

Pumping Biomass

Using Teledyne ISCO Syringe Pumps

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Overview

Developing the most economical processes for the conversion of biomass into alternative fuels and chemicals is dependent upon precise laboratory modeling of real-world conditions. Steady, scalable proportioning and accurate flow rates are essential for bench-scale reactor testing of processes such as pyrolysis or gasification of organic materials. System components must handle varying ranges of viscosities and particulate content when breaking down biomass materials.

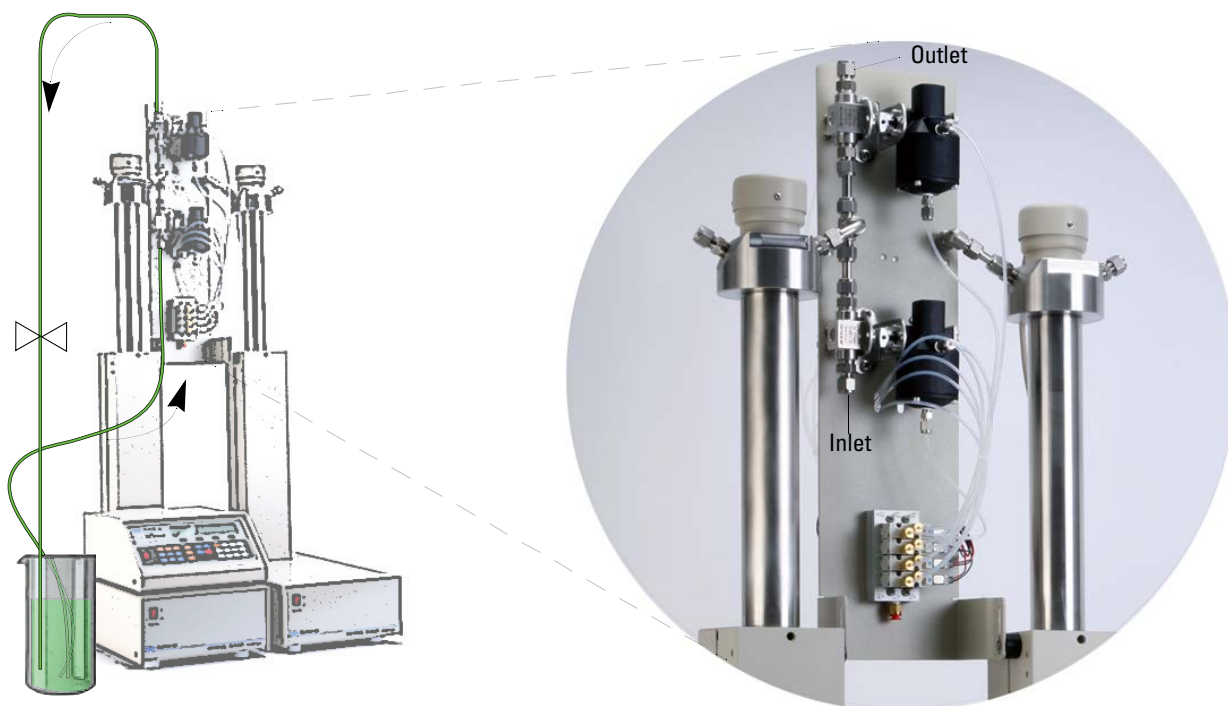


Figure 1: ISCO pump refill configuration using varying port sizes and viscosities

Laboratory Setup

In the laboratory at Teledyne ISCO, slurry mixtures with specific weight-weight ratios were pumped through a Teledyne ISCO Syringe Pump system in order to determine what degrees of slurry thickness could be pumped with an ISCO pump.

The dual pump system consisted of a controller and two pump modules with dual air ball valves, as shown above in Figure 1. The refill inlet was connected to $\frac{3}{8}$ " O.D. PTFE tubing, 1 meter long. The outlet was connected to $\frac{1}{4}$ " O.D. SST tubing.

The ISCO pump used in the experiment was the model 500HV [note 1]. The 500HV is a custom pump for high viscosity materials that is equipped with larger ports for reduced flow resistance and improved filling.

Experimental Procedures

Three different substances (water, uncooked cornstarch, and vegetable oil) were mixed at varying weight-weight ratios with a base of water to create several specific viscosities.

Each experiment was considered successful if the pumps completed the refill without cycle interruption, or blockage.

Table 1: 500HV Performance Data

Mixture	Set Flow Rate	Average Pressure	Run Time
Water only	132 ml/min	2,000 psi	30 min.
20% Cornstarch	132 ml/min	2,000 psi	30 min.
40% Cornstarch	132 ml/min	2,000 psi	30 min.
Vegetable Oil	132 ml/min	2,000 psi	30 min.

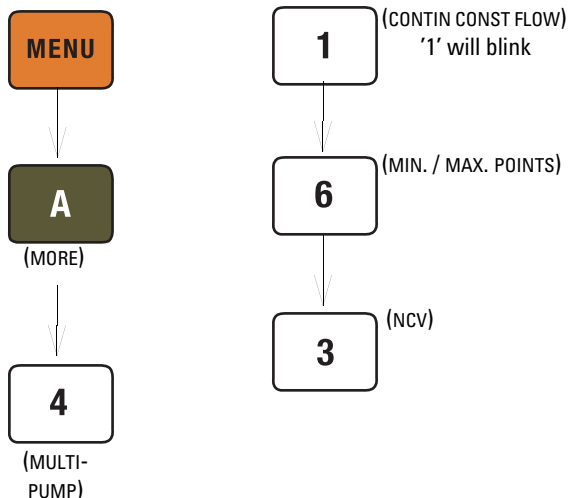
Custom Software

To reduce line restriction, the current 500xv pump for high-viscosity materials does not have a check valve on the inlet. (This was also true of the 500HV pump.) Consequently, the 500xv pump controller has a NO CHECK VALVE (NCV) feature to prevent backflow from the inlet valve at the end of a pumping cycle.

NCV can be set to reduce the pressure to a set value (minimum of 10 psi), so that when the valve opens, pumped liquid is not pushed back out. The software also keeps the valve closed for a set time to allow the pump to reach the specified pressure.

NCV Programming for the 500xv

To program the 500xv pump to reduce pressure and to time the inlet valve, select:



Pressing '3' (NCV) presents further options. Set the pressure and time values by selecting:

- 1** (PRESSURE POINT : 010 PSI)
Enter the desired pressure. Minimum 10 psi.
- ENTER**
- 2** (TIME POINT : 15 SEC)
Enter the desired time interval.
- ENTER**
- 3** (FUNCTION NCV : ON)
Press to toggle 125d function on/off. Default: OFF. 125d selections will not work until turned ON.
- D** (PREVIOUS)
Press 5x to return to RUN screen.

500xv System Details

The ISCO 500xv pump features flow rates up to 132 mL/min at pressures up to 344.7 bar (5,000 psi), with 500 mL capacity, as well as 3/8" ports for handling viscous fluids.

Table 2 lists major system components with part numbers.

Note:

The 500HV model pump is discontinued. Current model 500xv is the recommended replacement for the older 500HV model.

*October 31, 2012; revised November 7, 2023
Product model names have been updated in this document to reflect current pump offerings.*

Table 2: 500xv System Components

500xv Pump Module 117V	68-1240-829
500xv Pump and Controller 117V	68-1240-850
A500xv Dual Pump System for continuous flow 117V	68-1240-829 with (2) + 68-1240-850 with (1) + 60-1267-020 with (1)

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