

Liquid Flow Bench – Draft Standard Operating Procedure

R.C 8-2016

Safety

- All students must wear safety glasses when working in the lab
- Never leave this equipment operating unattended
- Mix all chemicals in a fume hood
- All chemicals, solutions and standards must be stored in a sealed container. The container must be labeled with: the chemical(s) name and concentration, the user name or group name.
- All chemical containers must be sealed when not in use.
- All unwanted material must be placed in a Nalgene container. The container must be labeled “Unwanted Material” the label must include; the chemical(s) name and concentration, the user name or group name.

Equipment Description:

The Liquid Flow Bench is comprised of the following equipment

Sta-Rite centrifugal pump model JHF-51HL, 1 ½ horsepower motor

Omega Engineering Model FPR-200 paddlewheel type flowmeter, range 0-50 GPM

Control Valve Assembly – FLO-TITE 3-way diverting valve with actuator and positioner

Metering Pump – Pulsatron model LPK7SA-PTC3, flow rate 30.3 LPH, Max Pressure 50 PSI

Pressure Transducers: Rosemount 1PDT52, range 0-15 inches of water.

Rosemount 1FT609, range 0-200 inches of water

Dwyer Model 629, range 0-25 PSI

Handheld manometer, Dwyer Series 490-3, range 0-50 PSI

McCrometer V-Cone flow meter, Beta 0.613, I.D# 94100511, model V-1401

Data acquisition and control system: Opto 22

Feed tank, diameter 3 feet, height roughly 4 feet (before internal level sensor)

Miscellaneous valves including gate, globe, needle, ball

3-Packed Beds: Approximate I.D. 6 inches, packed with glass beads, catalyst pellets and sand grains approximately 1 mm in diameter.

Various pipe and tubing lengths as listed below in addition to a stainless steel tube coil, various elbows and smooth 90 and 180 degree curves. Each pipe section is fitted with analog pressure gauges and threaded taps allowing connection to digital manometers.

7 feet - ¾ inch stainless steel pipe

10 feet 1 inch stainless steel pipe

10 feet 1 inch stainless steel tube

10 feet 1 inch galvanized steel pipe

60 feet ½ inch stainless steel pipe

10 feet, glass, flow-visualization tube, approximately 3 inches I.D, with dye injection system.

Operation Guidelines:

The fluidized bed is typically used to measure pressure drops across pipe, tubing and the packed beds.

Measurements are taken by connecting poly-tubing from a pressure tap on a pipe or packed bed to a manometer, either a hand-held manometer which does not log data or one of the fixed pressure transducers that transmit data to the Opto22 control system.

Flow is controlled by adjusting the computer controlled 3-way diverting valve and the manually operated recycle valve. Care must be taken not to dead-head the pump when adjusting the valves.

When the diverting valve is set to 0% all the flow will go through the recycle valve and into the feed tank.

With the diverting valve set to 100% all flow is directed into the piping system.

The 3-way diverting operates in a non-linear manner as described below.

Determining maximum flow out of the pump:

- a. Set the valves such that the water flows through all the horizontal pipes and tubing except the 60 foot section.
- b. Open the manually operated recycle valve 100%
- c. Set the diverting valve to 100 %
- d. Start the pump.
- e. Close the recycle valve
- f. The maximum flow rate as displayed on the Opto control system will be in the range of 21-22.5 GPM

Determining the minimum flow out of the pump:

- a. Stop the pump.
- b. Set the tubing valves as described above in determining maximum flow.
- c. Open the manually operated recycle valve 100%
- d. Set the diverting valve to 50%
- e. Start the pump and observe the pressure on the pump outlet pressure gauge, it should be below 50 psi.
- f. Observe the pump outlet pressure, it should remain below 50 psi if it exceeds 50 psi, open the diverting valve until the pump outlet pressure is no greater than 50 psi. Do not exceed 50 psi on the pump outlet pressure gauge.
- g. Now set the diverting valve to 43% and observe the flow rate. The average minimum flow rate is approximately 2.2 GPM, this is achieved with recycle valve closed and the 3-way diverting valve set to 43%. Setting the 3-way diverting valve to a setting lower than 43% will stop the flow through the system.
- h. The minimum and maximum flow will of course depend on the pressure drops within the flow path.

Measuring pressure drops:

When measuring pressure drops always take your first measurement using the Dwyer hand-held series 490 manometer. Once you have an idea of the range of pressure you will be reading you may then connect the pressure taps to the appropriate data logging pressure transducer as listed in the equipment description section.

Take care to observe the high and low pressure designations for the pressure taps on each pressure transducer. Connecting the high pressure side to the low pressure connection of the transducer can damage the instrument.

Viewing and saving the data

1. Once you have exited the Opto program, open Excel
2. In Excel go to: Open, then navigate to the data folder, C:\Data Liquid Flow Bench. In the bottom of the Excel window click on the drop-down window and select All Files, the data files should now be displayed. The data files are organized by date.
3. Double-click on the file you wish to open. The Text Import Wizard will open. Select delimited then click Next, then select Comma delimited, select Next, select the General data format option and then select Finish. The data should now be displayed in Excel.
4. Save this data to a flash drive after each lab.

Shutdown:

1. Stop the pump.
2. Set the Control valve to 50%
3. Turn of the Pulsatron metering pump.
4. Properly label and store any sample material.
5. Make sure all fittings and pressure taps are sealed and secure.
6. Exit the Opto data – control system.
7. Save your data to a flash drive.
8. Open the drain valve on the feed tank.
9. Do NOT shut down the computer.