Do not leave the butterfly valve open, or else the pump will draw air into the system, which is bad. After the butterfly valve is closed, re-open the pump inlet throttle valve all the way.

It is important to leave the large blue pump inlet throttle open all the time unless feeding, as a partially closed valve could cause pump cavitation during mixing operations, which could introduce air into the system, as well as producing large pressures inside the pump potentially bad for our happy bacterial friends.

Using the HMI (Human Machine Interface)

The HMI is shown at right. It is enclosed in a robust weatherproof plastic enclosure with a transparent front. This system is used to view the real time values reported by the sensors and adjust the mixing times and heater settings.

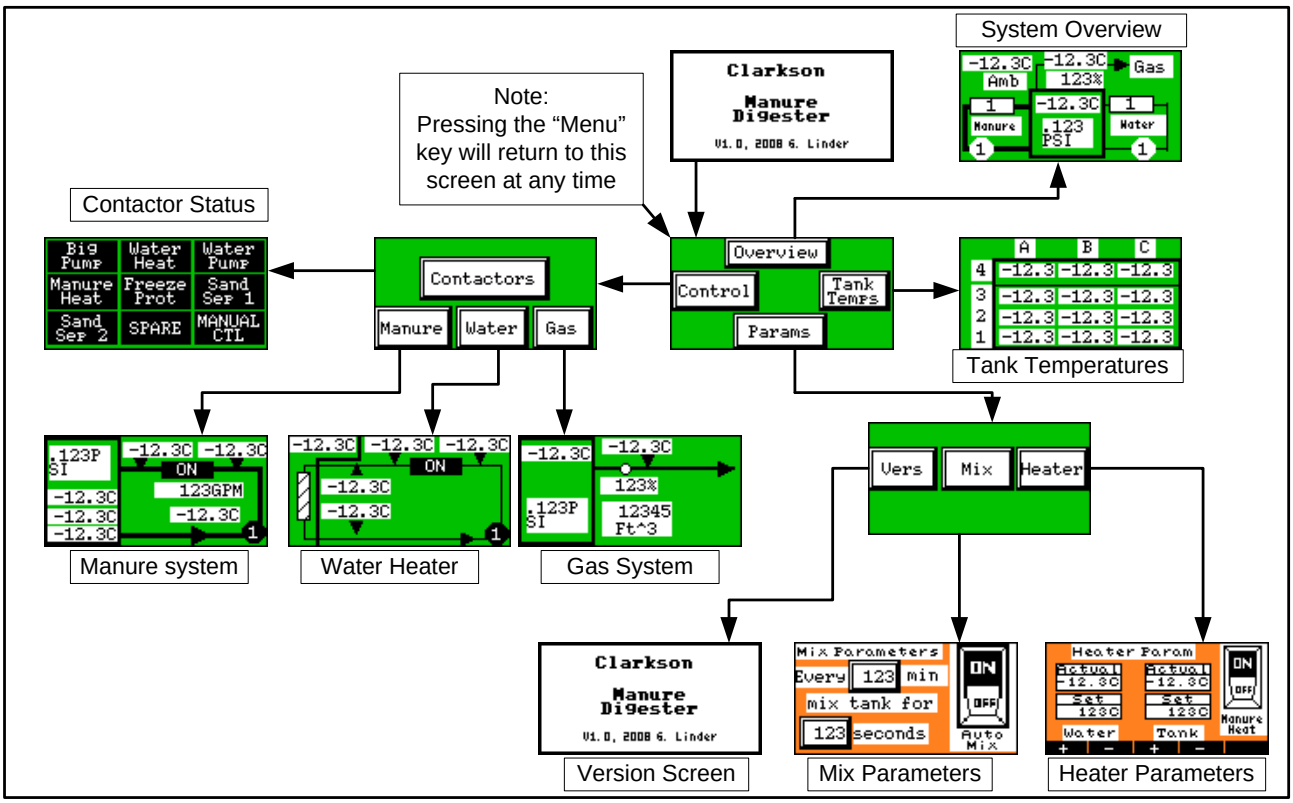
The HMI is merely a view into what the PLC is doing. The PLC is located in the PLC/DAQ cabinet on the back of the digester. If the HMI is damaged or breaks for any reason, the digester will continue to operate, the FEED and MIX buttons will still work, and the data acquisition will continue.

The HMI itself consists of an LCD touch screen display and a membrane keypad. The system is drip proof and low voltage, meaning wet hands on the panel itself will cause it to become dirty, and nothing more. However, please remember to close and latch the PLC's weatherproof enclosure when not using the functions of the PLC.

The general layout of the screens is shown in the following image. In general, there are three key systems:

1- Manure System
2- Water Heater system
3- Gas System

Pressing the "menu" key on the HMI bezel will take you to the main menu screen. From here, if you want to examine the data in the system, touch "control" on the screen. This will take you to the screen shown below at left of the main menu screen. From here, to look at the manure system, water heater system, or gas system measurement, touch the appropriate system name.



Manure System:
The manure system screen contains the following data items, having to do with the flow of manure:

1- Tank Pressure (measured at gas system metering equipment)
2- Tank Temp (low, medium, high) at the left hand side
3- Heater status (The rectangle shows on / off of the manure heater)
4- Heater entry temperature
5- Heater exit temperature
6- Pump Temperature
7- Pump Status (1 for on, 0 for off)

Water Heater system:
The water heater system screen contains the following items, relating to the water circulation system:

1- Tank Temperature (far left temperature measurement)
2- Heater Element Status (rectangle at the top of the screen)
3- Heater element inlet temperature
4- Heater element outlet temperature
5- Tank heat exchanger (spiral coil) inlet temperature
6- Tank heat exchanger (spiral coil) outlet temperature
7- Heater pump status (1 for on, 0 for off)

Gas System:
The gas system screen contains the following items, relating to the gas system:

1- Tank head space temperature (measured at the top of the tank, in the gas space)
2- Tank Pressure (measured at gas system metering equipment)
3- Gas measurement system temperature (measured at gas system metering equipment)
4- Methane concentration (measured at gas system metering equipment)
5- Total cubic feet of gas produced (incremented from gas meter)

Note that there is no real time flow indication of the gas. This will have to be computed after the fact, using the DAQ records from the PLC and the time stamps to compute average flow. With flow rates of only a few cubic feet per day, real-time measurement was not deemed cost effective at this stage in the project.

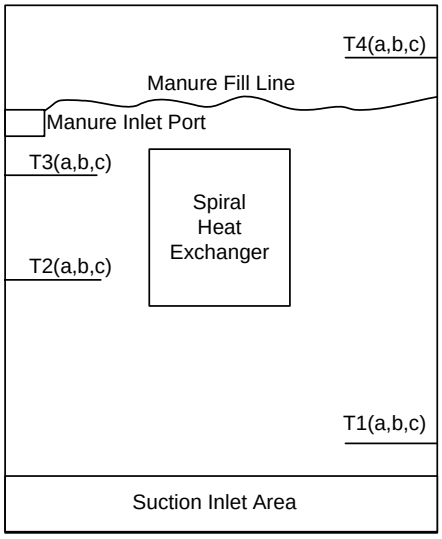
These values are not stored on power loss, and the total cubic feet of gas produced will be reset to zero if the power is cycled.

Contactors:

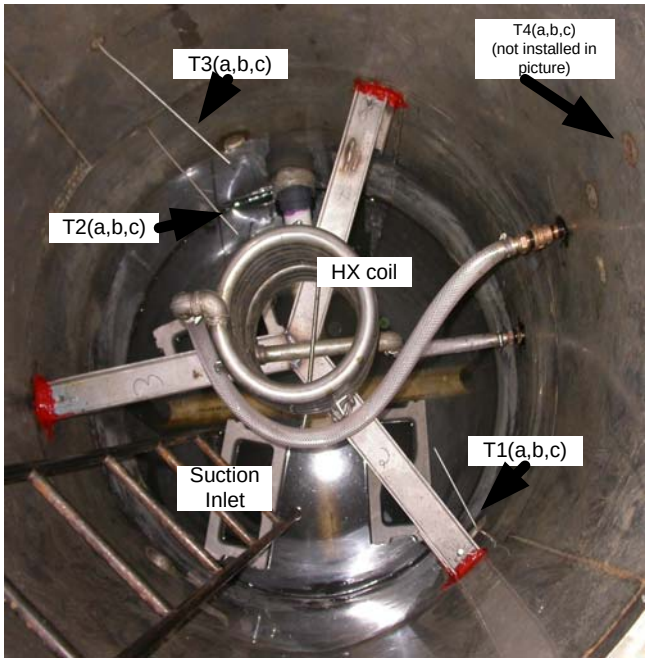
The contactors screen shows the current state of the contactors. Mainly this was installed as a debugging aid. Under normal operation, the status indicated here should agree with the selector switches on the front panel of the AC enclosure.

Tank Temps:

From the main menu, pressing "tank temps" will show the tank temperature screen. This shows all the thermocouples located within the tank. There are a total of 12, mounted at four different heights. The bottom three rows are located at approximately 1.5', 3', 4' from the bottom of the tank. The top row thermocouples are located in the gas space above the tank, approximately 6 inches down from the lid. Each thermocouple probe has three individual sensing elements, which are read from right to left on the screen. All these temperatures are saved in the DAQ system. The locations of the tank temperature sensors are shown diagrammatically at right.



To the right is an illustration showing the inside of the tank, with relevant parts labeled.



Parameter Settings:

Pressing the "params" button from the main screen allows you to adjust the operating settings of the digester. These settings are stored in nonvolatile memory in the PLC, and will therefore be maintained if the power is lost. The parameters menu screen has three buttons:

Ver:

Returns to the version screen upon initial powerup, showing the version number of the firmware installed in the HMI

Mix:

The mix parameters screen contains the following sentence:

"Every [xxx] minutes mix tank for [xxx] seconds". These are numeric entry boxes. Touching the "xxx" minutes button enables you to enter in a new mix interval, either via the membrane keypad on the HMI or the on screen numeric pad the appears. The function operates exactly the same for the for the [xxx] seconds setting.

It was found during testing that with the tank running full open, at 215 GPM, that the tank can be fully mixed such that all the tank temperatures are within 1 degree of each other in only about 30 seconds of run time. Appropriate settings for initial heat up may be to mix every 45 minutes for 30 seconds. Once the tank reaches its operating temperature, and the pump is bypassed throttled to a more appropriate mixing rate, mixing every 30 minutes for 45 seconds may be appropriate.

It should be noted that whatever mix settings are chosen will fill the entire plumbing system up with heated manure from the tank, and mix the cool manure from the plumbing into the tank. The 3" manure plumbing and the big pump holds approximately 45 gallons, or about 8% of the total volume in the system. As a general rule, more mixing means more heating.

The "mix" pushbutton described in the "tank mixing" section will run the pump for [xxx] seconds, as configured in this screen. There is also a virtual rocker switch on this screen. If, for whatever reason, automatic tank mixing is NOT desired to occur at all at any time interval, this virtual rocker switch can be set to OFF, thereby disabling the auto mix feature. When auto mixing is turned off, the MIX pushbutton described in the "tank mixing" section will still operate, mixing the tank for the number of seconds specified on this screen.

Heater:

The heater settings screen enables the control of the water temperature, tank temperature, and manure heater settings. All temperature set points are controlled with +/- 1 C of hysteresis. This means that upon heating, if the set point is 37 degrees, the heater will run until the tank reads 38 degrees, then shut off until the tank temperature drops to 36 degrees. These temperature fluctuates are visible in the DAQ records for the tank.

Water Temperature:

The water temperature controls the maximum temperature of heater fluid flowing in the system. The actual temperature controlled is the average temperature of the water heater outlet and the heat exchanger inlet. The maximum temperature the system will operate at is 49 C, although the numbers on the display can be set higher. During testing, it was found that a water temperature set point of 44 degrees works quite well to maintain a tank temperature of 40 C. If the operating point is set to be 37 C in the tank, a water temperature max of 40 may be sufficient. The lower the tank temperature setting, the less power is used maintaining the heater loop temperature.

Tank Temperature:

The tank temperature is actually controlling based on the average of six thermocouples in the tank. The math averages T2(a,b,c) and T3(a,b,c) together, and controls to this temperature, within +/- 1 C. The recommended tank operating temperature is 37 C, which will actually result in average tank temperatures fluctuating between 36 and 38.

Manure Heater:

The manure heater rocker switch turns on and off the self-regulating heater tape underneath the yellow plastic on the manure inlet to the tank. This system has no thermostat, and is either on or off. When the tank is mixing or feeding, the power to the heater tape is turned off, even if this switch is set to

on. The idea behind the manure heater is to maintain an extra volume of manure at the proper tank temperature, to help keep the heat loss through the pipes to a minimum.

Downloading Data

The data acquisition system is set to store values every 10 minutes from the moment it is first powered on. It will accumulate these data points for two weeks, at which point it will be full. When the system is full, or will start over writing the first data records stored. It is therefore important to download data at least every week, perhaps more often if required.

The right hand cabinet contains most of the PLC hardware and 24 V control equipment. The lower right hand module inside this cabinet is the PLC itself, and has an Ethernet cable attached to the top right hand port. This cable can be plugged into a laptop computer to get the data from the PLC.

The SIXNET IO Tool Kit software can be installed on any computer. In order to download data, you can get a free version of this software from Sixnet's web page, www.sixnetio.com and click on "software tools".

SPECIAL NOTES ON GETTING DATA:

DO NOT LEAVE THE DATA ON THE LAPTOP. Copy it off onto a USB key or otherwise, as this laptop's disk is not entirely reliable. In fact, email the data to me, greg.linder@gmail.com, and I'll keep it someplace.

PLUG THE LAPTOP INTO A REAL OUTLET.
This laptop's battery is quite old, and does not run reliably. Plug the machine in while downloading data, so it doesn't die in the middle of a transfer.

The PLC's IP address is **10.1.0.1.** To download the data from the PLC, do the following:

1- Make sure it isn't raining too hard. The PLC cabinet itself is weather tight, but when open, it isn't.
2- Open the cabinet by operating the five catches on the front.
3- Locate the Ethernet cable for the PLC, which should be stored rolled coiled up in the bottom of the cabinet. Do not unplug this cable from the PLC, as it is annoying to plug in again.
4- Plug the Ethernet cable into a laptop equipped with the SIXNET I/O Tool Kit. The laptop I left there needs to have it's PCMCIA Ethernet card installed, as the on board Ethernet cable does not work.
5- Start the SIXNET I/O Tool Kit. The configuration file should already be loaded. If not, open the file PLC_FIRMWARE_V0_1, located in the DigesterFirmware directory.
6- Click on the item labeled "PLC" in the main window. It's the lower right hand unit in the "right rear panel" tab on the right hand side of the screen.
7- Go to Operations -> Datalogging (Sixlog) -> Read and Clear Data Records.
8- A menu will pop up saying "Choose Sixlog". Just press ok.
9- A new window will open called "SXLogView". Follow the prompts to get the data, which involves just clicking "okay" a few times. The data will be transferred to the laptop.
10- At this point, the data has been read into the laptop and erased from the PLC. The data needs to be saved as a CSV (Comma Separated Value) file. Go to File->Save and store the data in a meaningful place.
11- Please name the files something useful, like dataweek01 -> dataweekxx, as someone is going to have to string these weekly data files together in order to extra long term performance data.

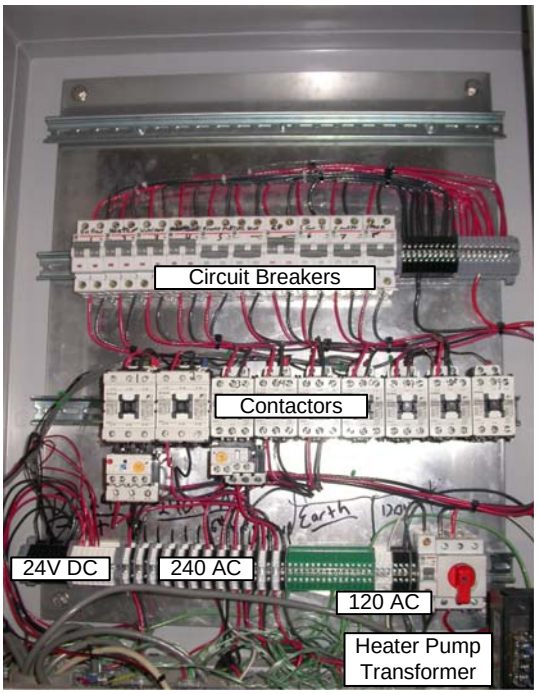
12- When you have saved the file, unplug the Ethernet cable from the laptop and coil it back up inside the enclosure. Shut the door and fasten all clasps to keep it shut.

Congrats! You have now saved the data from the PLC.

A look inside the cabinets

AC Cabinet:

We have already seen inside the PLC cabinet to get data. If you need to go into the AC cabinet to reset a circuit breaker or whatever, please reference the following image to know you way around. Be warned that there are many hazardous voltages inside the AC cabinet, so be careful when the door is open. All line voltage equipment is confined to the AC cabinet, except for one set of wires the runs into the PLC cabinet to supply power to the 24V power supply.



At lower right is another switch, the big red knob to turn the system on and off. The circuit breaker external to this panel, to the lower left of the cabinet, is the better way of turning on and off the power. Also at lower right is the black transformer that runs the water heater circulation pump. This is a live transformer, so be careful with the terminals.

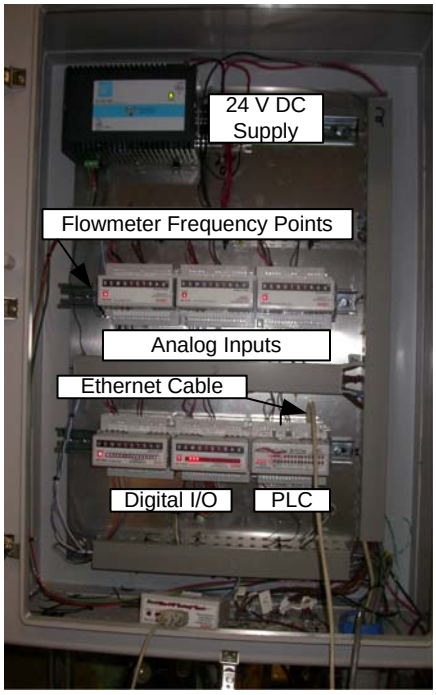
At the top is a line of circuit breakers. The functions of these breakers are written in Sharpie on the breaker, and are numbered as well. These numbers correspond to the contactor as well as the selector switch on the front of the panel.

The circuit breakers are as follows, from left to right:
(front panel number) Description

- (1) Big Pump
- (2) Water Heater
- (3) Water Pump
- (4) Manure Heat
- (5) Freeze Protection (unused)
- (-) Gas Heat (Always on. Runs the heater tape on the gas system)
- (-) CP (Control Power- This breaker runs the 24V DC power supply for the PLC and telemetry systems)
- (6) SSep 1 (Sand Separator one, currently unused)
- (7) SSep 2 (Sand Separator two, currently unused)
- (8) Spare (Spare contactor/breaker/switch, currently unused)

The contactors are numbered left to right with the same numbers as are in parenthesis above. Where the wires leave the cabinet at the bottom, the conduit is labeled in sharpie indicating where the wires go.

PLC Cabinet:



The PLC Cabinet contains the PLC and the IO modules for gas sensing and temperature sensing. There is another small box next to the HMI enclosure which holds more analog inputs to read the thermocouples mounted on that section of the tank. There is an RS-485 loop the runs from the PLC and daisy chains all the IO modules together.

At the top of the PLC cabinet is the 24V supply. This is an autosensing DC supply that can take input voltages from 120 -> 240 without any trouble. The output of this goes to a set of jumper blocks that distributes the DC around this cabinet, and to two larger gauge red and black wires that take the DC to the DC distribution section of the AC cabinet.

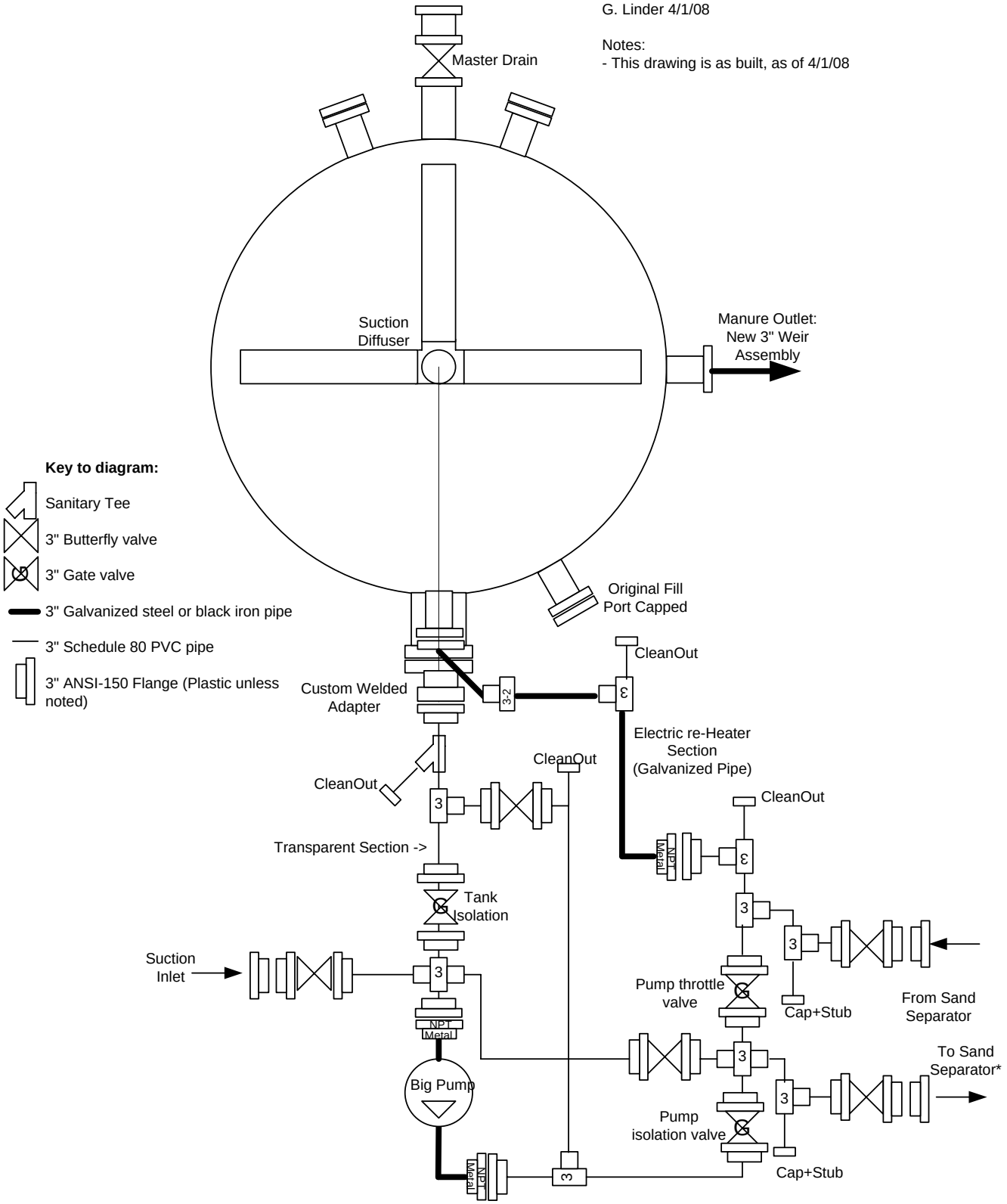
There are three analog input modules in the center of the enclosure. The left hand module reads the gas system analog data. The other two read temperature data. In the lower row, from left to right, is a digital input module that read the front panel pushbuttons, a digital output module that drives the contactors, and the PLC itself.

Also of note here is a set of terminal blocks to the left of the analog input modules. There is a twisted pair of white and blue wires that goes and terminates in these points. This is the output from the water system flow meter that we did not have time to fully integrate. Using a good multimeter on its frequency (Hz) setting, and measuring across these pins will give you the frequency output of the flowmeter. There is a calibration sheet in this manual that is yellowed and terrible looking. This has the data required to read that frequency. In case that sheet gets lost or crumbles to dust, the flow meter outputs 64.072 cycles per gallon. Knowing that constant and the frequency of pulses (at one pulse per revolution of the meter), you know how many gpm is flowing through the heater system. Typically, it reads around 16 Hz, which corresponds to around 15 GPM. If you read 60 Hz, you aren't touching the pins themselves, and the meter is reading the 60 Hz from the AC lines that run the power supply at the top of the box, which pass several inches away from these terminal blocks.

Manure System Plumbing Diagram

Plumbing Layout for Manure Mixing System
G. Linder 4/1/08

Notes:
- This drawing is as built, as of 4/1/08



Control System Addresses

Station Number	Station Name	Local Pins	Data Type	Modbus	Sixnet	Tag Name	Description
1	PLC	DI 1	24V DC	00047	X46	Gas_Pulse	Input f rom Pulser
Right Rear Cabinet		internal	Analog	30007	AX6	meth_volume	Counter for Gas_Pulse
2	OUPUTS1	DO1	24V DC	00009	Y8	Big_Pump	Manure pump contactor
Right Rear Cabinet		DO2	24V DC	00010	Y9	WaterHeater	water heater contactor
		DO3	24V DC	00011	Y10	WaterPump	water pump contactor
		DO4	24V DC	00012	Y11	ManureHeater	manure heater contactor
		DO5	24V DC	00013	Y12	FreezeProt	freeze protection contactor
		DO6	24V DC	00014	Y13	SS1	sand separator 1 contactor
		DO7	24V DC	00015	Y14	SS2	sand separator 2 contactor
		DO8	24V DC	00016	Y15	Spare	spare contactor
		DO9	24V DC	00017	Y16	Spare_Lamp	spare pushbutton indicator (FEED OFF)
		DO10	24V DC	00018	Y17	Mix_Lamp	mix pushbutton indicator
		DO11	24V DC	00019	Y18	Feed_Lamp	feed pushbutton indicator (FEED ON)
3	INPUTS1	DI1	24V DC	00013	X12	spare_button	spre pushbutton (FEED OFF)
Right Rear Cabinet		DI2	24V DC	00014	X13	mix_button	mix pushbutton
		DI3	24V DC	00015	X14	feed_button	feed pushbutton (FEED ON)
4	TEMP1	1-2	Type T TC	30047	AX46	Heater_In	Heater Inlet temperature
Right Rear Cabinet		3-4	Type T TC	30048	AX47	Heater_Out	Heater outlet temperature
		5-6	Type T TC	30049	AX48	HX_Return	HX return temperature
		7-8	Type T TC	30050	AX49	HX_Supply	HX supply temperature
		9-10	Type T TC	30051	AX50	T4A	Tank Temp T4A
		11-12	Type T TC	30052	AX51	T4B	Tank Temp T4B
		13-14	Type T TC	30053	AX52	T4C	Tank Temp T4C
5	TEMP2	1-2	Type T TC	30015	AX14	T1A	Tank Temp T1A
Right Rear Cabinet		3-4	Type T TC	30016	AX15	T1B	Tank Temp T1B
		5-6	Type T TC	30017	AX16	T1C	Tank Temp T1C
6	TEMP3	1-2	4-20 mA	30023	AX22	meth_conc	Meth concentration, 0-100%
Right Rear Cabinet		3-4	0-5 V	30024	AX23	tank_pressure	Tank pressure, 0-1 PSI
		5-6	4-20 mA	30025	AX24	poop_flow_rate	poop flow rate, 0-200 GPM
8	TEMP4	1-2	Type T TC	30031	AX30	pump_t	Pump Temperature
Side next to HMI		3-4	Type T TC	30032	AX31	T2A	Tank Temp T2A
		5-6	Type T TC	30033	AX32	T2B	Tank Temp T2B
		7-8	Type T TC	30034	AX33	T2C	Tank Temp T2C
		9-10	Type T TC	30035	AX34	Manure_Heat_in	Manure heater inlet temp
		11-12	Type T TC	30036	AX35	Manure_Heat_out	Manure heater outlet temp
		13-14	Type T TC	30037	AX36	Gas_temp	Gas system temperature
9	TEMP5	1-2	Type T TC	30039	AX38	T3A	Tank Temp T3A
Side next to HMI		3-4	Type T	30040	AX39	T3B	Tank Temp T3B

			TC				
		5-6	Type T TC	30041	AX40	T3C	Tank Temp T3C
		Internal	Int temp sns	30046	AX45	T_Ambient	Ambient Temperature
None	HMI	Virtual	Boolean	00025	Y24	Mix_enable	Enable / disable auto mix feature
In HMI Enclosure		Virtual	Boolean	00026	Y25	manure_heat_on	Turn on and off the manure heater
		Virtual	Unsigned 16	40001	AY0	T_water_SP	Water temperature setpoint
		Virtual	Unsigned 16	40002	AY1	T_tank_SP	Tank temperature setpoint
		Virtual	Unsigned 16	40003	AY2	mix_time	mix time (seconds)
		Virtual	Unsigned 16	40004	AY3	mix_interval	mix interval (minutes)