

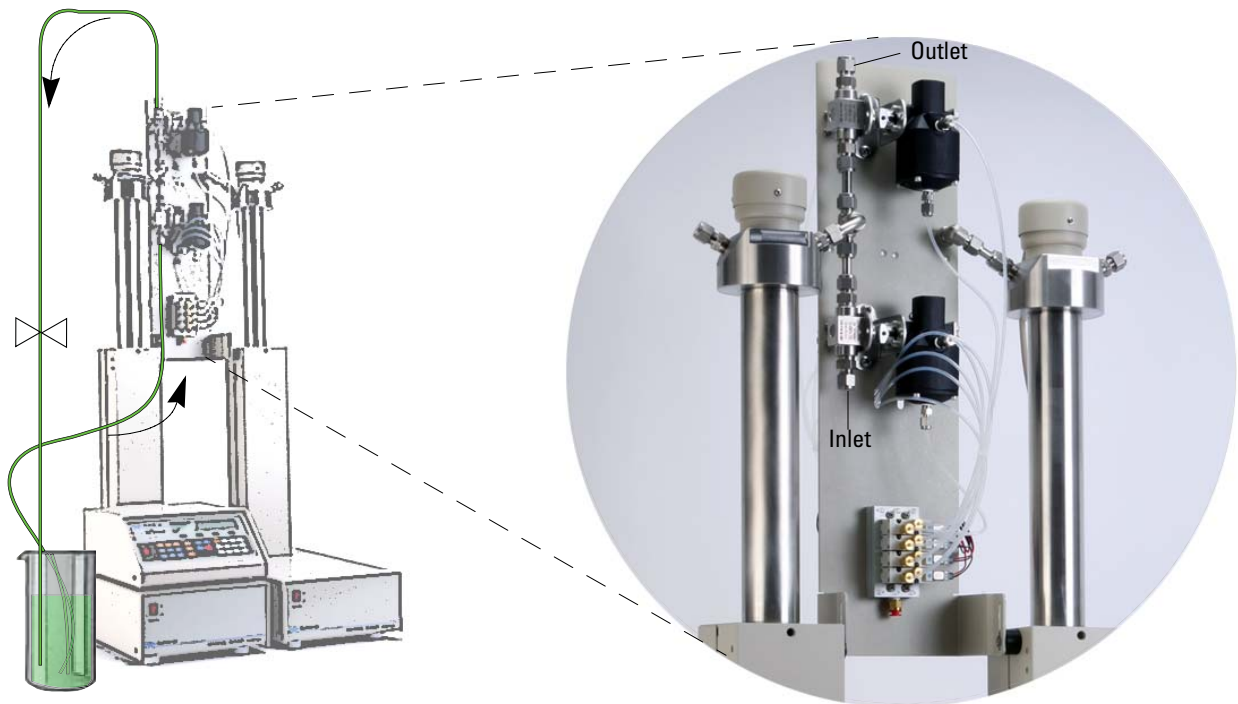
# Pumping Biomass

## Using Teledyne Isco Syringe Pumps

Teledyne Isco, Inc. USA

### 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, Inc., 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. The 500HV (High Viscosity) is a custom pump 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 determined 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.

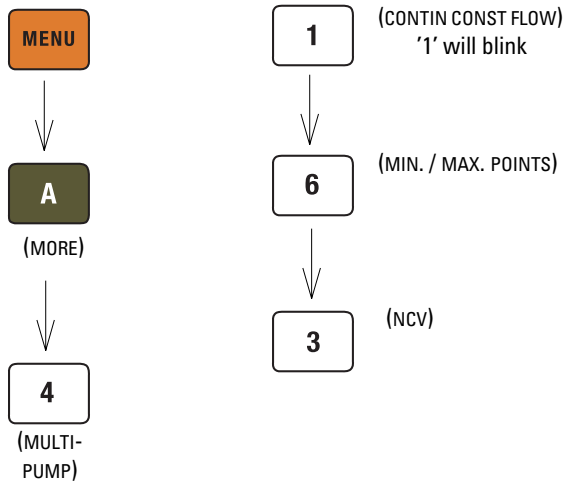
### Custom Software

In order to reduce line restriction, the 500HV pump does not have a check valve on the inlet. Consequently, the 500HV requires modified software for the controller to prevent backflow from the inlet valve at the end of a pumping cycle.

The software version Custom 125d is modified 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.

### 125d Software Programming for the 500HV

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



3 (NCV) brings up the custom 125d software menu. 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.

### 500HV System Details

The Isco 500HV pump features flow rates up to 132 ml/min at pressures up to 258.5 bar (3,750 psi), with 500ml capacity, as well as 3/8" ports for handling viscous fluids.

Table 2 lists major system components with part numbers.

**Table 2: 500HV System Components**

500HV Pump Module 117V	60-5364-226
500HV Pump and Controller 117V	60-5364-229
A500HV Dual Pump System for continuous flow117V	60-5364-230

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