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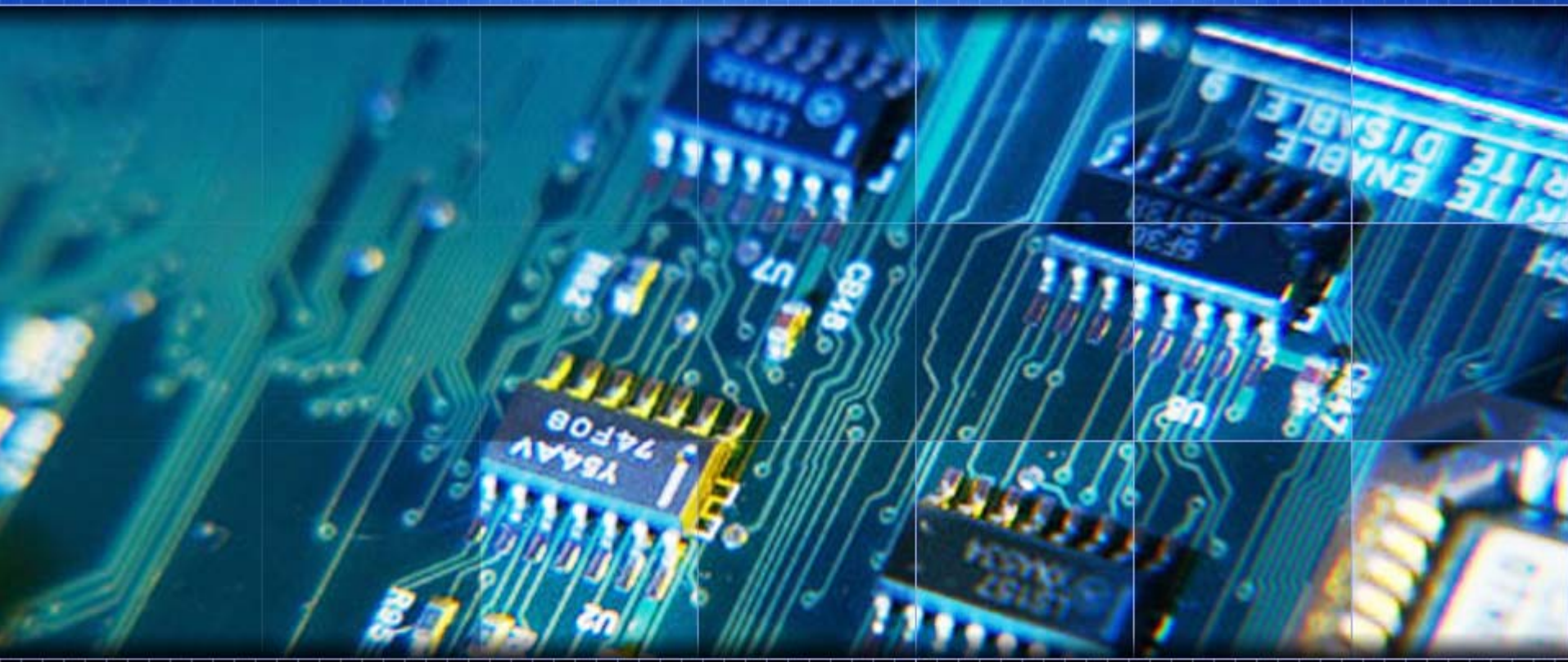
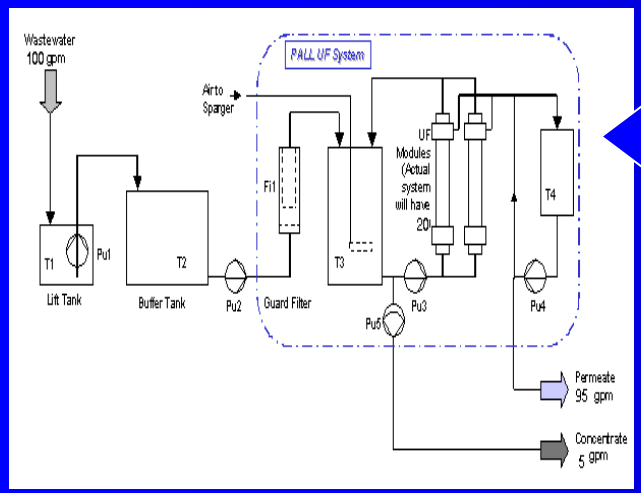
Filtration. Separation. Solution.SM



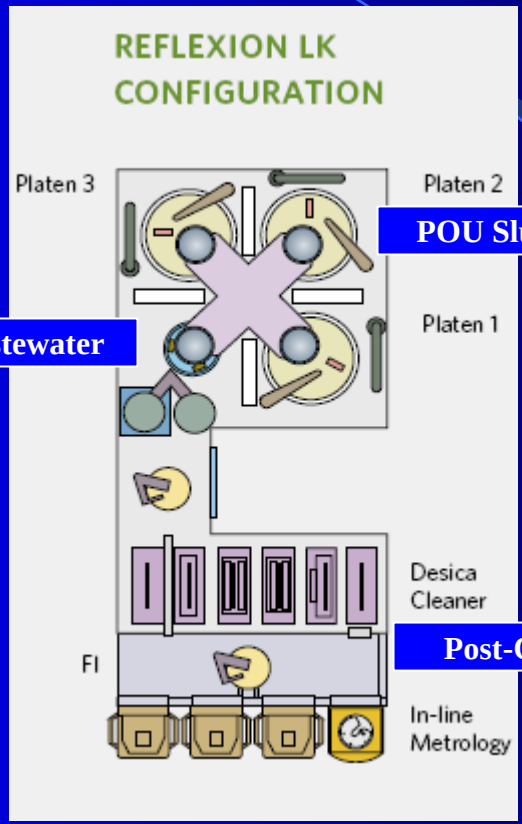
Developing Filtration Solutions for Advanced Technology Nodes

September 10, 2008

Pall Filtration Solutions for CMP

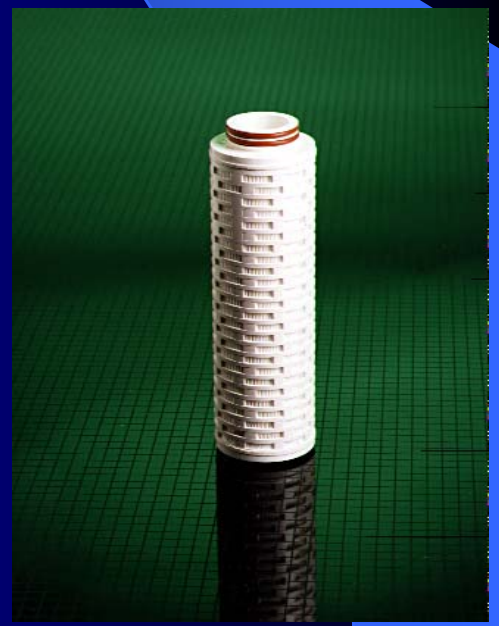


Wastewater



POU Slurry

Post-CMP



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Full-Scale System for CMP Waste:

Up to 20 Modules/ 8...25 m^3/hr

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Why treat CMP Wastewater?

- Suspended solids too high to discharge to sewer
- Traditional flocculation, clarification requires large tanks, lots of chemical addition
- Allows reclaim of water with associated environmental and cost benefits
- Allows reclaim of slurries applicable for low quality applications other than CMP

Challenges: abrasive material, broad pH range, nanoparticles, prevention of membrane fouling, recently high peroxide concentrations

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Solutions for Post-CMP

Pall Varafine™ VaraClean Filters

- Patented highly asymmetric polysulfone membrane
- 3X Flow rates of PTFE membrane
- Hydrophilic – requires no prewetting
- Polysulfone hardware
  - higher temperature
  - chemical compatibility
- POR for major tool manufacture

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Solutions for CMP Slurry Filtration

(A little background)

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What is the best filtration for a slurry?

(question posted on Semineedle.com)*

Posting created a variety of reactions – Here are few of my favorites

- "A few words about absolute ratings in slurry filtration: there is no such thing..."
- "some filter suppliers come with nominal or absolute ratings. They take advantage of the ignorance that these retention curves do exist and also that filtration is not something easy to catch. IC makers should compel retention curves for each kind of filters to all suppliers."
- " I do not appreciate suppliers that comes and says that the rating is the good one and tries to convince you that a 0.5µ filter will absolutely stop everything equal or higher than 0.5µ at 99,99%."
- "the point here is for customers to ask questions of the filter suppliers when it comes to CMP slurry filtration. The key to future improvements in the area of defect reduction is more and better collaborations between the filter suppliers and their customers."

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** Permission has been granted to use the material from this website*
According to Semineedle all postings are for public record

In the beginning (the mid 1990′s)

- Recommended standard industrial filter cartridges
- Defined filter performance based upon standard retention ratings (Absolute or nominal filter ratings, beta ratios)
- Product developed to meet “absolute” ratings using fine test dust
- Filter life considered but also based upon results from fine test dust
- Retention performance in CMP slurry often did not correlate with stated claims
- Performance not always consistent between one slurry and the next

The early years (still last century)

- A standard Pall cartridge used for early CMP applications
- Defined by beta rating

- Some of the first capsules specifically made to fit into a CMP tool
- Defined by Beta Rating

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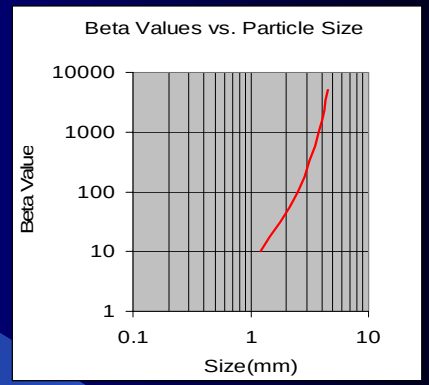
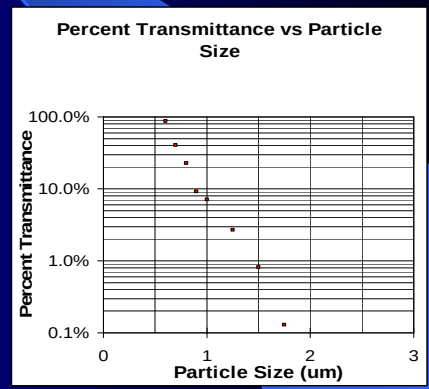
Retention Ratings

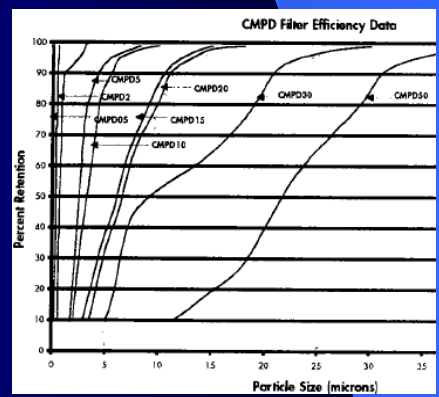
- Beta Ratios did not provide information on the tendency for filters to “strip out” particles



- Transmittance curves used to address this with photographic emulsions



- Retention curves utilized to market CMP slurry filtration



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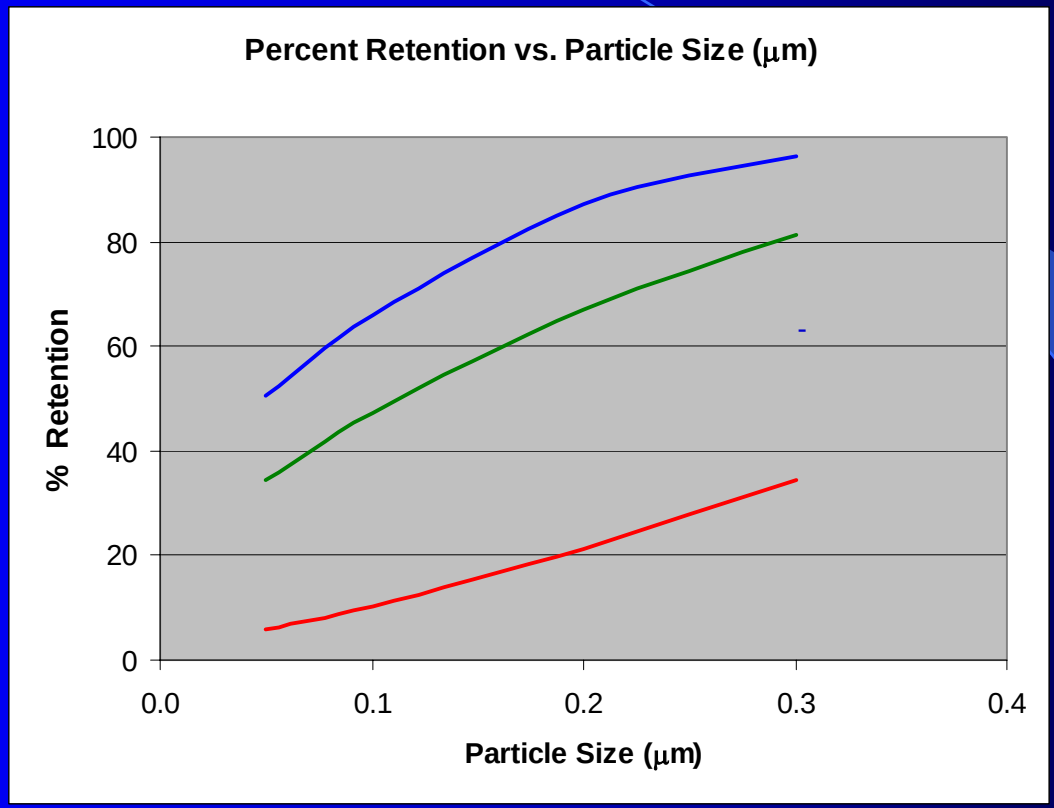
** All graphics on this slide pertain to Pall Corporation products*

Retention Curves

- show the relative steepness which better indicates the likelihood particles will be stripped out
- results are still very much dependent upon the nature of the test material and test conditions
- can be very effective if the right test “contaminant” is used
- test can be manipulated to get the results desired

Manipulation of Retention Curves?



The same filter produced these 3 very different retention curves

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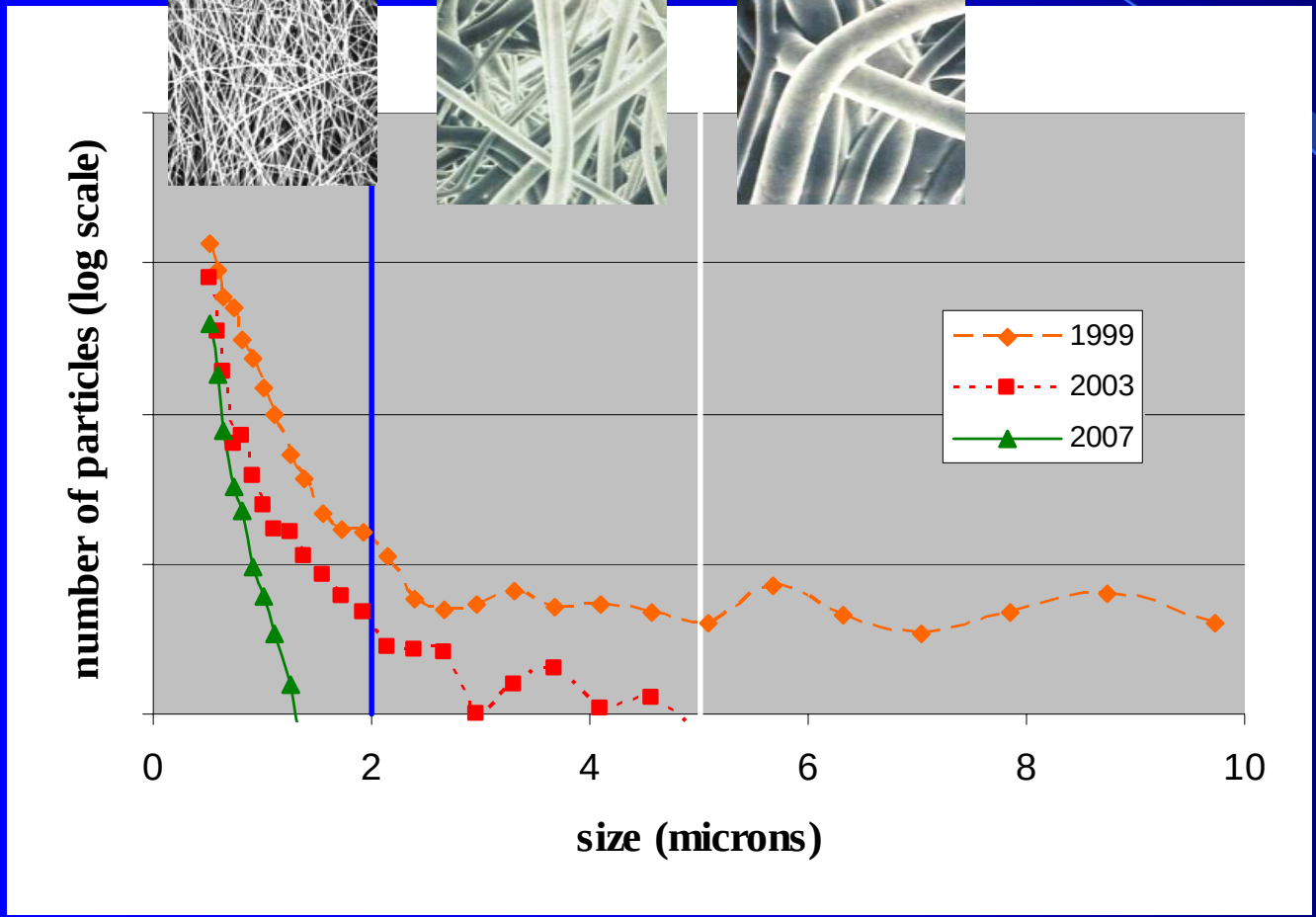
Recent trends

- More collaboration between suppliers and endusers
  - filter customization opportunities (media and/or package)
- Product development based upon the characteristics of a given slurry (i.e. high solids fumed silica)
- Incorporate quality methodology into CMP product development
- Finer fiber development initiatives are addressing future generation slurries requiring greater cleanliness

Development based upon slurry characteristics

Evolution of typical LPC distributions for fumed silica CMP slurries



- Specifically designed for use with high solids silica CMP slurries (typically used for ILD-CMP)
- Pall has combined its extensive knowledge of melt blown media manufacturing with its understanding of the evolution of fumed silica CMP slurry particle size distributions to develop a filtration solution providing the optimal on tool life at a desired efficiency
- Several factors (including enhanced filtration) have led to a reduction in the number of oversized particles (especially >2µm) present in today's fumed silica CMP slurries. Coarse pre-filtration layers no longer improve the life nor the efficiency of the filter

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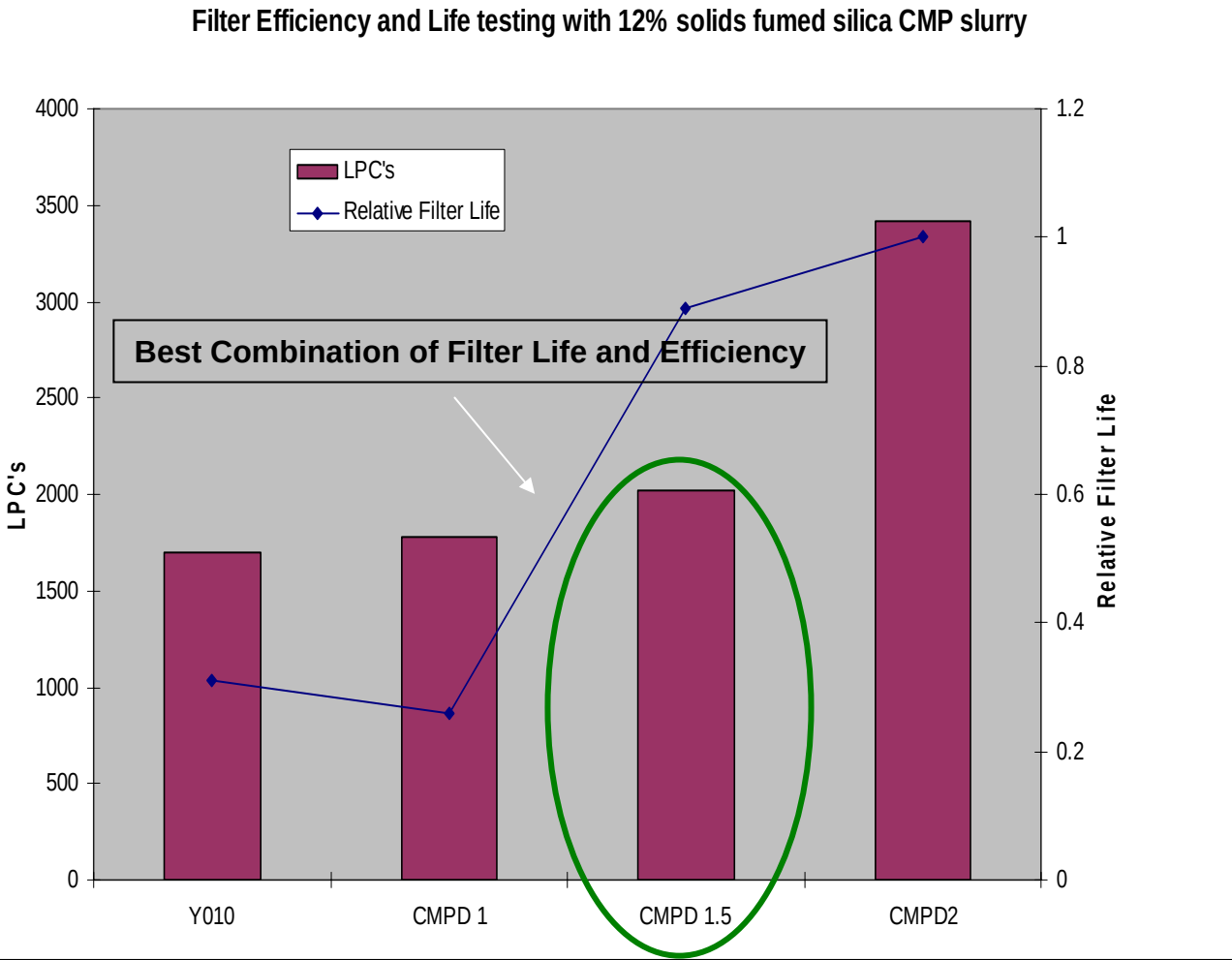
Results



The solution:

"**Pall's CMPure CMPD 1.5 filter**" incorporates a proprietary media gradient to maximize the filter's ability to capture particles in the targeted size range while minimizing the unnecessary retention of smaller particles that can lead to shortened filter life

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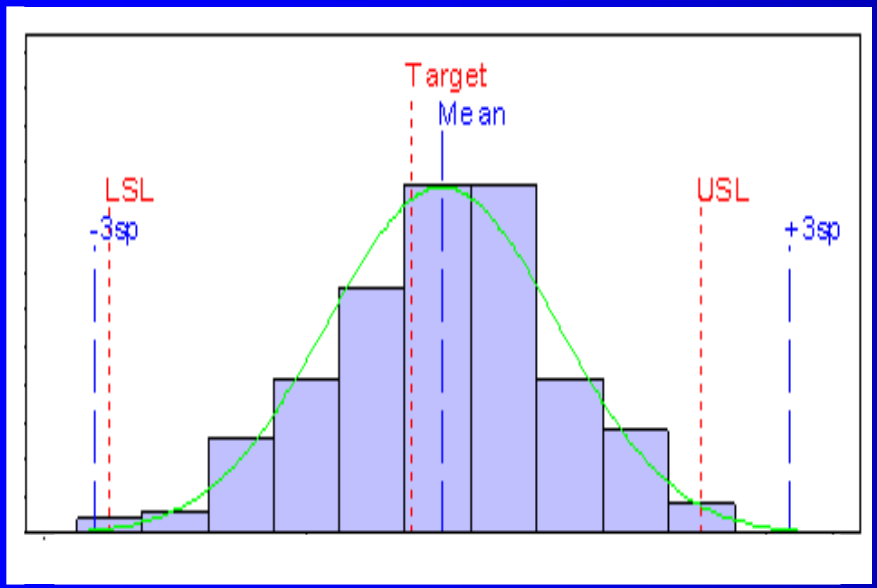
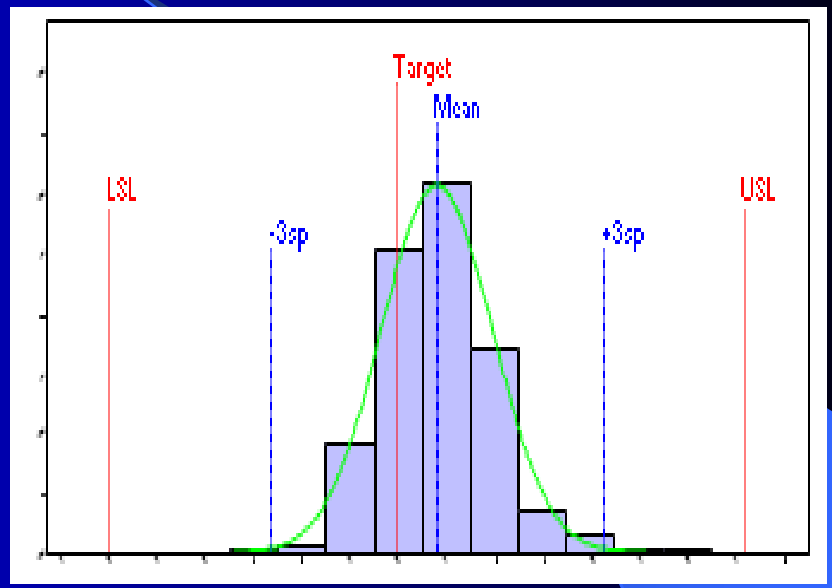
Development based upon Quality Methodology (Improving Product Consistency)



Typical manufacturing data for a legacy CMP product



Manufacturing data for a recently developed CMP product

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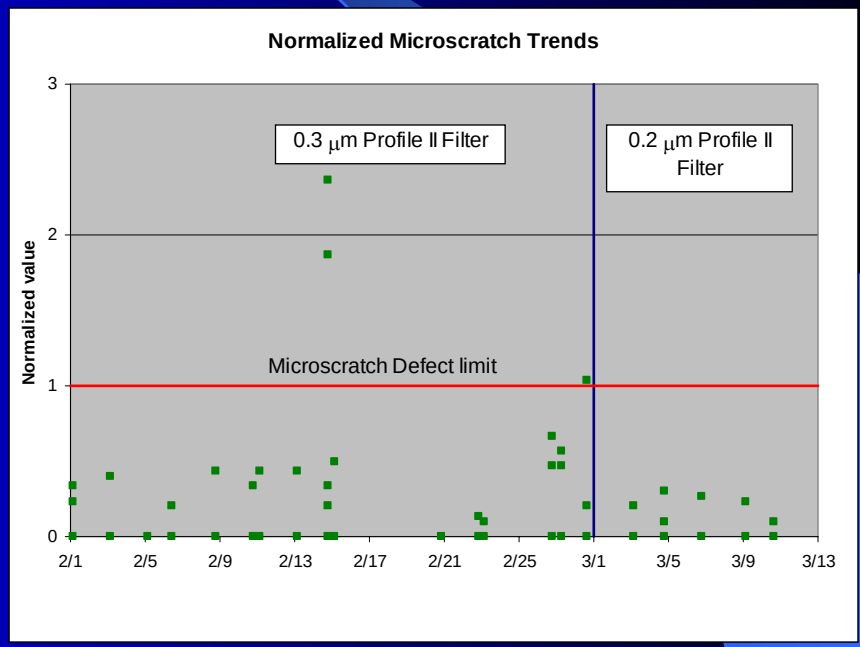
Finer Product Development (Now)

Methods for Manufacturing Finer Melt blown Filters

	Potential Impact on Filter Performance		
Manufacturing Methods	Efficiency	Differential Pressure	Life
Produce finer fibers	↑	↑	↔
Increase media depth	↑	↑	↔
Reduce void volume (media calendaring)	↑	↑	↓

Microscratch defect results



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Fiber media development
(Next Generation)

Pall is diligently working towards advancing the state of the art in advanced melt blowing and other fiber based technologies to reach the next level of CMP slurry cleanliness

Current cutting-edge product	Next generation prototype
✓ Efficiency with PSL = 68%	✓ Efficiency with PSL = 99%
✓ Norm. Mean pore size = X	✓ Norm. Mean pore size = <0.5X
✓ Removal efficiency with TD = 93%	✓ Removal efficiency with TD = 99.5%
✓ LPC reduction efficiency = TBD	✓LPC reduction efficiency = TBD

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