Introduction

Levitronix® provides a closed-loop flow control system for batch tool applications to control the turnover rate. The system mainly consists of a *Bearingless Pump System* (BPS) and a flow meter. The flow controller itself is implemented on the pump controller of the *Bearingless Pump System*.

Closed-loop flow control systems are provided for a wide flow range from 5 mL/min up to 120 L/min, dependant on the used *Levitronix®* pump and flow meter selected, along with the size of the bath and the desired recirculation flow rate.

Please contact *Levitronix®* for special requirements.

Levitronix® has designed the closed-loop flow control system to offer the following benefits for batch tool recirculation applications:

- Closed-loop flow control system

- Precise liquid flow control independent of
    - Filter loading
    - Viscosity and density of medium
    - Temperature of medium
    - Contamination of medium

- Continuous smooth process flow with no pulsation that increases uniformity of processes

- Constant recirculation rate provides additional parameter for process recipe

- Higher repeatability of process

- Dynamic Condition Trending (DCT) allows observation of the filter loading

- The contact free pump technology reduces the number of particles

- Increased Availability of tool based on very high MTBF of pump

Levitronix® recommends this setup for following processes:

- ✓ Batch cleaning applications

- ✓ Batch etching applications

- ✓ Batch plating applications

System
Overview

All wetted parts of the hydraulic components are fabricated from fluorocarbon resins. The sensor signal of the flow meter is fed to the pump controller of the *BPS* system. The closed loop flow controller is running on the pump controller itself. The pump speed is set, so that the actual flow (signal from the flow meter) corresponds to the reference signal. The system overview is shown in Figure 1.
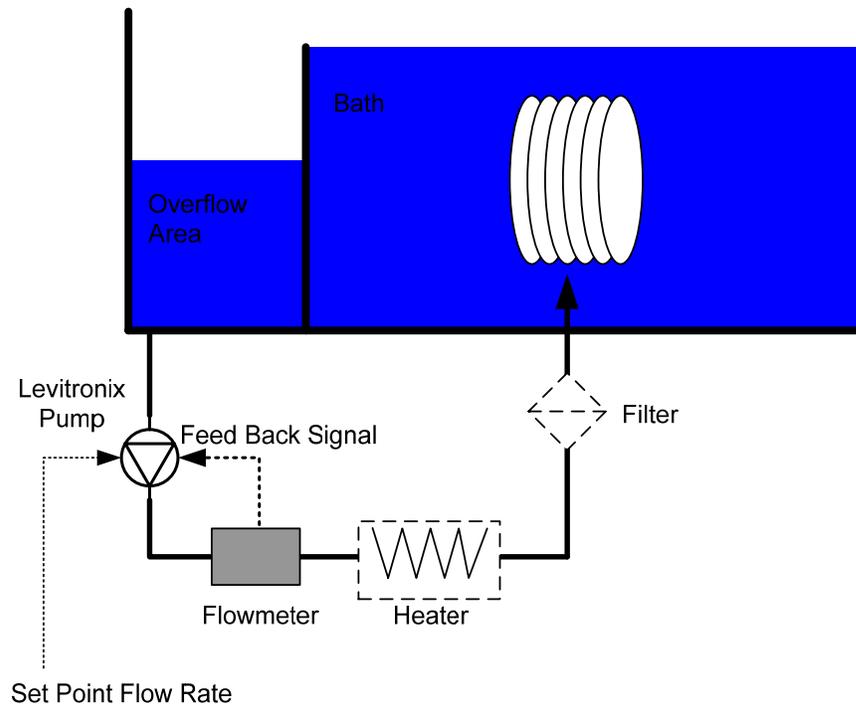
Figure 1: System Overview of the Closed-Loop Flow Control System

Dynamic
Condition
Trending
(DCT)

The system provides an actual flow signal and a *Flow Alarm*, whenever actual and set point flow doesn't correspond. Therefore low flow conditions are detected when caused by, for example, line clogging. In addition, a *Trend Warning* is provided, which enables failure prediction and scheduling of preventive maintenance. This so-called *Dynamic Condition Trending (DCT)* feature is based on pump speed information. *Figure 2* describes the function of this feature.
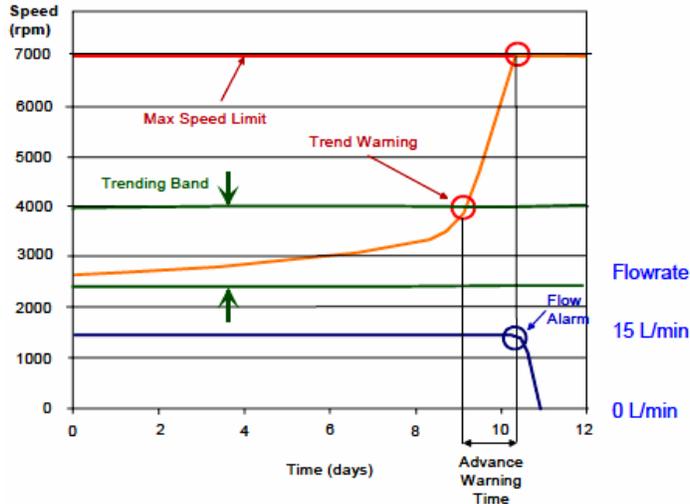

Figure 2: Dynamic Condition Trending (DCT) of Levitronix Flow Control System

The *Trend Warning* is some kind of advanced warning function. A warning on potential line-clogging is generated. The *Trend Warning* information is given by the pump speed.

Example: The flow control system is usually running with a pump speed of 2600 rpm to provide 15 L/min (maximum pump speed is 7000 rpm). If any component starts clogging (e.g. filter) the pressure drop in the loop is increasing, which means pump speed is slowly ramping up to maintain the set flow of 15 L/min. So if the pump speed exceeds 4000 rpm, the system provides a *Trend Warning*. The system is still able to provide the desired flow rate (there are still 3000 rpm until maximum speed is reached) but there might be an issue in the future. That gives time to schedule a preventive maintenance action. (All above mentioned parameters are configurable).

System
Operation

Turn key solution for replacing diaphragm or bellows pumps:

The *Levitronix®* flow control system can be operated by a single digital signal to turn on/off the pump system. In this case the set point flow rate is set as a fixed value in the controller (e.g. 10L/min). The turn on/off signal for the replaced air driven pump can be used for the Levitronix flow control system.

Integrated version into the tool PLC:

The *Levitronix®* flow control system can be operated by a single digital signal to turn on/off the pump system and an analog set point value for the desired flow rate. In this case the set point flowrate is given by the overlay PLC using a 4-20mA signal or a 0-10V signal.

The *Levitronix®* flow control system offers digital signals for process alarms and errors. The actual flowrate will be provided by an analog output 0-5V.

Technical
Support

For troubleshooting, support and detailed technical information contact *Levitronix®
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