STANDARD OPERATING PROCEDURE
STAN MAYFIELD BIOREFINERY PILOT PLANT

TITLE: Scrubbers Operation

AUTHOR: Ismael U. Nieves **DATE: August 20th, 2012**
APPROVALS: Process Change Committee **DATE: October 9th, 2012**

A. Scope

This SOP describes the procedure to operate the CO_2 and the bleach Scrubbers in order to remove volatile organic compounds from the venting system and inactivate any air borne Genetically Modified Organisms that may be contained in the vent gases from the fermentation system. The Scrubbers must be operational whenever any part of the main process is taking place.

B. Safety and Training Requirements

Refer to UF lab safety policies regarding equipment listed in section D below before starting any process work.

Refer to UF Biosafety guidelines and the NIH Guidelines whenever handling biological cultures/genetically modified organisms.

Review the location of fire extinguishers, fire blankets, safety showers, spill cleanup equipment and protective gear before beginning any process work.

During operations in the plant, the following safety gear will be utilized at all times:

- Safety Goggles
- Protective Gloves
- Hard Hat

C. Related Documents and SOPs

1. Sugars, Organic Acids and Inhibitors Concentration SOP-0505
2. Viable Plate Count SOP-0507
3. Sampling SOP-0511
4. Bleach Measurement SOP-0517
5. Beer Well SOP-4601
6. Process Water System SOP-9505
7. Waste Water System Operation SOP-9530
8. MSDS – sodium hypochlorite

D. Preparation/Materials/Equipment

1. PPE: face shield and respirator
2. Sodium hypochlorite solution (12.5% w/w)

3. Process water
4. Portable pump and hose to transfer hypochlorite solution.

E. Detailed Procedure

1. Assure the process water is ready according to the Process Water System SOP-9505.
2. Assure the Bleach Solution Tote contains at least 40 gallons of bleach solution (2% sodium hypochlorite). If not enough solution is present in the bleach tote:

CAUTION: Use face shield, respirator, chemical resistant gloves, and rain coat when handling hypochlorite solution

   a. drain the tote to the floor drain of the remaining solution,
   b. add water to the 250 gal mark on the tote using a process water hose via top port of tote,
   c. add a full drum (55 gal) of 12.5% sodium hypochlorite to the tote using portable pump,
   d. and fill the tote to 330 gal using process water hose.

3. Make sure the valves are set in the configuration outlined by the table below.

CO_2 Scrubber				
Line	Line Number	Valve	Position	Check
Ethanol to Beer Well	ETHW-7201-02-SS10	7201-V-05	Open	
		7201-V-10	Open	
	Pressure Indicator	7201-V-08	Open	
	Sample	7201-V-09	Closed	
	Drain	7201-V-06	Closed	
	ETHW-7201-04-SS10	7201-V-11	Open	
Process Water to CO_2 Scrubber	RCW-9501-10-SS9B Sample	7201-V-13	Closed	
CO_2 to Bleach Scrubber	CO2-7201-06-SS94	7201-V-15	Open	
	Pressure Indicator	7201-V-14	Open	
	CO2-7201-07-SS94 Pressure Indicator	7201-V-16	Open	
Pressure Indicator		7201-V-01	Open	
		7201-V-02	Open	
		7201-V-04	Open	
Level Indicator		7201-V-12	Open	

TITLE: Scrubbers Operation

Bleach Scrubber			
Base to Waste Water Tank	Base-7202-01-SS10	7202-V-06	Open
		7202-V-13	Open
		7202-V-15	Open
	Drain	7202-V-09	Closed
	Pressure Indicator	7202-V-11	Open
	Sample	7202-V-12	Closed
	Base-7202-03-SS10	7202-V-14	Open
Bleach to the Bleach Scrubber		7202-V-07	Closed
		7202-V-08	Closed
Vent to ATM	VTC-7202-04-SS10	7202-V-16	Open
Pressure Indicator		7202-V-01	Open
		7202-V-02	Open
		7202-V-04	Open
Level Indicator		7202-V-05	Open

4. At the HMI, set the bleach solution flow rate to 2 gpm using FIC-7203-09 and set the controller to AUTO.
5. At HMI, set the Bleach Scrubber liquid level to 60% in LIC-7203-05 and switch to AUTO.
6. At the HMI, verify that the level of the bleach scrubber is ~60%. If the level of the bleach scrubber is lower than 60%,
    a. Close valve 7202-V-06 at bottom of sump.
    b. Open valves 7202-V-07, -08 to connect the Bleach Solution Tote to the bleach solution supply line.
    c. At the HMI, turn on the Bleach Scrubber Pump (PC-7203) to transfer the bleach solution from the tote in order to fill the scrubber sump via the spray nozzle on the top of the Bleach Scrubber.
    d. A sample can be taken from the recirculation line using valve 7202-V-12 according to Sampling SOP-0511.

1. Verify the bleach concentration is between 1 – 3% using Bleach Measurement SOP-0517.

e. When liquid level reaches 60%,
   i. Open valve 7202-V-06 at bottom of sump.
   ii. Close valves 7202-V-07 and V-08 connecting the Bleach Solution tote.

7. If not turned on, start the Bleach Scrubber Pump PC-7203 at the HMI.
8. At HMI, turn on the CO_2 Scrubber Fan (FA-7201) to transfer the scrubbed vents of the CO_2 Scrubber to the Bleach Scrubber (SC-7203).
9. Make sure that valve 9501-V-31 is open in order to supply the process water to the CO_2 Scrubber (SC-7201).
10. At the HMI, set the process water flow rate to 2.00 on FIC-7201-09 and switch the controller to AUTO.
11. At the HMI, set the level of the CO_2 Scrubber to 50% on LIC-7201-05 and switch the controller to AUTO.
12. Assure the Beer Well is operational according to Beer Well SOP-4600.
13. Once the level is at (or slightly above) the set value (50-55%), turn on the CO_2 Scrubber Pump (PC-7201) at the HMI to start purging excess scrubbing liquid back to the Beer Well.
14. At HMI, monitor the temperature in the CO_2 Scrubber using TI-7201-04 to be between ambient and 200 F.
15. At HMI, monitor the pressure in the CO_2 Scrubber at top, midway and bottom using PI-7201-01, -02, and -03, respectively to be between -5 to +5 PSI.
16. Locally, monitor the pressure upstream and downstream of the CO_2 Scrubber Fan in PI-7201-07 and -08, respectively to be between -5 to +5 PSI.
17. Locally monitor the outlet pressure of the CO_2 Scrubber Pump in PI-7201-06 to be less than 10 PSI.
18. At HMI, monitor the pressure at the top, midway, and bottom of the Bleach Scrubber using PI-7203-01, -02, and -03, respectively to be between -5 to +5 PSI.
19. Locally, monitor the outlet pressure of the Bleach Scrubber Pump with PI-7203-12 to be less than 20 PSI.
20. Sample ports are provided in the ethanol (valve 7201-V-09) and process water lines (valve 7201-V-13) of the CO_2 Scrubber. Take samples according to Sampling SOP-0511 in order to measure volatile organic compounds (Sugars, Organic Acids and Inhibitors Concentration SOP-0505) and viable cells (Viable Plate Counts SOP-0507).
21. Sample ports are provided in the recirculation loop of the Bleach Scrubber to measure the hypochlorite concentration and/or presence of viable production organism.
    a. The bleach solution is sampled according to Sampling SOP-0511.

i. The Bleach Solution must be analyzed for having an effective concentration every two weeks (Bleach Measurement SOP-0517).
ii. During normal operation, when the pump is running, a sample can be taken from the recirculation line using valve 7202-V-12.
iii. If the pump is not running, a sample can be taken directly from the sump using valve 7202-V-09.

22. A sterile sample is obtained from the Bleach Scrubber using valve 7202-V-XX according to the Sampling SOP-0511 to test for viable microorganisms (Viable Plate Count SOP-0507).
23. When the process is complete, shut down the CO_2 and Bleach Scrubbers by:
    a. At the HMI, turn off CO_2 Scrubber Pump PC-7201.
    b. At the HMI, switch flow controller FIC-7201-09 to MANUAL and set the output to -5.00.
    c. At the HMI, turn off Bleach Scrubber Pump PC-7203.
    d. At the HMI, turn off scrubber fan FA-7201.