


# What is that Particle?

## (And will it kill my part or assembly?)

### Featuring JOMESA




product quality  
cleaning workshops


The PQCW offers practical,  
hands-on and independent,  
training in cleaning.

**More Info**  
[shsu.edu/pqcw](http://shsu.edu/pqcw)  
[pqcw@shsu.edu](mailto:pqcw@shsu.edu)

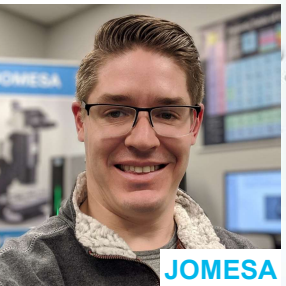
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# Webinar Hosts

## The PQCW Team



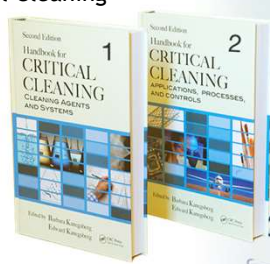
**Barbara and Ed Kanegsberg - "The Cleaning Lady and the Rocket Scientist"**

- BFK Solutions - Consultants in Critical Cleaning
- Authors and Editors of the two-volume CRC Handbook for Critical Cleaning
- Independent evaluations and recommendations
- Co-chairs of the Product Quality Cleaning Workshops
- [barbara@bfksolutions.com](mailto:barbara@bfksolutions.com) and [ed@bfksolutions.com](mailto:ed@bfksolutions.com)



**Darren Williams - "The Professor"**

- Professor of Physical Chemistry at Sam Houston State University
- Leader of the Cleaning Research Group
- Co-chair of the Product Quality Cleaning Workshops
- Performs cleaning trials and formulates cleaning chemistries
- [williams@shsu.edu](mailto:williams@shsu.edu)



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## Product Quality Cleaning Workshops

- ▶ Workshops
- ▶ Webinars
- ▶ Resources for more effective cleaning processes
- ▶ More information
  - ▶ [shsu.edu/pqcw](http://shsu.edu/pqcw)
  - ▶ [bfksolutions.com/manufacturing-minds-pqcw/](http://bfksolutions.com/manufacturing-minds-pqcw/)

Q: What was most valuable to you?

A: *"The general overview of cleaning and the introduction to cleaning processes."*

- a 2018 attendee

*"The vendor demos were great."*

- a 2018 attendee

*"All the lab activities were interesting and made me think about things I need to consider in my own lab work."*


- a 2018 attendee

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## Our Speaker

### Peter Feamster of JOMESA



- Graduated in 2010 from Central Michigan University with a BBA
- Started in manufacturing cleanliness with Durr Ecoclean in 2011
- Learned parts cleaning and the role of technology and science behind it.
- Now with JOMESA which is built on technical cleanliness expertise and innovation
- JOMESA has developed his knowledge of industrial production and cleanliness

- Born and raised in Southeast Michigan and a fan of all things Detroit
- Loves sports as well as the outdoors especially the Detroit Red Wings
- Has played hockey since he could walk
- Married in September 2016 and happily living in South Lyon, MI with their dog Obie
- Likes cooking, hiking with his wife, and gardening.

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# JOMESA PSE Precision Scan for Elements

Extended Analysis for Process Improvements

Peter Feamster  
Product Management – JOMESA North America

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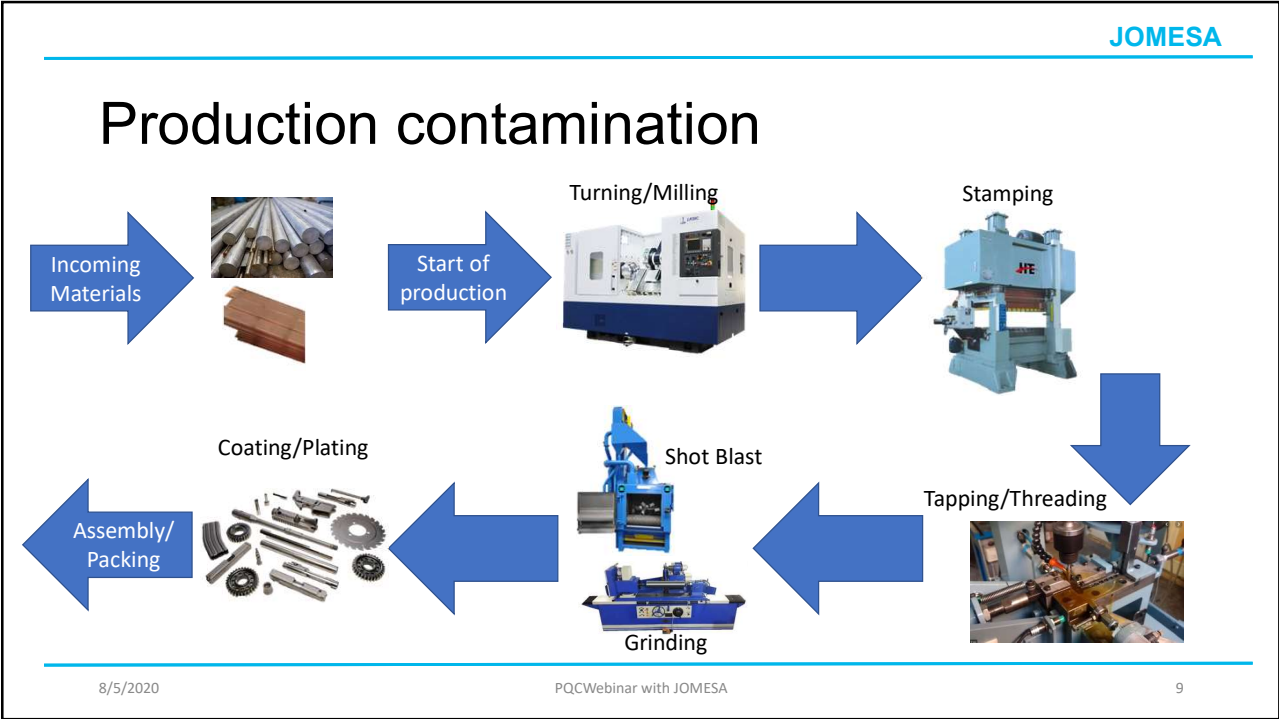
## Agenda

- JOMESA introduction
- Optical analysis limitations
- JOMESA PSE
- Correlating data with process improvements

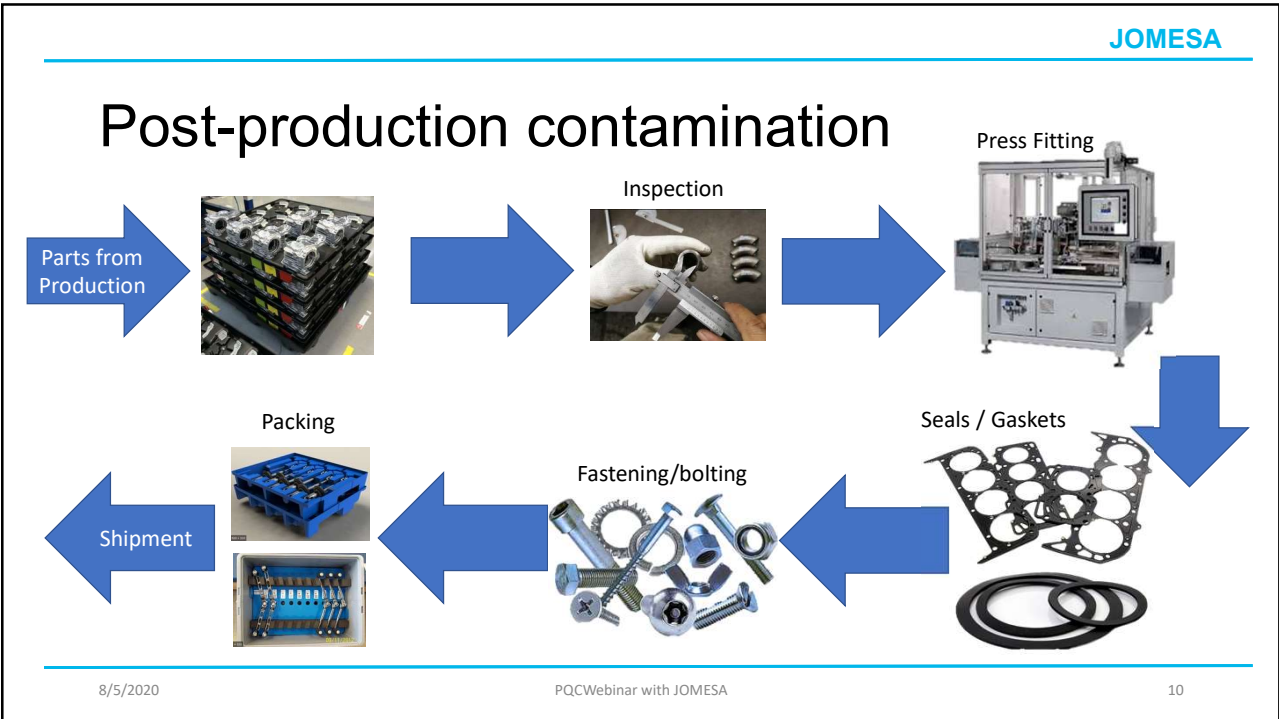
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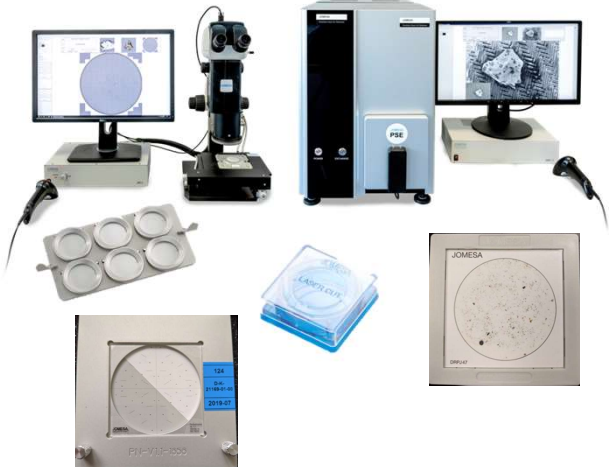
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# JOMESA

- 1987 – Company founded, digital image retouching/measurement software
- 2001 – First automated filter analysis system delivered
- 2004 – Introduction of particle standards for calibration verification, consumables production begins
- 2006 – Patent for automated metal/non-metal categorization
- 2009 – JOMESA North America established
- 2018 – Introduction of SEM/EDX analysis system (JOMESA PSE)



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## JOMESA HFD

### Optical analysis advantages

- Metal/non-metal/fiber categorization
- Measurements starting from 5 $\mu$ m
- 47mm filter measured in <5 minutes
- Quantify and track contamination control performance
- Evaluate intermediate/final washing performance
- Environmental particle trap evaluation
- Measure cleanliness level of fluids



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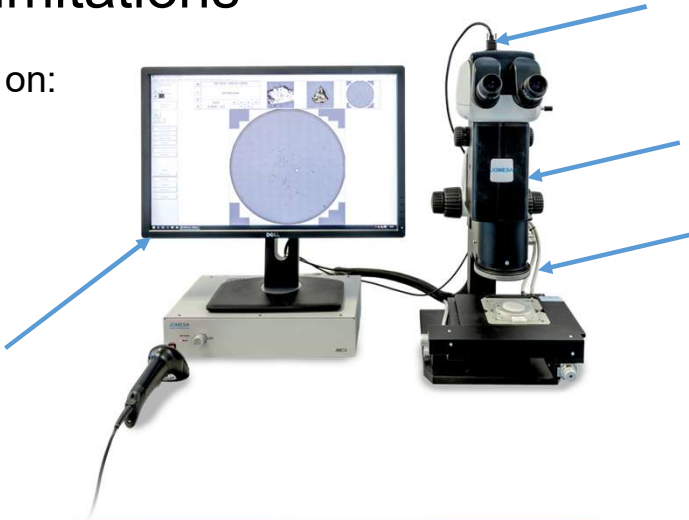
# Optical analysis limitations

More data is necessary to develop “cleaner” process strategies

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# Optical analysis limitations

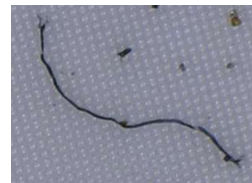
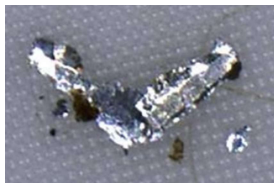
- Optical analysis relies on:
  - Light
  - Lenses
  - Camera
  - Software



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## Optical analysis limitations

- Automated optical microscopes generally categorize particles into three broad types.
  - Metallic (reflective)
  - Non-metallic (non-reflective)
  - Fiber (non-reflective + length/width ratio criteria applied)



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## Optical analysis limitations

### Assumptions for optical particle detection (per ISO 16232)

- Background of image is “white” (filter membrane)
- Particles detected are  $\leq 70\%$  of the maximum grey value (polarizer)
  - Must be distinguishable from filter surface
  - Abrasive particles (Glass, SiC,  $\text{Al}_2\text{O}_3$ ) are nearly white or translucent
- Metallic particles must be reflective to be categorized as such
  - Heat treat, soot, grease, paint etc. can remove metallic shine

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## Optical analysis limitations



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## Optical analysis limitations

Abrasive particles are nearly invisible with ISO 16232 / VDA19.1 standard analysis particle detection settings.

- Silicon based abrasives (SiC, SiN)
- Glass bead
- Aluminum Oxide ( $Al_2O_3$ )

These particles are very small ( $<150\mu m$ ) and extremely damaging to fluid systems and close-tolerance moving parts (bearings, pistons, valve body assemblies, etc.)

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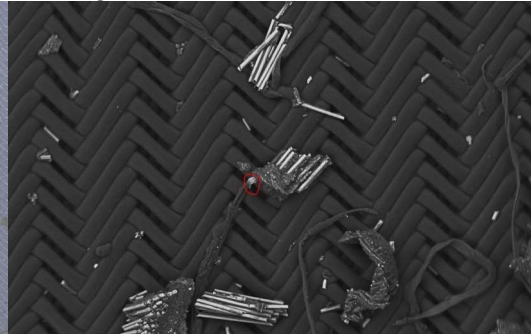


## Optical analysis limitations

Optical Image



PSE Image



Optical system does not recognize translucent/yellowish particles, they do not exceed the grey value necessary for detection by camera.

Same particles using PSE, hard particles are brighter than others. Notice the amount of hard Si based particles that are not visible to the optical camera.

## JOMESA PSE

Precision Scan for Elements (SEM/EDX)

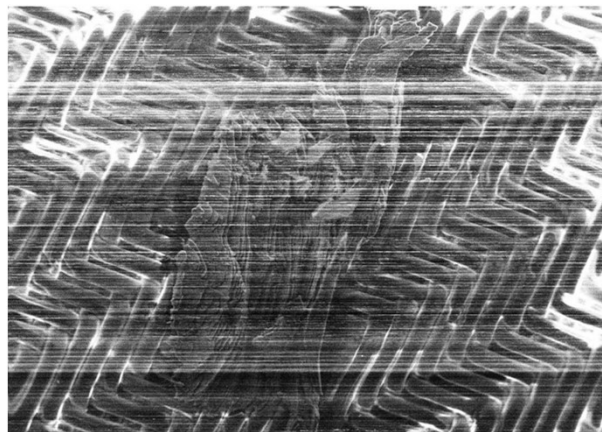
Correlative microscopy for cleanliness analysis

## Disadvantages of SEM/EDX

- Locating a particle of interest that was measured during optical analysis can be extremely time consuming in a SEM system.
  - Correlation of the particle coordinates is not practical in short time, special fixturing and programming required.
- Operators often remove particles from filters and place on carbon tape for SEM/EDX analysis.
  - Tedious and un-reliable process, easy to lose or destroy particles completely
- Organic/carbon-based particles not easily detected automatically against filter background.
- Effects of high-vacuum and charging cause particles to “jump” away from filter surfaces or obscure SEM images.

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## Disadvantages of SEM/EDX




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## JOMESA PSE

### Correlative microscopy advantages

- Fast SEM/EDX analysis of individual particles detected with optical microscope.
- Particle coordinates are transferred via network connection.
- Detect and identify abrasive material particles that are not detected by optical microscopes.
- Customized material database for identifying process-specific contamination.
- Reduce full-filter scan time by detecting only certain size ranges or particle types (metal/non-metal).
- Common filter holder for easy transfer of samples.



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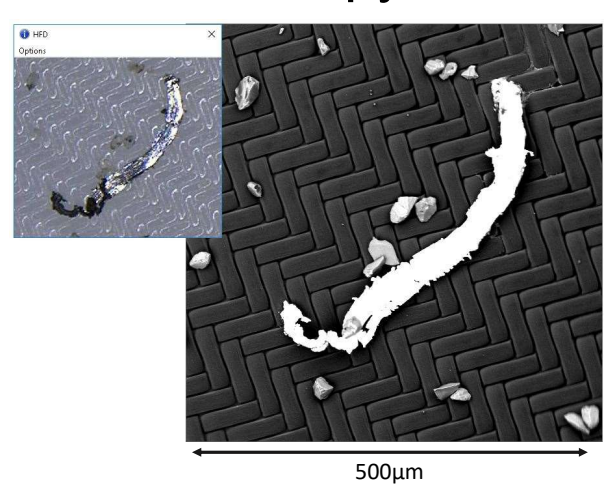
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## Correlative microscopy advantages



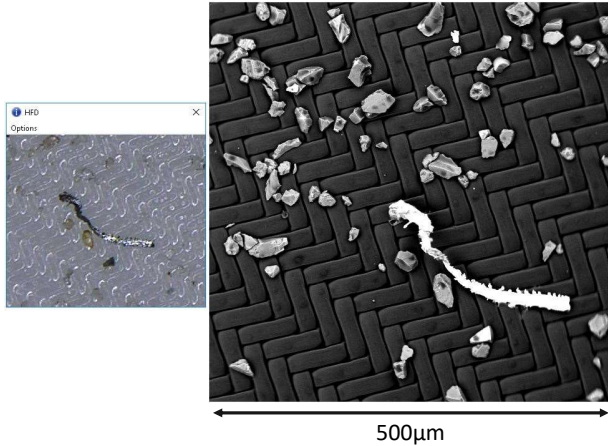
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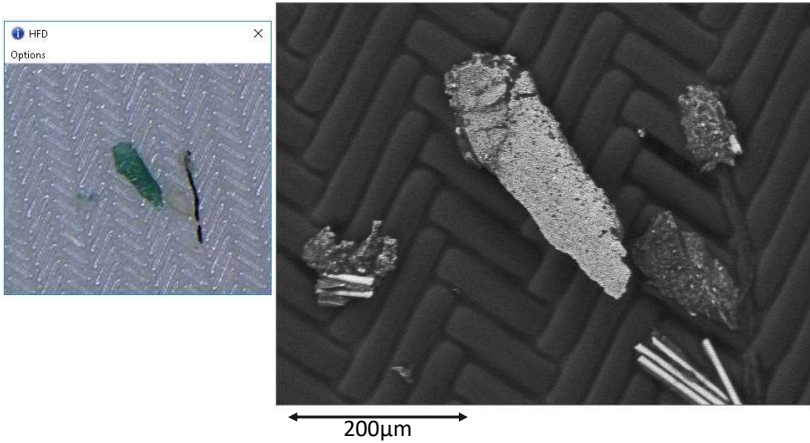
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# Correlative microscopy advantages

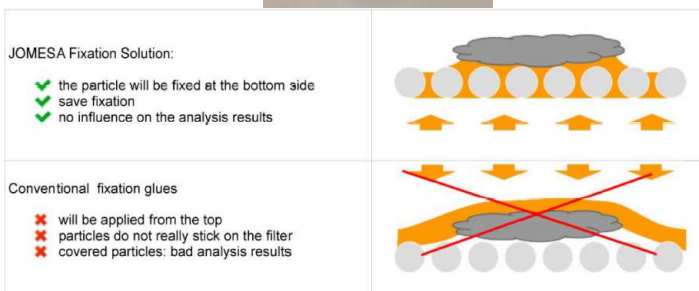


# Correlative microscopy advantages



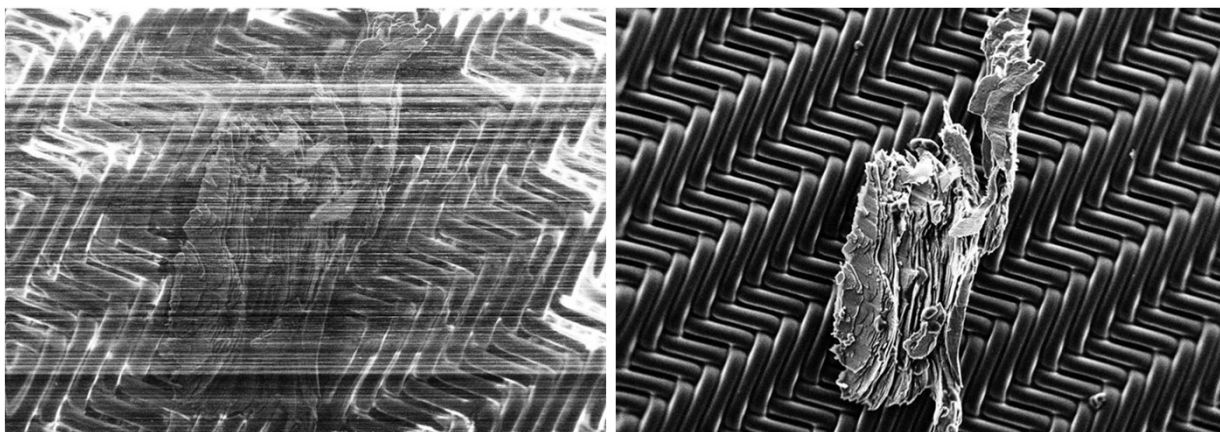
## Fixation and Conductivity Solutions

- When used together, these solutions allow for sharp images and more accurate EDX analysis in high-vac.
- Fixation solution prevents “jumping”.
- Conductivity solution prevents charging.




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## JOMESA Conductivity Solution



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## JOMESA PSE

### Correlative microscopy advantages

- Comprehensive report including:
  - Optical analysis results (HFD)
  - Individual particle EDX spectrums showing optical/SEM image (PSE)
  - Full scan EDX results



**Cleanliness Analysis according to ISO 16232**

**Microscopic Analysis**

**EDX Analysis**

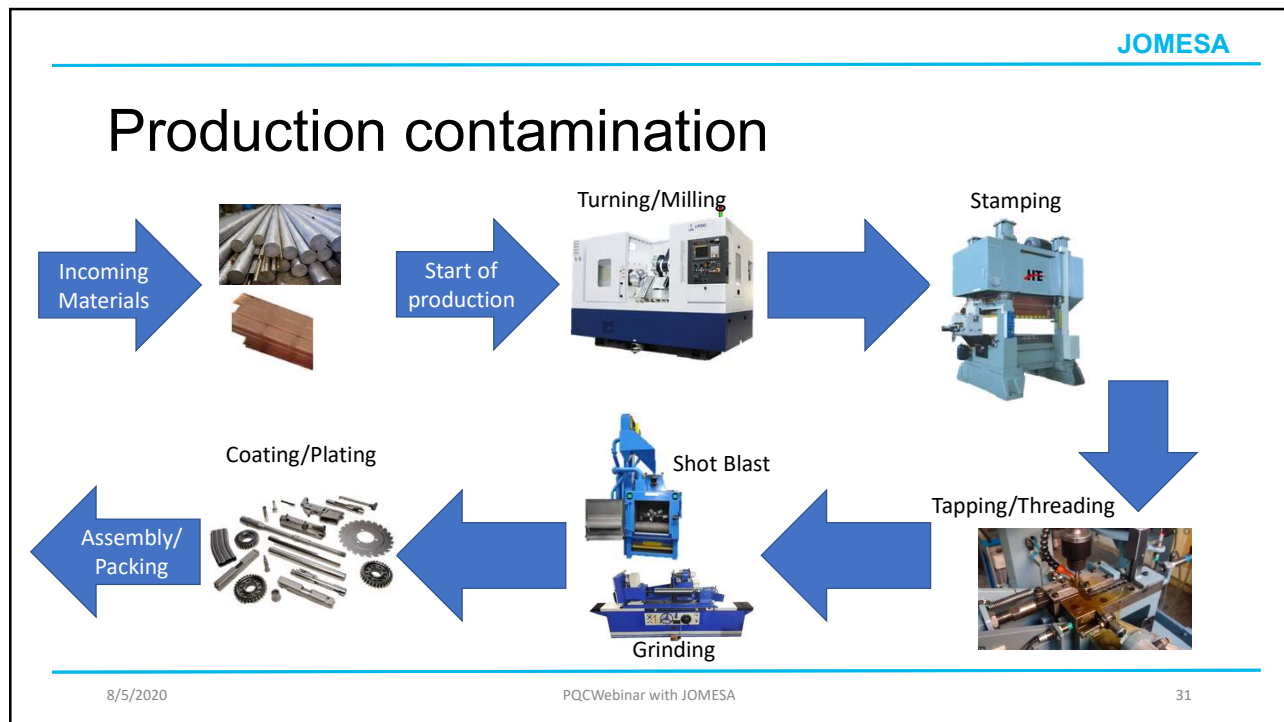
Length (µm)	Tot	B	C	D	E	F	G	H	I	J	K	L	M	N
5 - 15	15	0	0	0	0	0	0	0	0	0	0	0	0	0
15 - 25	25	0	0	0	0	0	0	0	0	0	0	0	0	0
25 - 50	50	0	0	0	0	0	0	0	0	0	0	0	0	0
50 - 100	100	0	0	0	0	0	0	0	0	0	0	0	0	0
100 - 200	200	0	0	0	0	0	0	0	0	0	0	0	0	0
200 - 400	400	0	0	0	0	0	0	0	0	0	0	0	0	0
400 - 600	600	0	0	0	0	0	0	0	0	0	0	0	0	0
600 - 1000	1000	0	0	0	0	0	0	0	0	0	0	0	0	0
1000 - 1500	1500	0	0	0	0	0	0	0	0	0	0	0	0	0
1500 - 2000	2000	0	0	0	0	0	0	0	0	0	0	0	0	0
2000 - 3000	3000	0	0	0	0	0	0	0	0	0	0	0	0	0
Corundum (Al <sub>2</sub> O <sub>3</sub> )	87	0	2	29	47	14	0	0	0	0	0	0	0	0
Steel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glass	83	0	12	40	22	7	1	0	0	0	0	0	0	0
Silicium	168	0	76	88	6	0	0	0	0	0	0	0	0	0
Si+Al+O	3	0	1	1	1	0	0	0	0	0	0	0	0	0
SiO <sub>2</sub>	5	0	2	3	0	0	0	0	0	0	0	0	0	0
Si+Al+Ca+O	2	0	0	2	0	0	0	0	0	0	0	0	0	0
Oxidized Al	2	0	0	0	1	1	0	0	0	0	0	0	0	0
AlCu	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Al Alloy other	10	0	1	5	3	1	0	0	0	0	0	0	0	0
Cr coating	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non ferrous metal	2	0	0	1	0	1	0	0	0	0	0	0	0	0
Salts	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Mineral fibre	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mineral others	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbon compounds	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	28	0	11	12	4	1	0	0	0	0	0	0	0	0



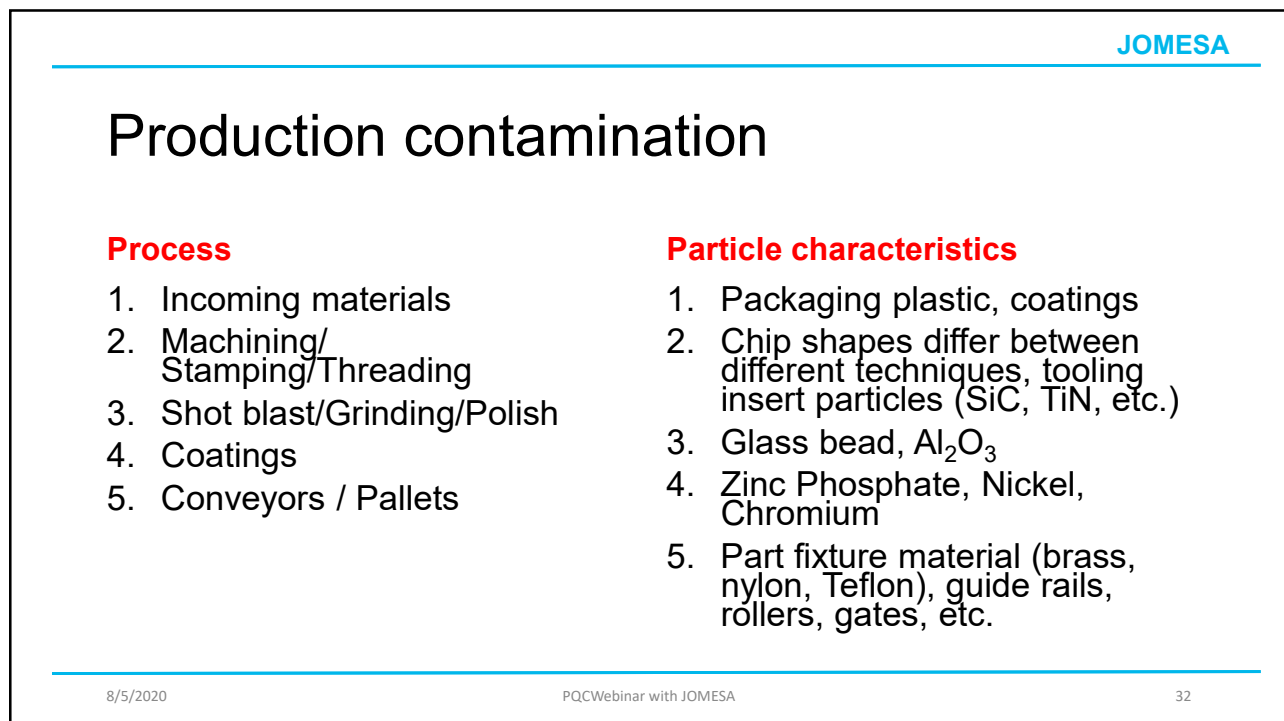
# Correlating data with process improvements

Utilize optical and EDX data to improve production cleanliness and beyond

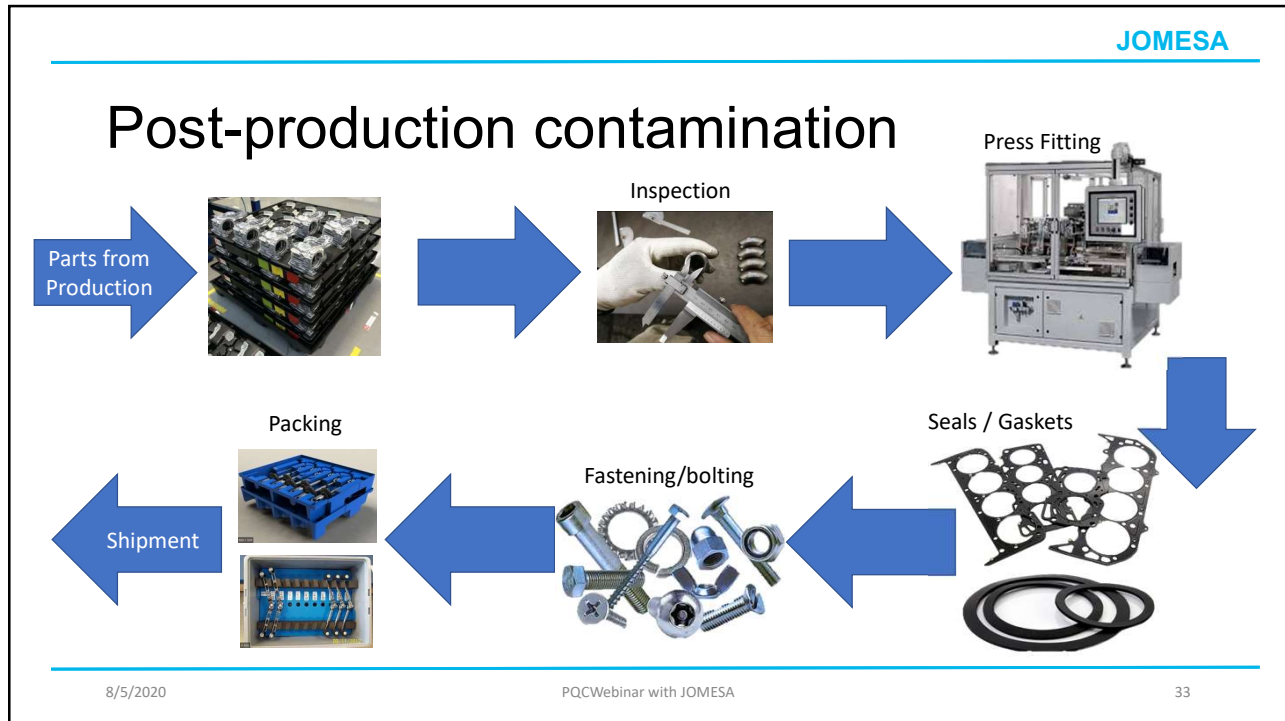




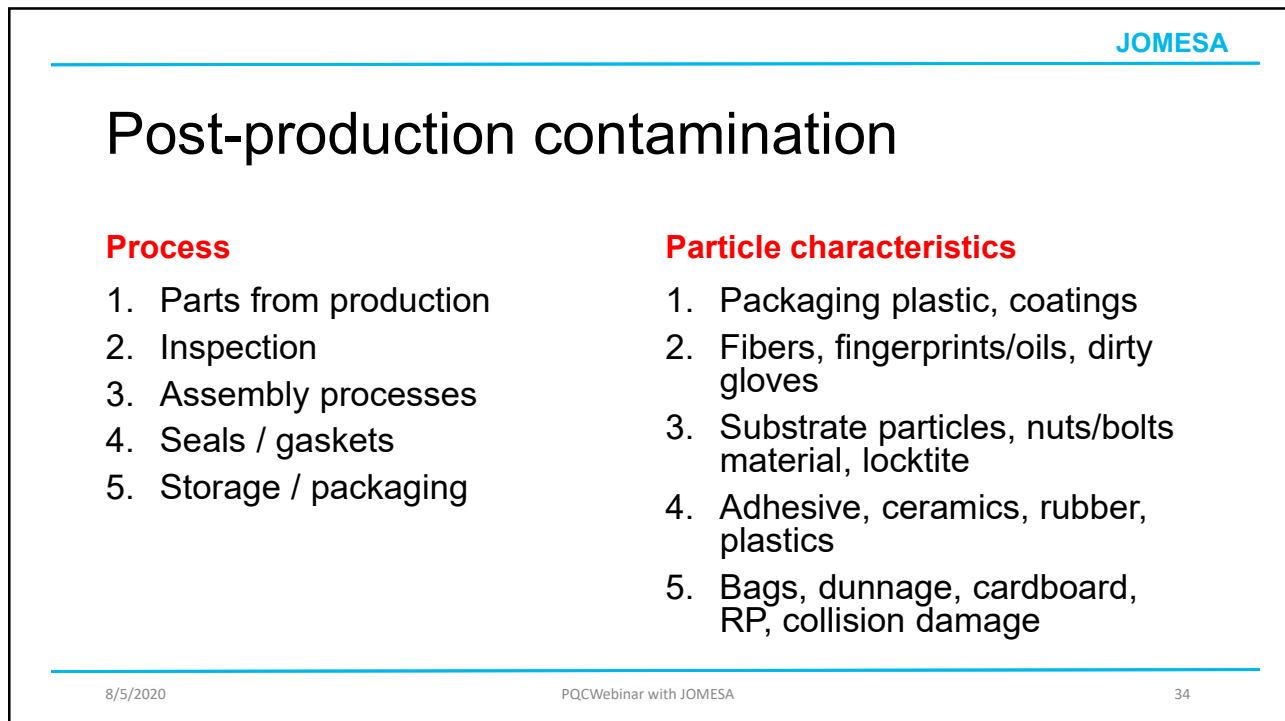
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# JOMESA

North America, Inc.

2095 E. Big Beaver Rd.  
Troy, MI 48083  
248-457-0023

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## Thank you for attending!

### The PQCWebinar: What is that Particle?

product quality  
cleaning workshops

The PQCW offers practical,  
hands-on and independent,  
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# Product Quality Cleaning Workshops

COME TO THE PQCW

- ▶ **When?** To Be Announced
- ▶ **Where?** Sam Houston St. Univ., Huntsville TX
- ▶ **More Info?** Visit <http://shsu.edu/pqcw>



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## Have a great rest of your day



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