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The Influence of Pump Technology on Large Particle Count (LPC) of CMP Slurries in Hard Drive Industry

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Outline

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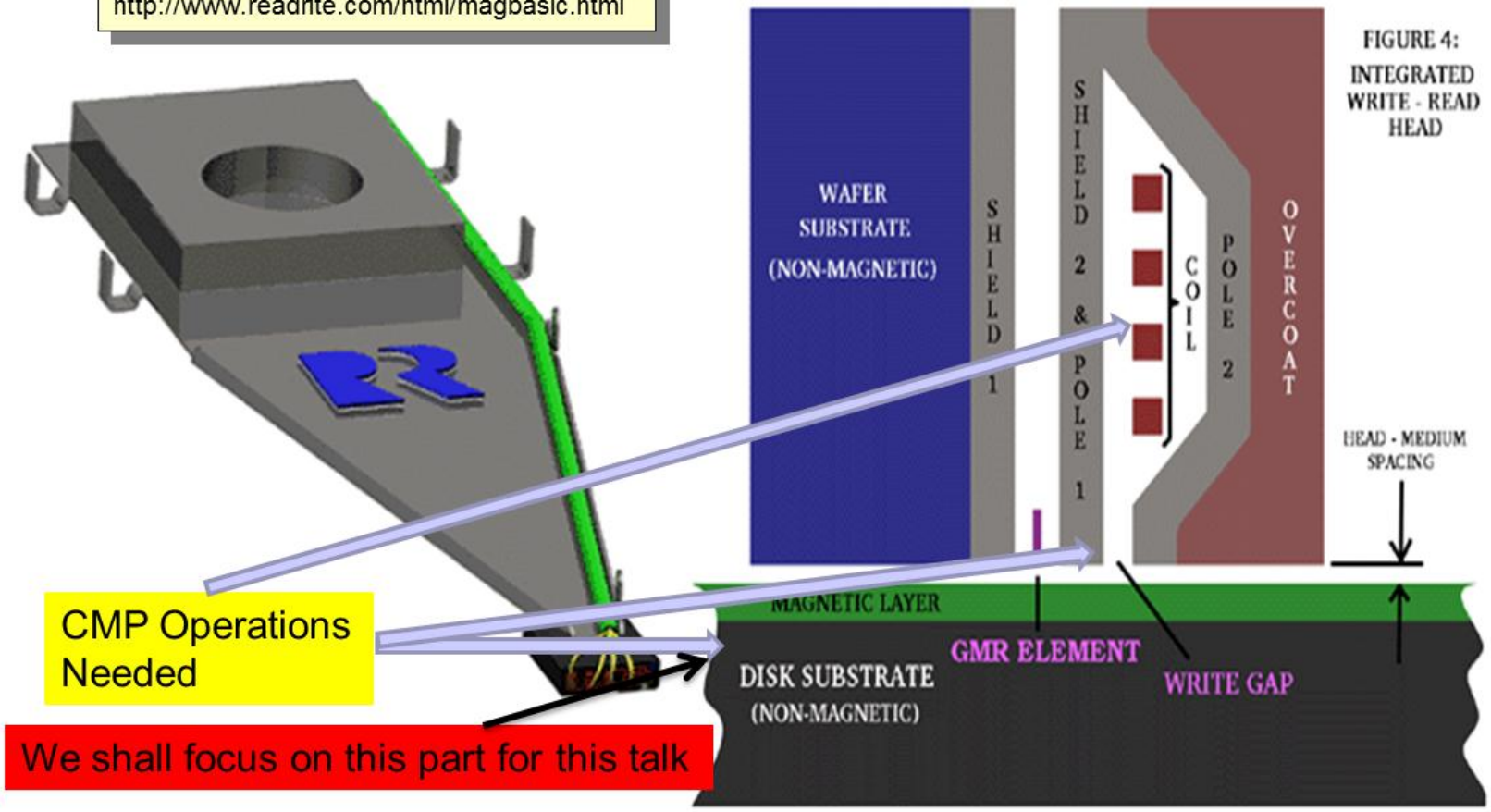
1. **Introduction and Motivation**
2. **Influence of Pump Technology on LPC**
3. **Effect of Pump Technology and LPC on defects in Ni/Al Disks**
4. **Effect of Pump Technology and LPC on defects in Glass Polishing**
5. **Summary**

Harddrive

A Closer Look at Read/write Gap

http://www.readrite.com/html/magbasic.html



Slide by Clarkson University.

CMP Steps in Harddrive

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Substrate: Glass or Aluminum

On top of aluminum,
a layer of NiP is needed

Typically need three step polishing:

1. Ceria for glass; alumina for NiP
   - Reduce micro/macro waviness
2. Silica for fine polishing
   - Reduce surface roughness
3. Silica or AFS for final conditioning
   - Reduce surface defects

Transition from LMR to PMR demands higher throughput and lower defectivity

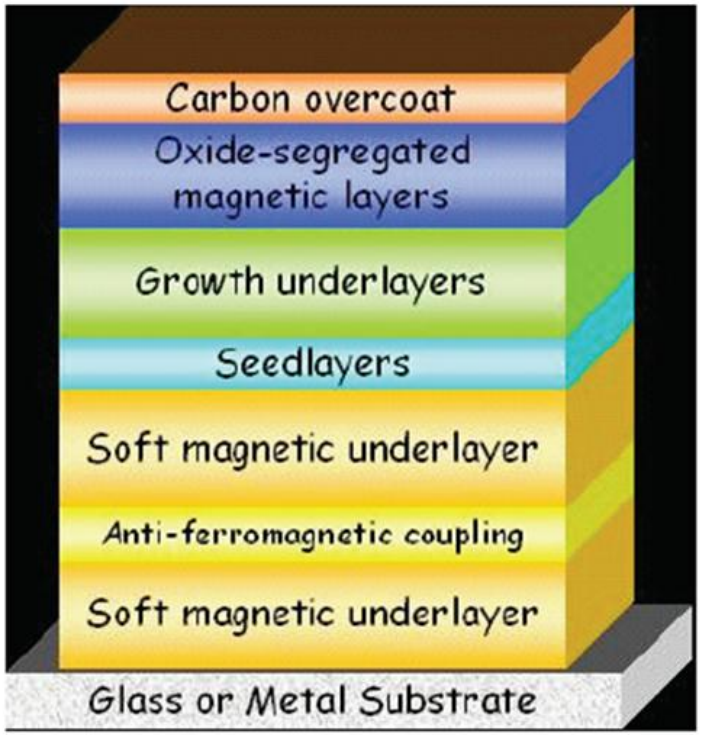

Figure 4: Hitachi Perpendicular Media Structure

http://www.bellmicro.com/partners/linecard/suppliers/hitachi-global/PMR_white_paper_final.pdf

Slide by Clarkson University.

Correlation between LPC and Defect Count (Scratch Count) in IC CMP

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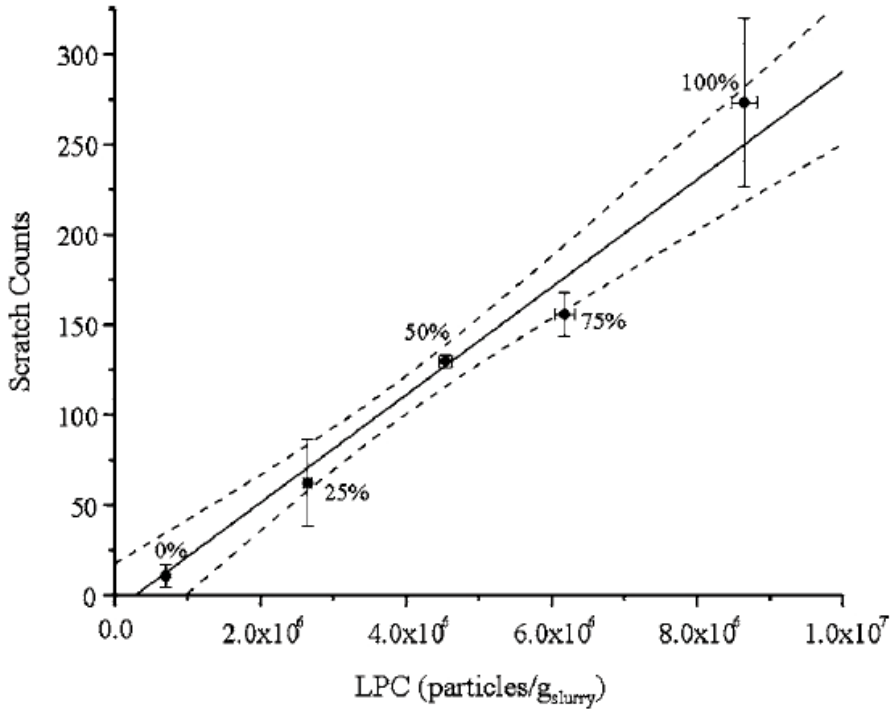

Figure 1. Correlation between scratch counts and LPC determined for particles with diameter ≥0.469 μm (S03 + S05) with mixtures of slurry A (0 wt % slurry B) and slurry B. Weight% slurry B for the mixtures is labeled at the corresponding data point. The weighted linear regression fit to the data set and 95% confidence limits are represented by the solid line and the dashed lines, respectively. Error bars correspond to ±1 standard deviation.

•E. Remsen, S. Anjar, D. Boldridge, M. Kamiti, S. Li, T. Johns, C. Dowell, J. Kasthurirangan, and P. Freeney,
• "Analysis of Large Particle Count in Fumed Silica Slurries and Its Correlation with Scratch Defects Generated by CMP,"
•Journal of The Electrochemical Society, 153 (5) G453-G461(2006).

There are many sources for LPC

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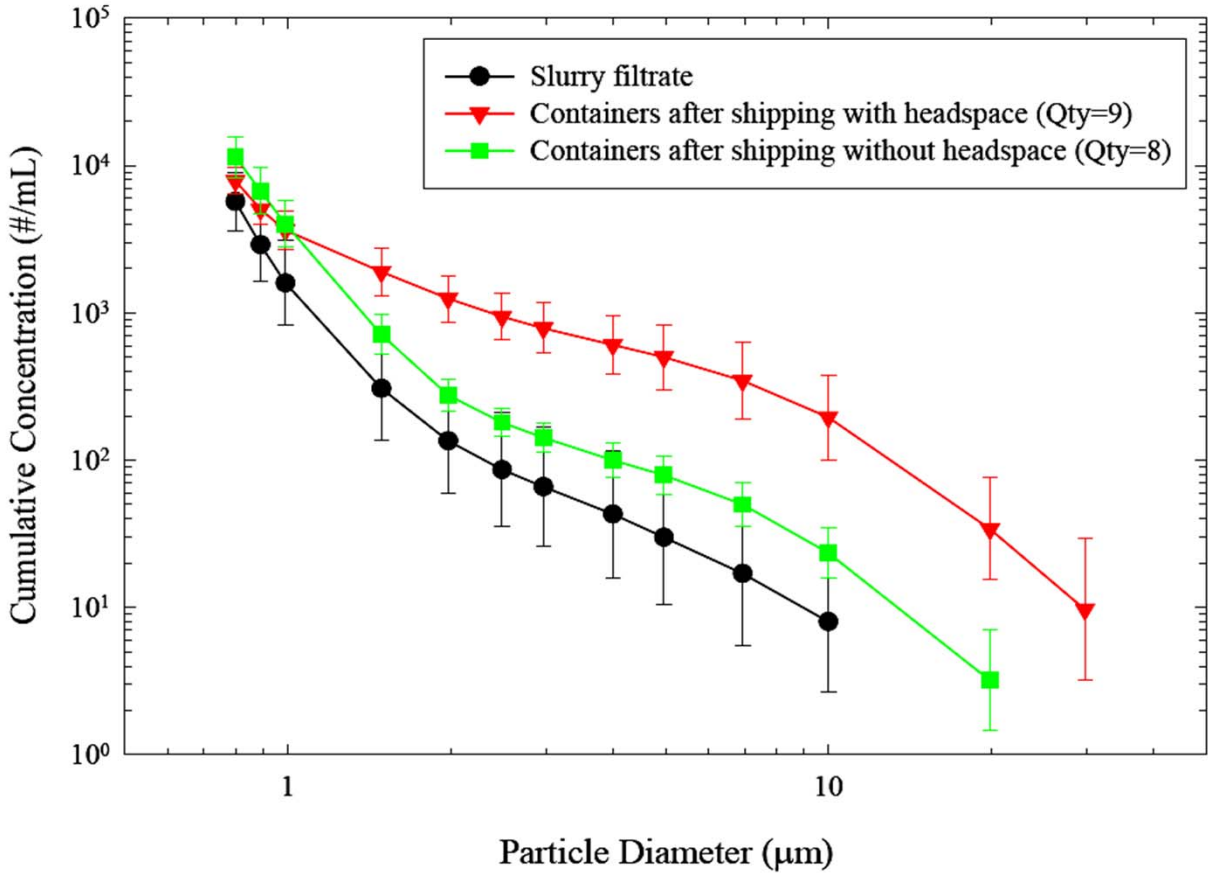
Effect of Headspace in (Shipping) Containers / Tanks / Vessels on Slurry PSD



Source: Don Grant, CT Associates, Levitronix CMP Conference 2005

➔ Avoid headspace in shipping containers, vessels and tanks

LPC with Different Pump Technologies

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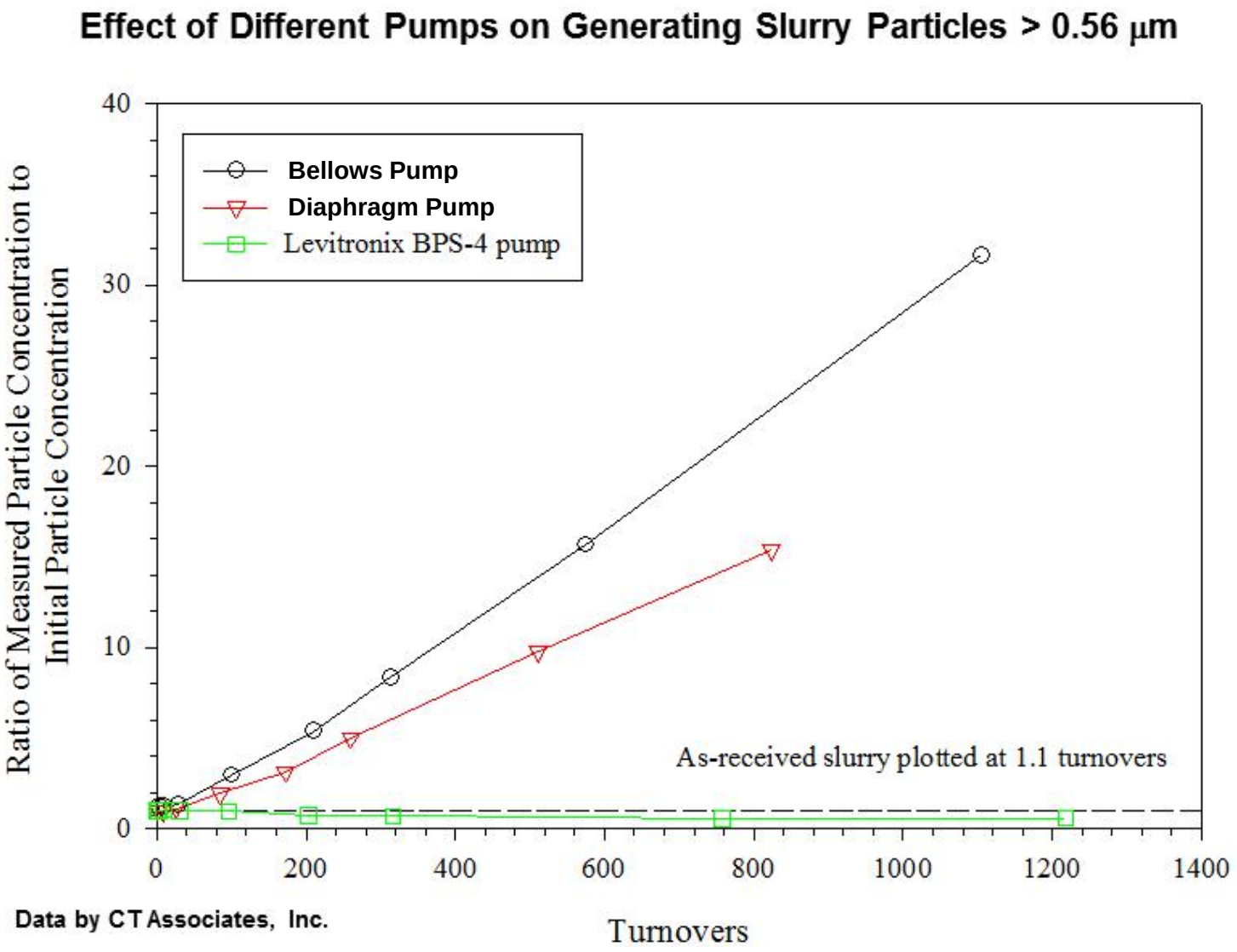

Effect of Different Pumps on Large Particle Concentration in Fumed Silica Slurry (Cabot® SS-12)

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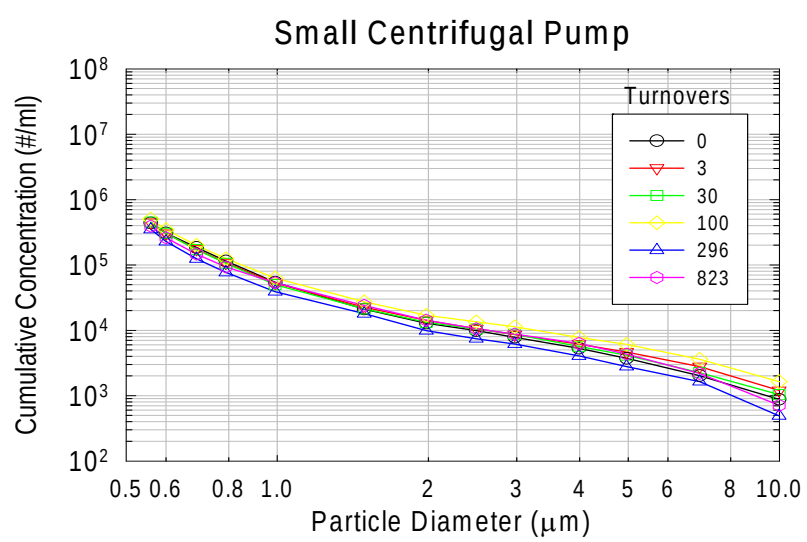

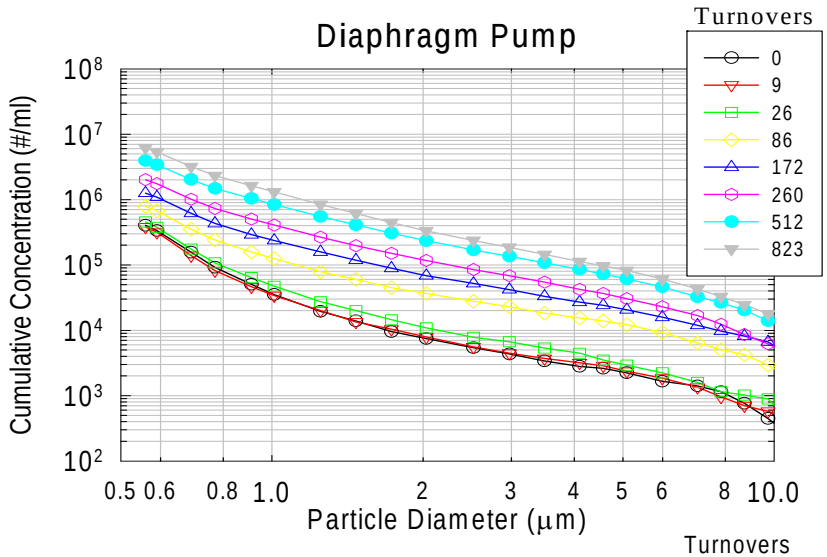

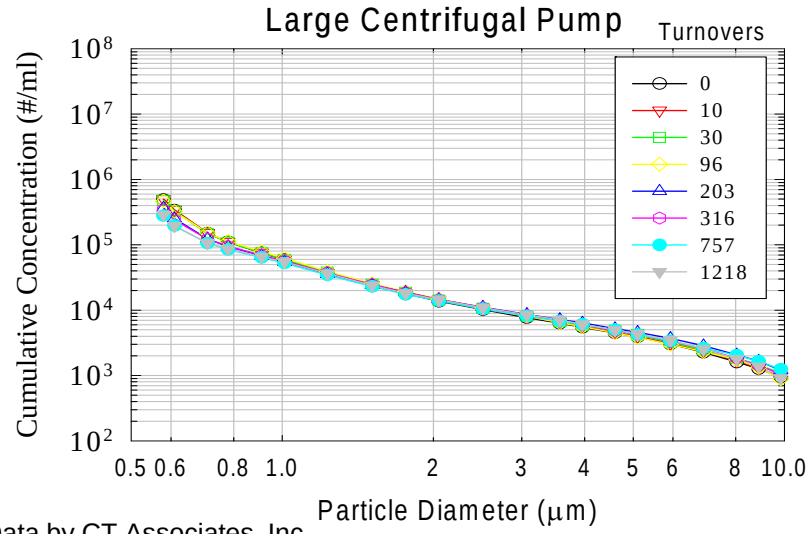

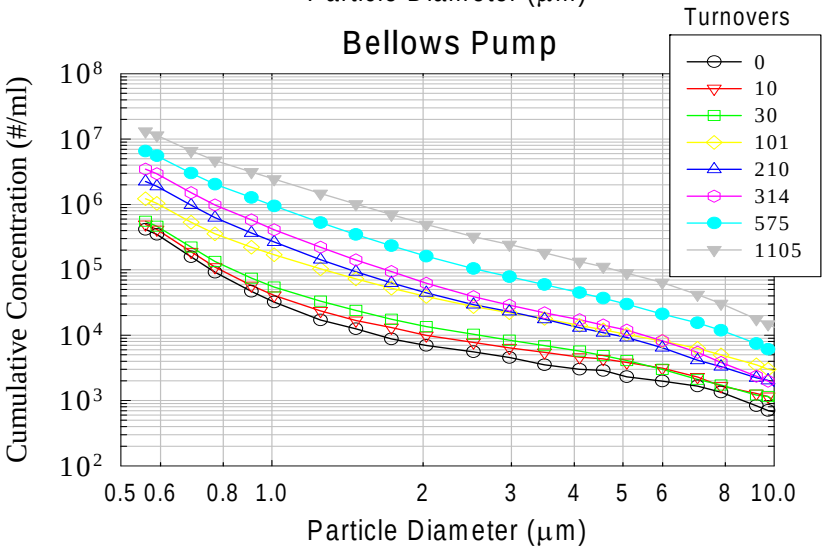

Data by CT Associates, Inc.

20% BindZil EF70515 (Eka, 70-80 nm) processed with different pump (Levitronix BPS4 vs. Bellows Pump)

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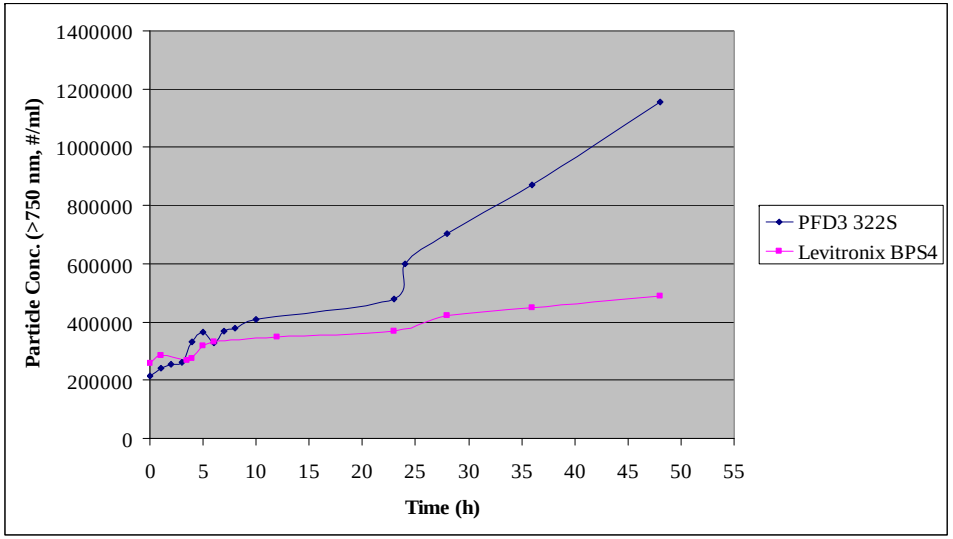
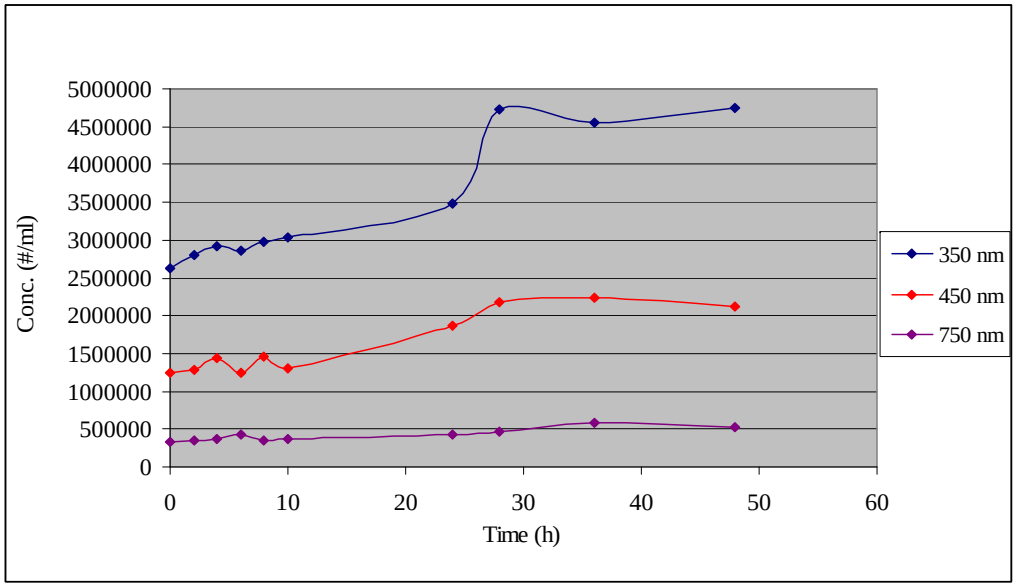


Data by Clarkson University.



Slurry pumped with Bellows Pump

Smaller particle concentration increases in higher rate.

15% NexSil 12 (NYACOL, 30-40 nm) processed with different pump (Levitronix BPS4 vs. Bellows Pump)

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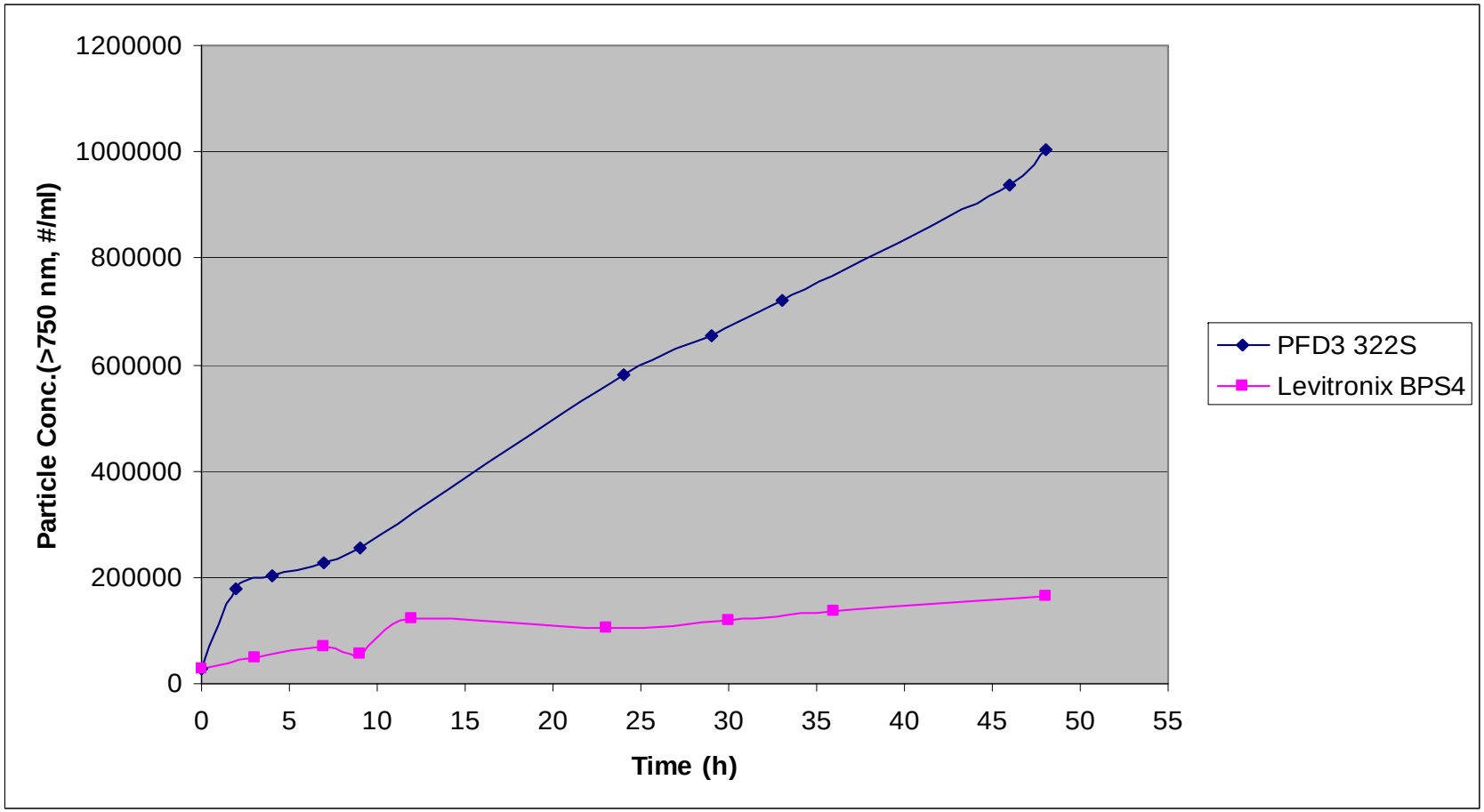

Data by Clarkson University.

15% NexSil 12 (NYACOL) processed with different pump (Levitronix BPS4 vs. Bellows Pump)

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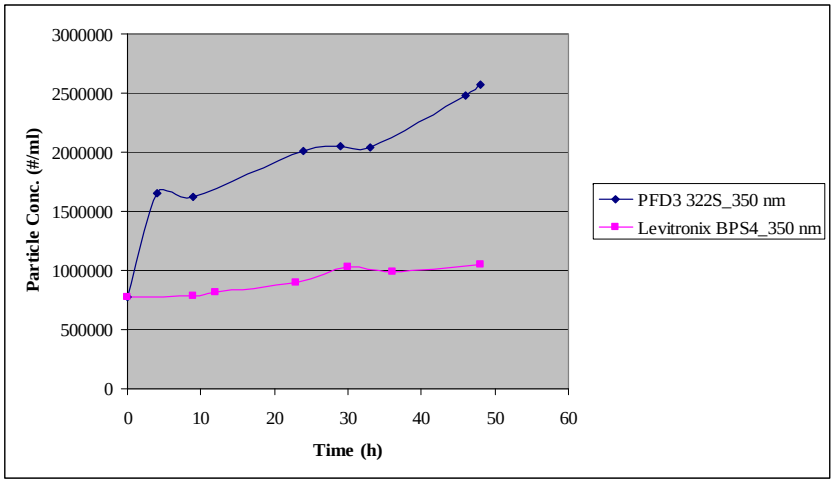

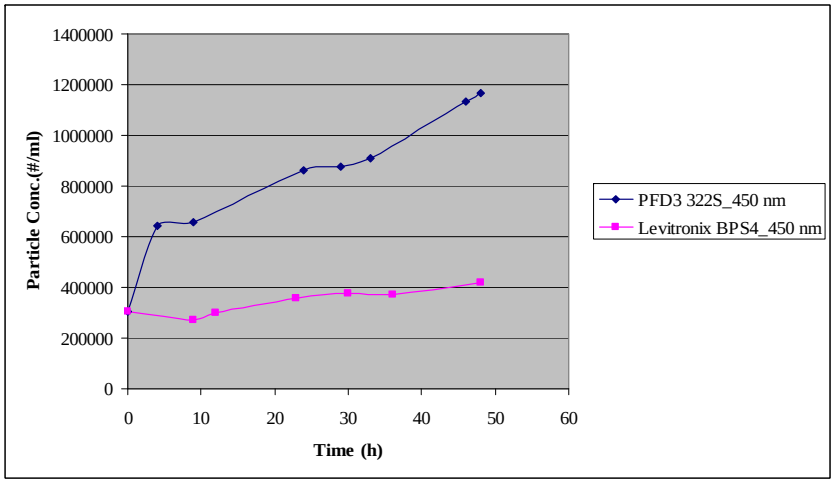

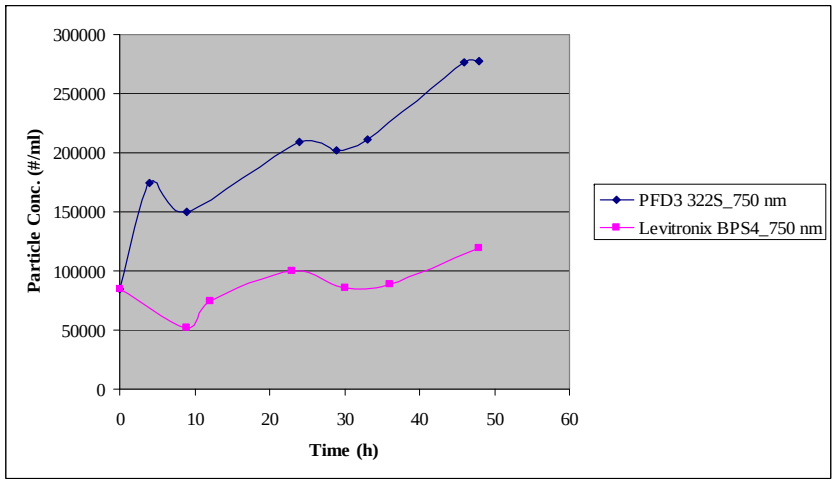

Data by Clarkson University.

In Levitronix BPS4 system, large particle concentration with different thresholds are constant compare with increasing trend in Bellows Pump system.

Levitronix BPS4 yield lower surface defectivity in NiP polishing

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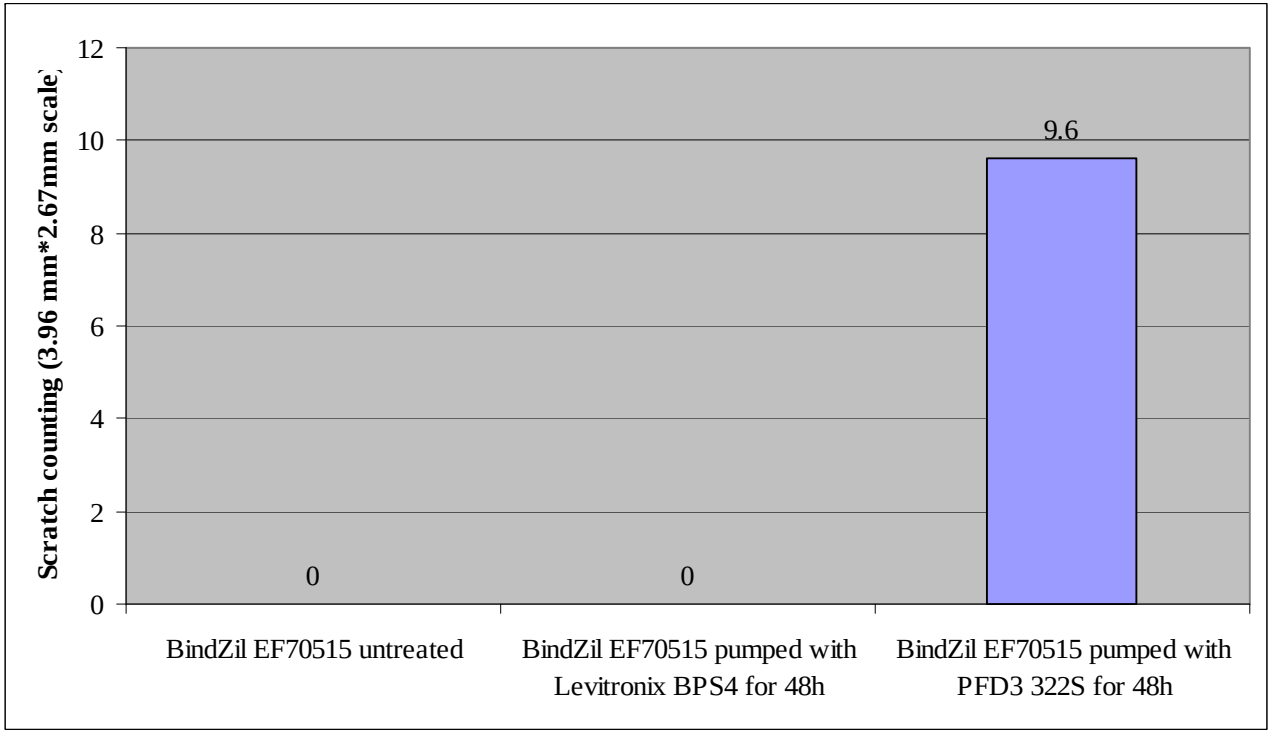
Data by Clarkson University.



Oversized particle lead to high surface defectivity in NiP polishing, while untreated slurry and slurry from Levitronix BPS4 system yield scratch free surface.

NiP Surface Images After CMP

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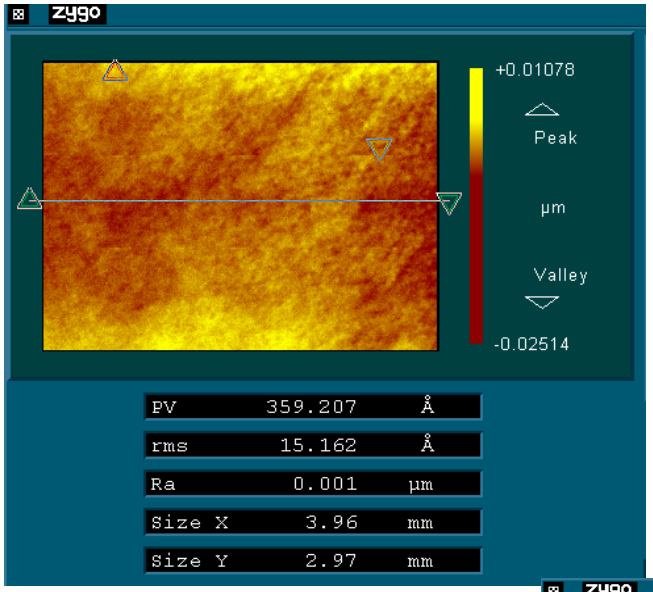
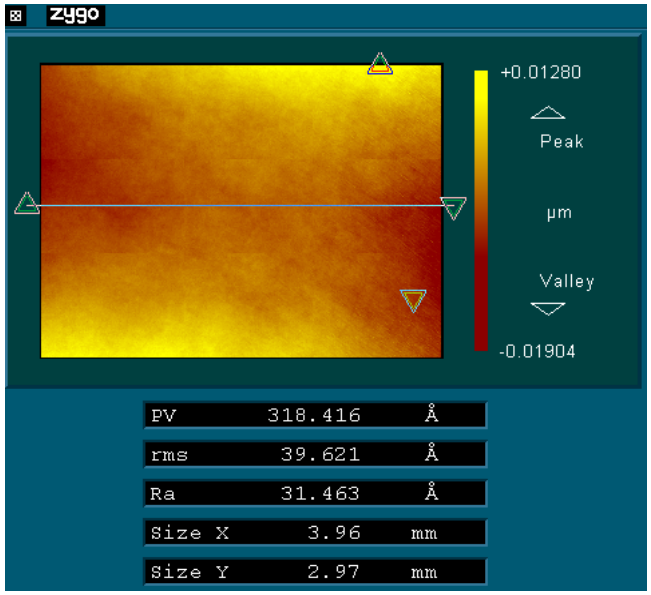
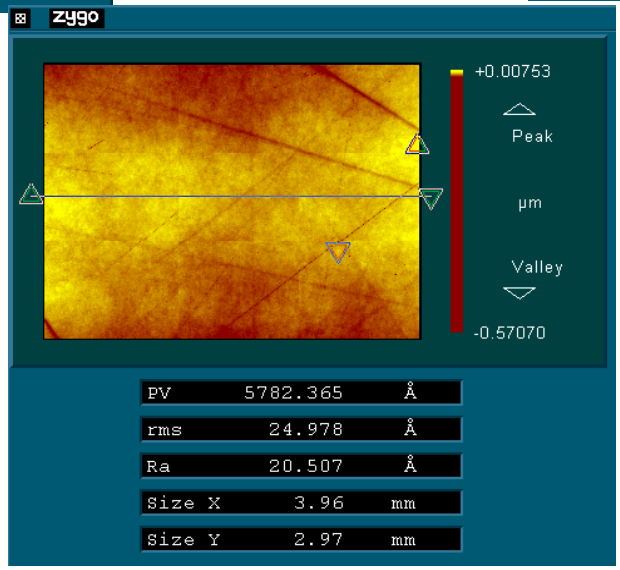


Untreated slurry



Slurry pumped with Levitronix BPS4



Slurry pumped with Bellows Pump

Data by Clarkson University.

Levitronix Pumps helps colloidal silica based slurry to yield lower post CMP LPC and lower defect counts in Glass Polishing

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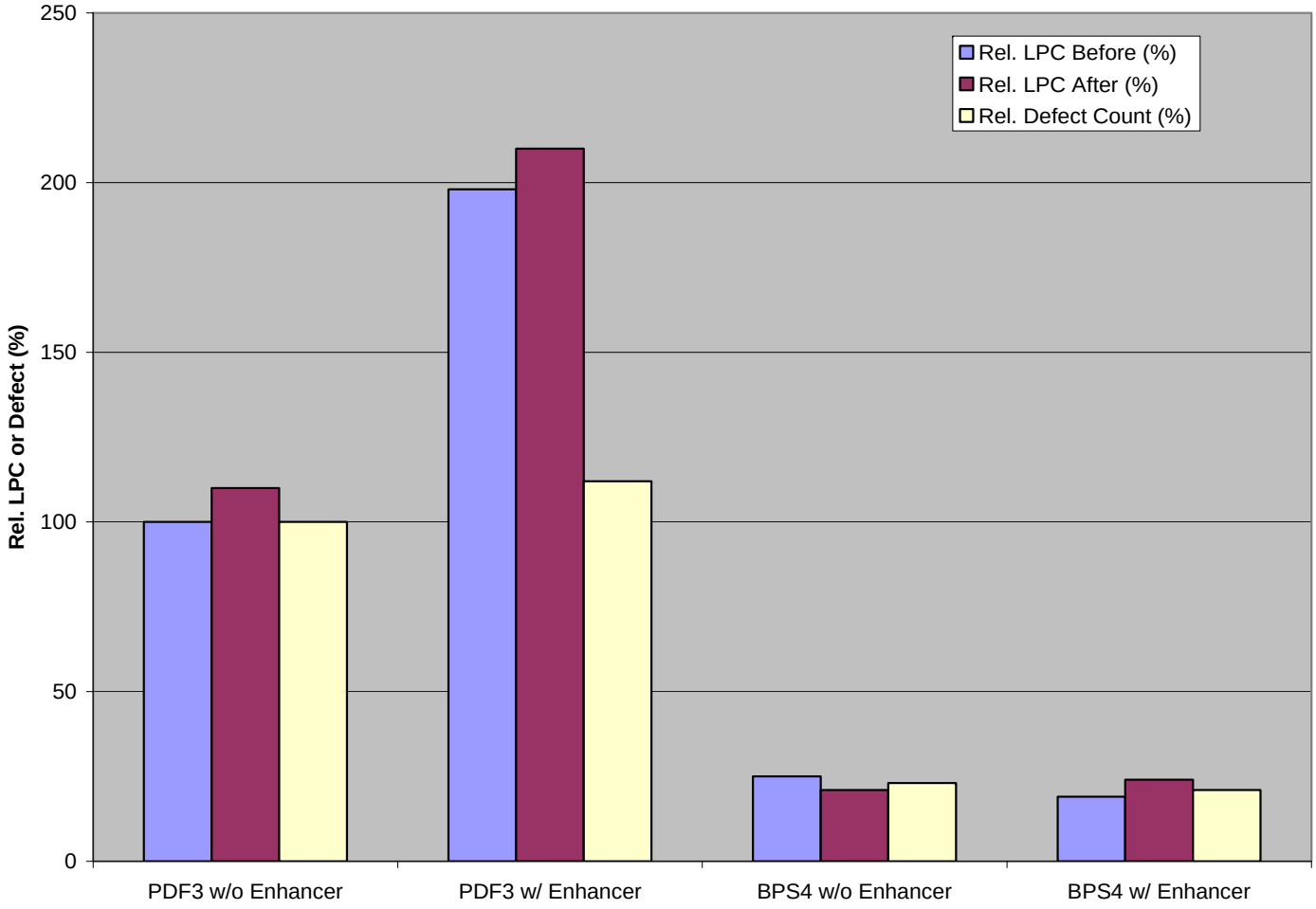

Data by STNL.

Levitronix Pumps helps fumed silica based slurry to yield lower post CMP LPC but not on defects in Glass Polishing

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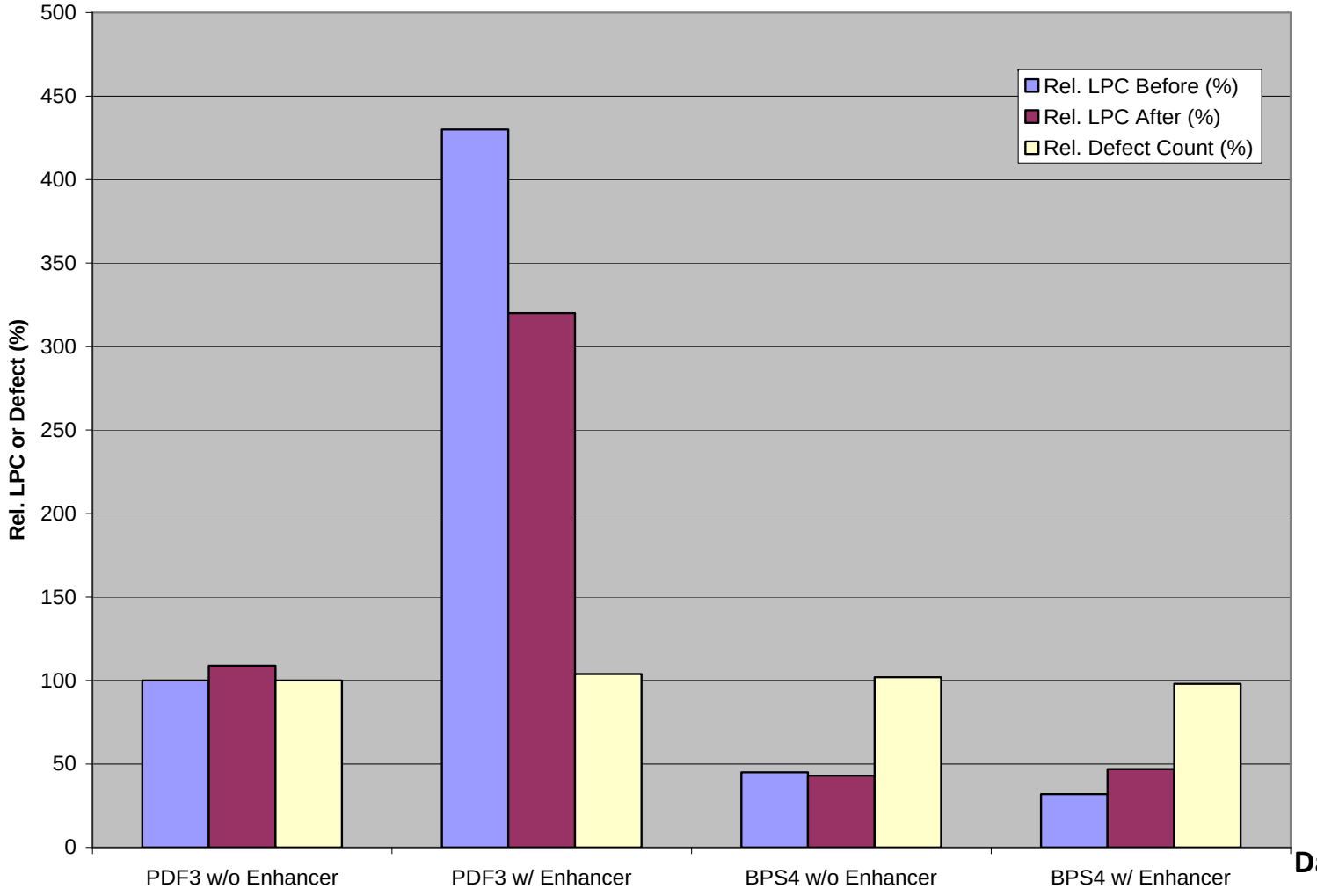

Data by STNL.

Levitronix Pumps helps ball milled ceria slurry to yield lower LPC but not much impact on surface defect in Glass Polishing

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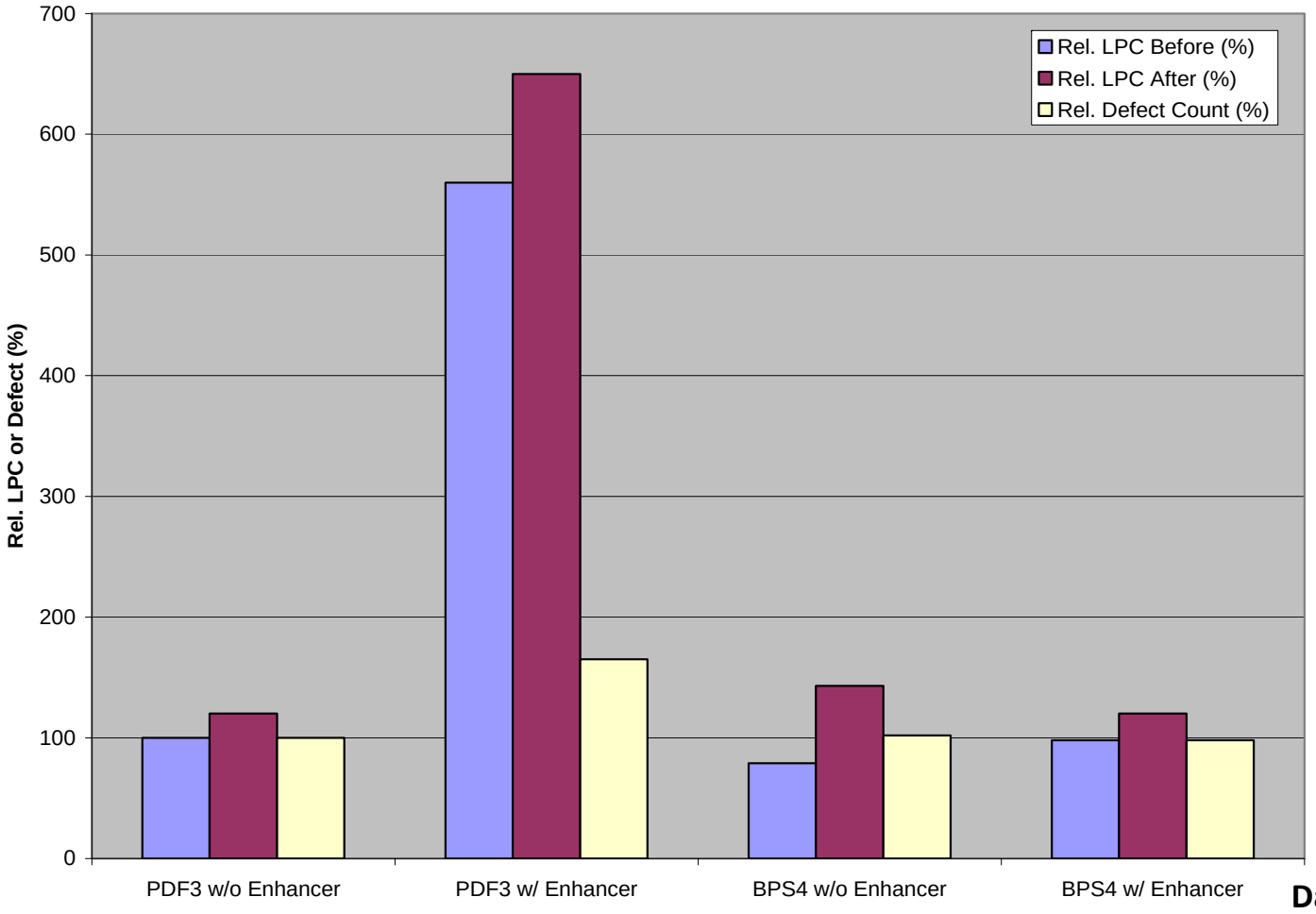

Data by STNL.

Colloidal Ceria Particles (60 nm): Levitronix Pumps helps to lower the defect count in Glass Polishing

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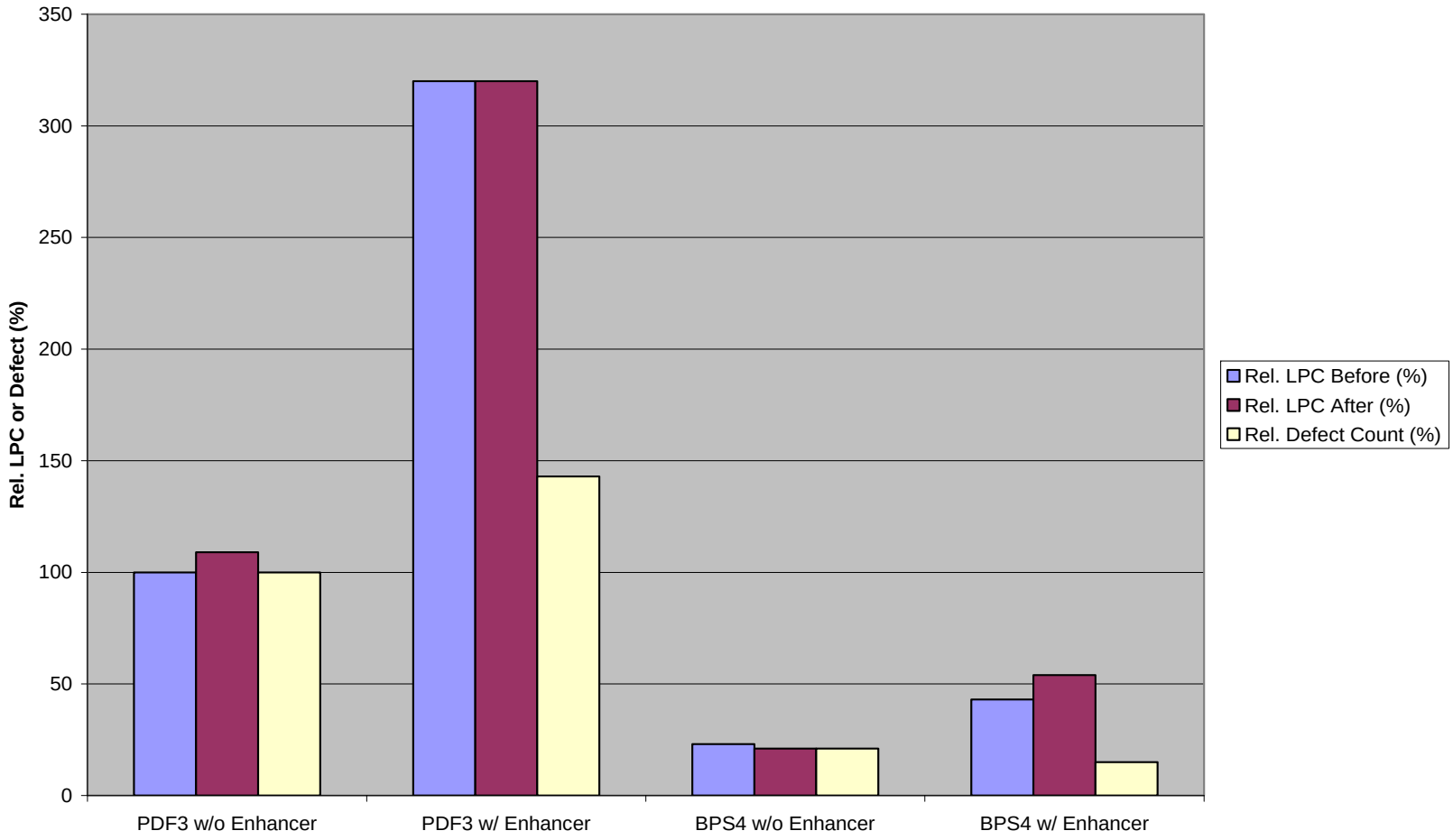

Data by STNL.

Summary

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- The pump technology influences the LPC on CMP slurries. MagLev Pumps does not significantly influence the LPC count while other pump technologies do.

- High LPC increases the chance to scratch the NiP surface and therefore the defect rate.

- For glass polishing, such an improvement on LPC is more pronounced for colloidal silica and ceria particles. With fumed and ball milled slurries, the LPC improvements do not seem to result in a direct benefit regarding defect counts. However, for colloidal silica and ceria, the improvement on LPC can translate to lower defect counts.