

$$\int_0^{\infty} f(\text{cat}) = \text{INPROCAT}$$

QUANTA™ TECHNOLOGY

A New Frontier in FCC

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CatCracking.com
MORE PRODUCTION • LESS RISK!

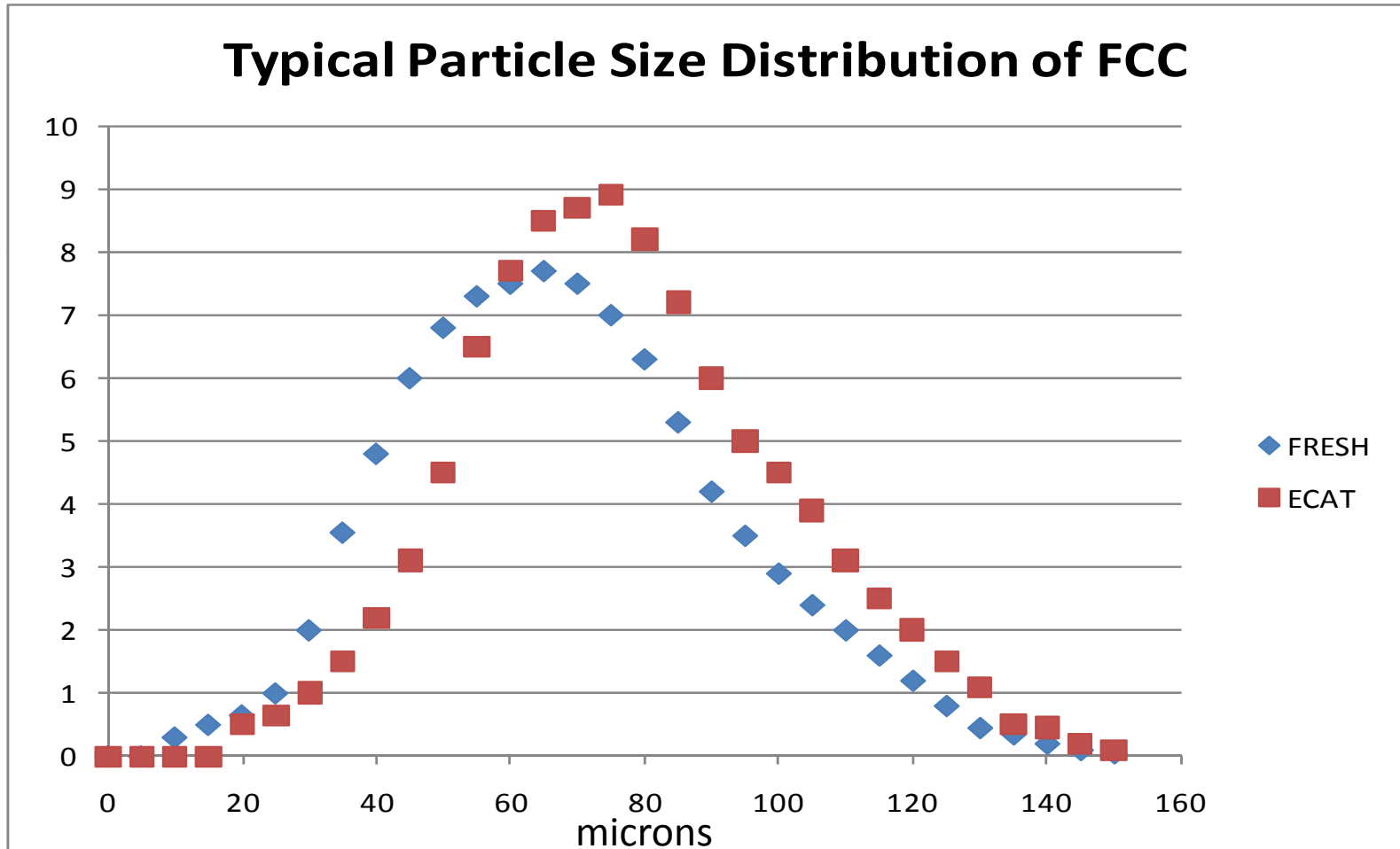
Houston, TX 14th April 2010

Outline

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- Role of Particle Size Distribution in FCC
 - State-of-the Art
 - INPROCAT's QUANTA™ FCC Catalyst Technology

FCC Particle Size Distribution $\int_0^\infty f(cat)$



Particle Size Distribution $\int_0^{\infty} f(cat)$

- Minimize 0-20 micron fraction
 - 0-2 wt% typical specification
- 2-3 grades of 0-40 micron specification
 - ~12-20 wt% typical range
 - Special requirements

State of the Art

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- FCC Catalyst Plants have a small operating window to control PSD
 - No known effort to control PSD to drive particular selectivity
 - Modifications to PSD are only achieved by air classification
 - Only documented application is removal of very fine particles

Why is PSD Control Desirable? $\int_0^{\infty} f(\text{cat})$

- 10-15% of all units have “Physical Properties Issues”
 - Catalyst losses
 - Catalyst Circulation Improvements
- Many reactions in FCC are diffusion limited
- Metal deposition is not homogeneous

**INPROCAT'S
QUANTATM TECHNOLOGY**

History

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- INPROCAT has been investigating the impact of several physical parameters of FCC Catalyst and how they can be controlled
 - We have learned a lot about physical properties of FCC over the past year
 - We have found many potential applications

QUANTA™ Technology

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- INPROCAT has now developed, patented and demonstrated technology that allows for particle size control to levels not achieved by air classification
 - It applies to fresh FCC and ECAT
 - The technology is part of the portfolio of technologies that INPROCAT is developing to introduce new FCC Products with superior performance

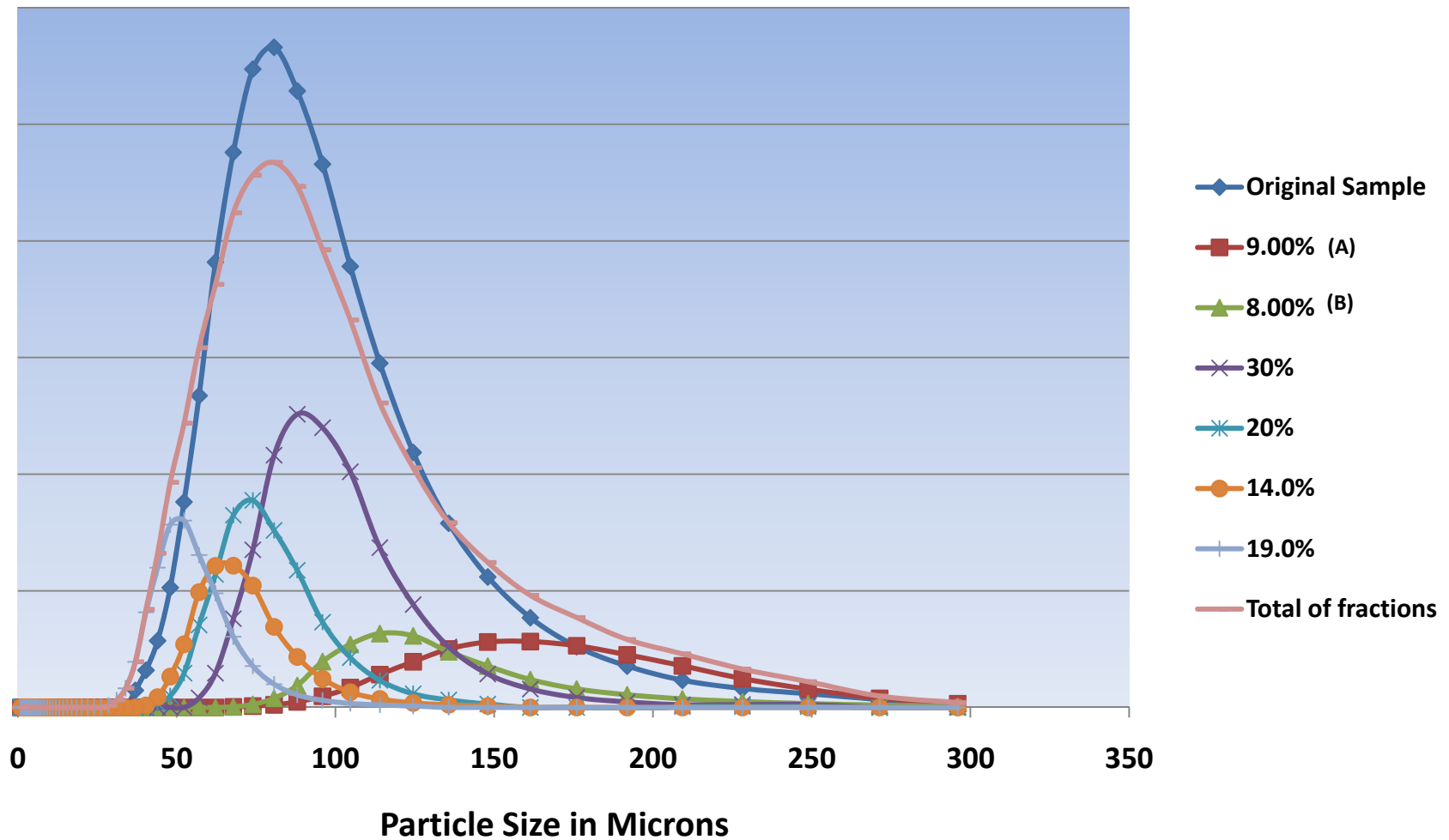
Basic Principles of Process $\int_0^\infty f(cat)$

- INPROCAT's innovative process achieves what a sink-float density separation with fluids of different densities achieves
 - Separates particles based on their physical/density differences

But...

- It does it in a dry environment
- It can control particle size of the desired fractions with high degree of precision

Separation via QUANTA™ Technology $\int_0^{\infty} f(cat)$



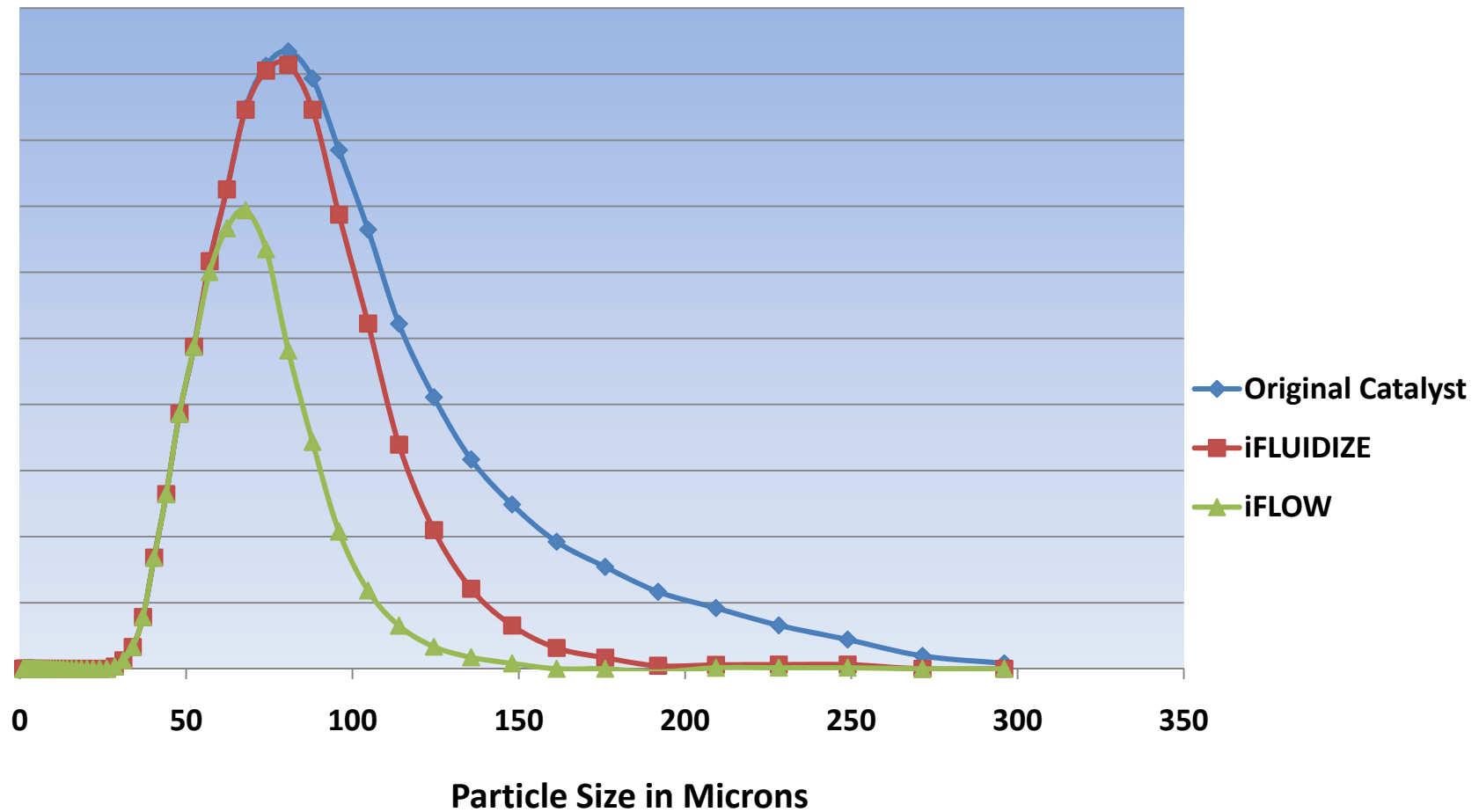
QUANTA™ Steps

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- We can deliver FCC catalysts with narrow particle size distribution at any size:
 - Low average particle size for fluidization aid (iFLOW™)
 - Removal of large particles (iFLUIDIZE™)
 - Removal of fines to help meet emissions target and/or protect turbo expander blades (iSHIELD™)

PSD Enhancements via QUANTA™ Technology

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Current Status

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- We have demonstrated the process (using ECAT) in equipment at rates of 2 tons/hr that can be scaled up to 5,000 to 10,000 tons per year
 - Process can be scaled-up within 3 months
 - We are currently working with 2 major global companies in demonstration of the technology for specific FCC units

Other Opportunities

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- Improvement of FCC Yields is difficult and involves costly evaluations and risk
 - FCC Unit Limits Described as:
 - Coke Selectivity limits (~50%)
 - Wet Gas Compressor limit (~25%)
 - Physical Limitations (~10%)
 - FCC Catalyst cost remains one of the largest variable costs in refinery operations

Other Opportunities

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- Most FCC units withdraw ECAT regularly and sell it (10%-15%) or dispose of it
 - Catalyst disposal is an extra expense
 - ECAT is a blend of a continuum of age and activity/selectivity
 - Some particles with better than average properties

Other Opportunities

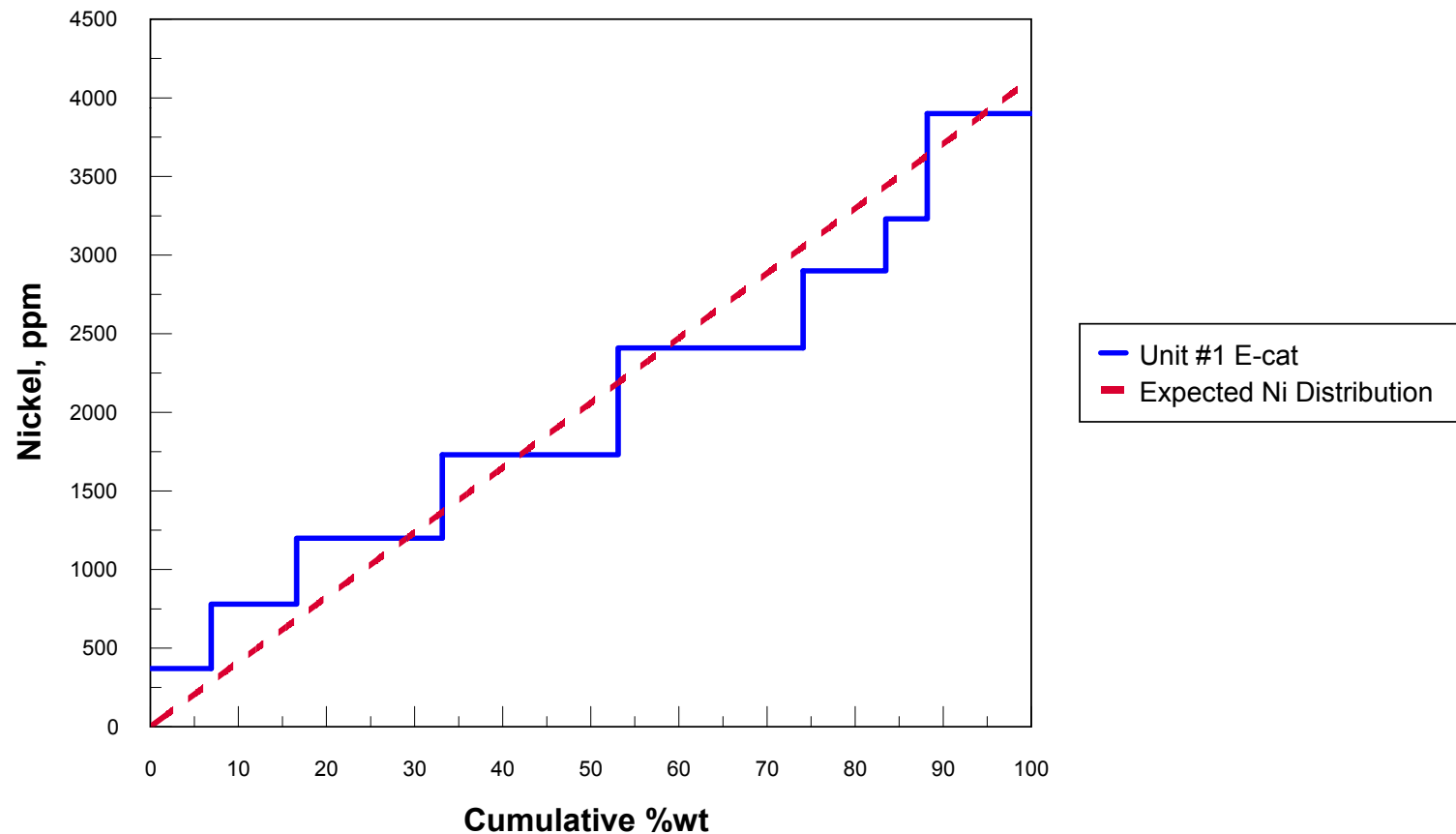
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- Many undesirable reactions come from heavily contaminated or old ECAT
- However, fresh catalyst also has poor selectivity:
 - Poor coke selectivity
 - Poor dry gas selectivity

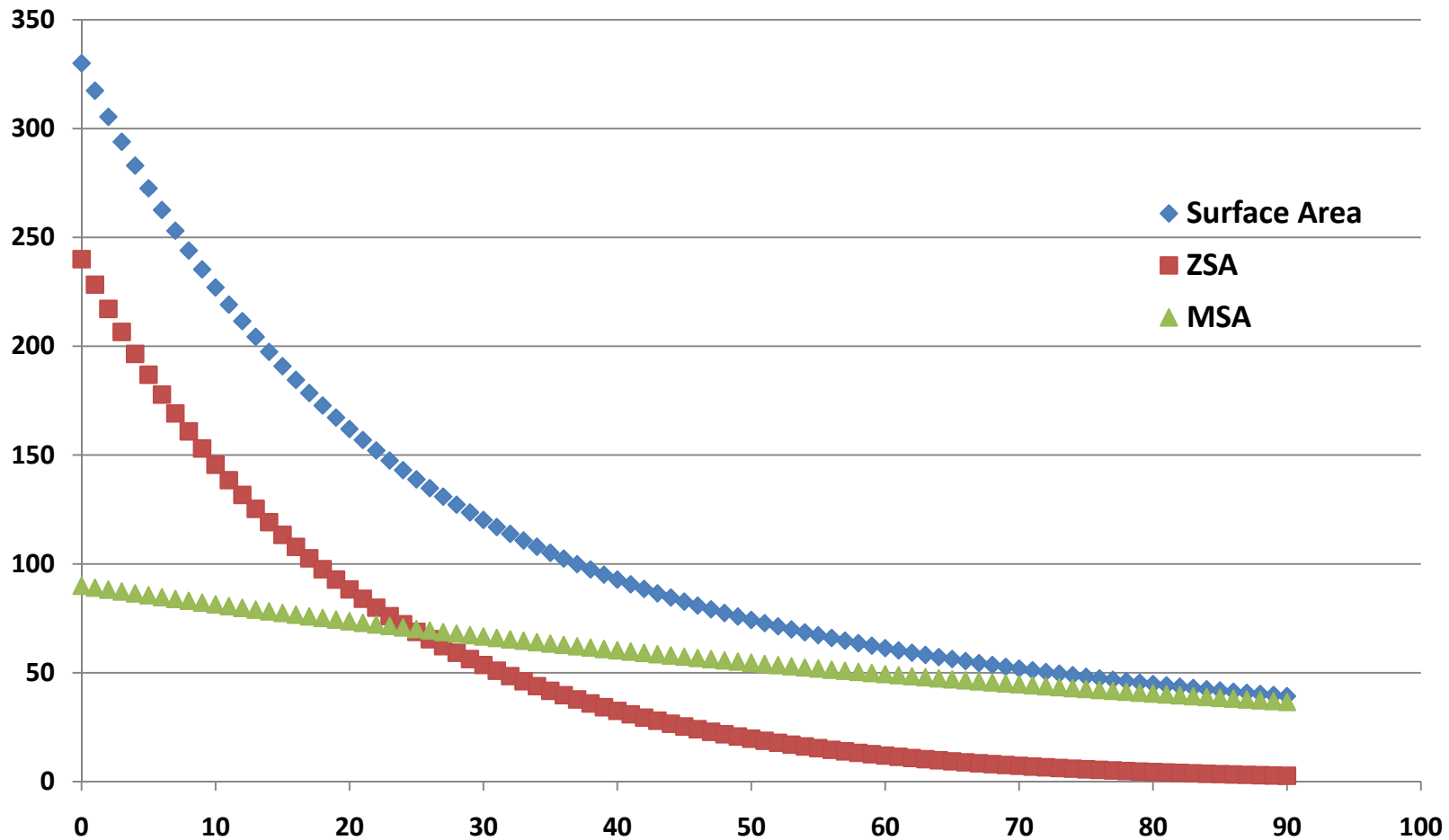
Ni distribution on FCC Catalyst

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Nickel Distribution on Commercial FCCU Catalysts
Sink-Float Separation Data



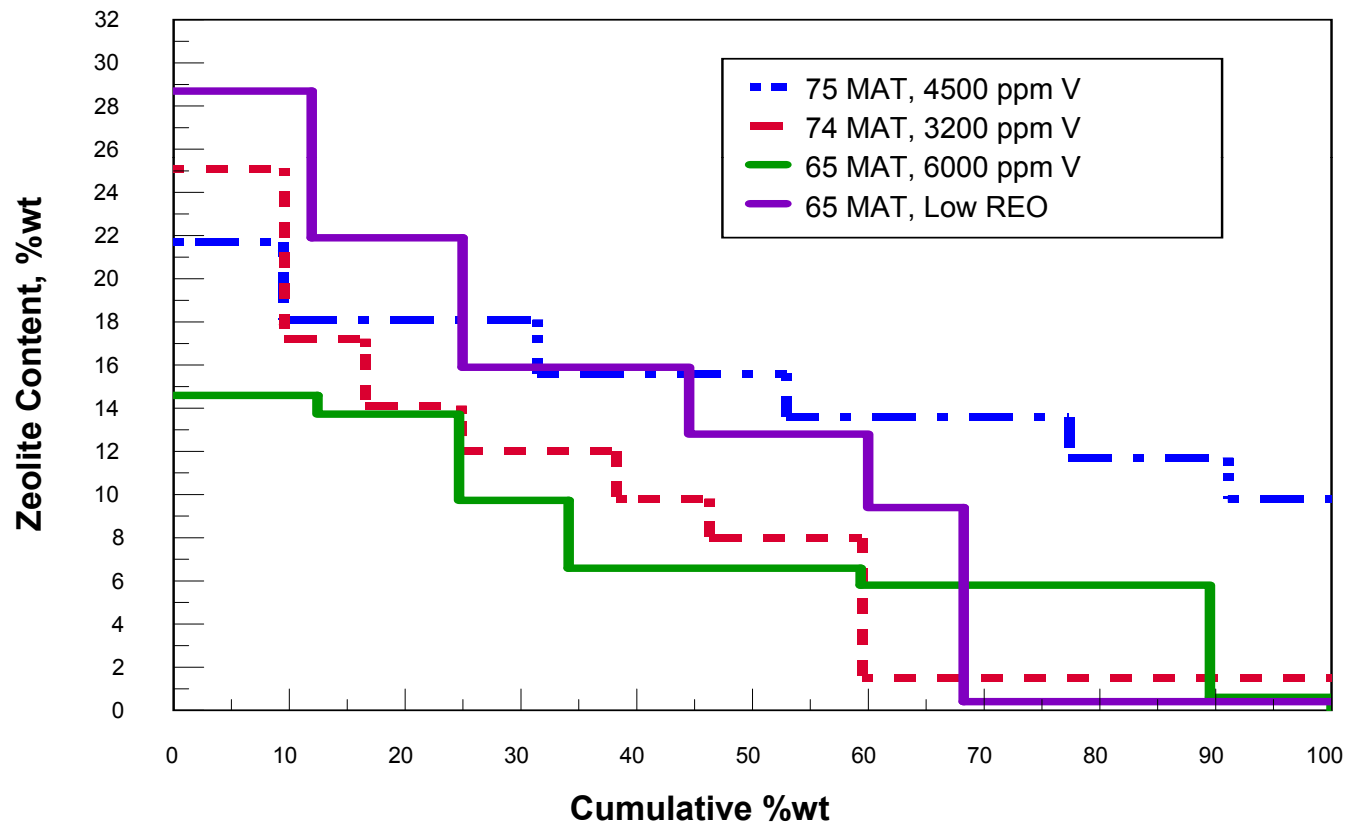
FCC Catalyst Surface Area Decay $\int_0^\infty f(cat)$ (in the presence of V)



Effect of Vanadium

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Zeolite Distributions of Commercial "RESID" FCCUs
Sink-Float Separation Data on E-cats



Different catalysts in the different units

Other processes

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- Industry has seen attempts to reduce metals via chemical media
 - Process was not successful
 - Expensive, environmental issues
 - MagnacatTM Process
 - Limited success
 - Costly
 - Limited to heavily contaminated ECAT

Our Solution

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- QUANTA™ technology can take ECAT from units and reject the undesired fraction(s)
 - Applicable to VGO and Resid units

Many Potential Applications $\int_0^\infty f(\text{cat})$

- Improve coke selectivity
- Improved gas selectivity
- Reduce Fresh Catalyst Addition
- Improve quality of ECAT for reuse
- Minimize disposal of “good” part of ECAT
- Control physical properties
 - Remove large/very old dense particles
 - Sharpen the PSD for higher bed density

Target Improvements

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- Higher ECAT surface area (15-30 m²/g)
- Metals reduction (15-30%)
- Improved Delta Coke of Inventory (-0.05)
- Improved Dry Gas selectivity (-0.2 to 0.5 wt%)
- Reduced waste
- Improved Physical Properties
- Economical and easy to implement

Summary

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- We believe that QUANTA™ technology can deliver added value by providing unique technologies based on a new level of control of PSD
 - Selectivity benefits and cost savings are also possible