Slurry Flow Monitoring for Cost Reduction

The Levitronix Smart System

Alain Chabourel
CMP Equipment Engineer
FTM Equipment Coordinator
Overview

Project Draw Up

Select a product

Slurry flow control

System make up

Drawbacks and Advantages

Conclusion

Acknowledgements
Most of the CMP tools are manufactured with peristaltic pumps.

A helix flow meter is used to measure the flow and transmit the feedback.
The flow on the pad is a « sinusoidal » projection
- Accuracy is around 10% to 15%
- Pumps need to be oftenly calibrated
- The flow meter clogs rapidly
- Before it clogs completly, the signal is lost and many alarms appears
- Lots of Fabs works without flow meters
The Challenge for this Year is Cost Reduction.
... No flow Detection = Alarm

... possibility to use any kind of slurries as well as DI Water

What are my NEEDS
In order to have...
...And select a product

... regular at any flow

... Capability to run very low flow

Select a product
### Select a Product

<table>
<thead>
<tr>
<th></th>
<th>Flow Controller “A”</th>
<th>Flow Controller “B”</th>
<th>Levitronix SmartSystem</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flow Measurement</strong></td>
<td>+/-1% of full scale from 20 to 100% flow. +/- 2.5% of full scale from 10 to 20% flow</td>
<td>+/- 1% of full scale</td>
<td>&lt;1%</td>
</tr>
<tr>
<td><strong>Response Time</strong></td>
<td>&lt;3 sec from 10 to 95% of full-scale</td>
<td>&gt;3 sec</td>
<td>&lt; 1sec</td>
</tr>
<tr>
<td><strong>Repeatability</strong></td>
<td>&gt; 1 millions cycles</td>
<td>&gt; 1 millions cycles</td>
<td>&gt; 1 millions cycles</td>
</tr>
<tr>
<td><strong>Reliability</strong></td>
<td>1% of full scale</td>
<td>+/- 2% of full scale</td>
<td>1% of full scale</td>
</tr>
<tr>
<td><strong>Pumps</strong></td>
<td>No pumps</td>
<td>No pumps</td>
<td>Bearing less pumps BPS-1</td>
</tr>
<tr>
<td><strong>Valves</strong></td>
<td>Pinch Valves</td>
<td>Needle valves</td>
<td>No valve</td>
</tr>
<tr>
<td><strong>Inlet Pressure</strong></td>
<td>&gt; 15 PSI</td>
<td>&lt; 10PSI</td>
<td>Just need to be charged</td>
</tr>
<tr>
<td><strong>Sub-Fab delivery</strong></td>
<td>10PSI ~10 meters high ~60 meters tubing</td>
<td>10PSI ~10 meters high ~60 meters tubing</td>
<td>10PSI ~10 meters high ~60 meters tubing</td>
</tr>
</tbody>
</table>
- Even if product A and B are attractive, their technology can be sensitive to clogging and can become an issue regarding our facilities concept.

- The inlet pressure for A is 15psi min required.

- The response time for B is > than 3 sec.

- Levitronix system fits to our facilities concept and to the low flow project and is an excellent compromise between the two competitors.

- Levitronix suggested us to build the system as our configuration. The project will be “plug and play”.

- A prototype was build in Levitronix’s lab to test with our slurry the system and this for three months.
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Select a Product

Slurry flow control
DOE done by Isabelle Vanni

RR vs Flow Rate

RR (A/min)

ml/min
- Actual process between 600ml and 510ml/wafer
- One of the cost reduction target is the slurry, by decreasing slurry consumption
- Continuous and regular flow are required at any time whatever the fluctuations in the main source line from distribution loop.
- **The flow has to be monitored**
System Make Up

10 psi slurry
From Facilities

Pressure Regulator

Levitronix Pump

Flow Meter

To the Pad
60/500ml

Pump Controller

Tool Slurry Feedback

Tool Software

Warning Or Alarm
System Make Up

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Drawbacks
Drawbacks

- The system is more sensitive:
  - to filter change due to new detection method (ultrasonic flow meter)
    but also to narrow windows of operation (2% warning and 5% alarm).
  - Clogging filters and tubings
  - Peristaltic pumps were not sensitive to that but issue was existing.

- The adjustments are not easy, a laptop is necessary to do the offsets.

- In case of maintenance, the pump access is quite difficult, but it is a compromise with the overall dimension.

- Difficulties to integrate the 3 controllers of the slurry pumps.

- Lots of place are needed to install all the components.

- Impossible to connect the three controllers at the same time to the laptop to do comparisons or checks platen to platen.

- Troubleshooting not very easy.
Advantages

- In case of maintenance the modularity of the system allows to change only incremented component and not the full assembly.
- Even if the access to the pump is difficult, the maintenance of the pump is once per 2 years in average (Impeller check).
- PFA tubing are used, so no defectivity. No Temperature effects on the pumps, neither from the pump to the slurry.
- The flow is stable at any value. The system is accurate, reliable and stable.
- The pump flow range does not depend on the flow range coming from facilities.
- Pump speeds from 0 to max flow in 0.15s
- Maintenance cost decrease: impeller check, flow check. Once the settings are adjusted, no more calibration has to be done.
Despite of its price, the Levitronix system satisfy our expectations by the:
- response time
- the size
- the accuracy
- the Reliability
- the multiples components.

On product A or B, if it breaks down, you need to change the whole system. On Levitronix system, you just have to replace the component that faults.

If it was to remake I would prefer a cheaper solution, maybe one Levitronix pump as a pressure booster with suitable flow controllers (one per platen)
Acknowledgments

- To Franck Berthet, ST Process Engineer, originator of the project called « Low Flow ».
- To Isabelle Vanni, ST Process Engineer, who made this project become reality.
- To Laetitia Sayer, ST Trainee, who studied the three flow controllers.
- Jean Philippe Rakitic, Entegris, who realized the concept for our tools.
- Simon Stoeckli and Jürg Burkhart, Levitronix, who developed the system.
- ...and

Guillaume Denoyelle, Entegris, who led and realized the installation.