Look Before You Leap

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About us

The Cleaning Lady
Barbara Kanegsberg, M.S.
- President, BFK Solutions
- 30 years industrial experience
- Recognized expert in critical/industrial cleaning and contamination control
- Experience in cleaning process development, troubleshooting for aerospace, medical, electronics, optics, automotive, engineered coatings
- Active in ASTM/ISO Standards Development

The Rocket Scientist
Ed Kanegsberg, Ph.D.
- Vice-President, BFK Solutions
- Expert in cleaning process design, productionization, and troubleshooting for high value product manufacturing, including additive and combination medical devices

The Professor
Darren Williams, Ph.D.
- Cleaning Research Group Leader and Professor of Chemistry at SHSU
- Six-Sigma Blackbelt Certified
- 20 years experience in precision cleaning, cleaning verification, and solvent formulation
Overview: Look Before You Leap

- Why look before you leap?
  - Making a change to your process is a “leap”.
- Quick cleaning tests
  - Doing your own small-scale tests is “looking” before you leap.
- The product and the process
  - Putting it all together
- Move forward!
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Begin with the end in mind: cleaning tests

- **Why do you need simple cleaning tests?**
  - Confirm current process is ok
    - Or, confirm problems
  - Confirm suspicions of poor cleaning
  - Make sure field cleaning is ok
    - Are IFUs (Instructions for Use) being followed
  - Confirm effectiveness of proposed and updated cleaning processes

- **What are you worried about?**
  - Oil
  - Particles
  - Mixed residue
  - Vague, nagging concern
    - product has to “look” right
Begin with the end in mind: cleaning process change

- Why change the cleaning process?
  - New product/new materials of construction
  - More business
  - Customer complaint
  - Surface problems
  - Regulatory/institutional issue
    - OSHA, EPA, FDA, NADCAP, ISO

- How soon must the new process happen?
- Is there a budget?
  - Details!

- Is there management support?

- What do you expect to achieve?
  - Are there performance tests?
  - Are there surface quality requirements?
Judges of Cleanliness – Cleaning Team is a Must

• Management
  • Buy-in a must
• Safety/environmental
• Design engineering
• Quality engineering
• Operations management

• Technicians, assemblers, operators
  • Buy-in is non-negotiable
  • Simple tests must be truly simple
    • Process control
    • Monitoring
  • New cleaning process
    • Perform well
    • Easy to maintain
    • Low odor
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Simple cleaning tests

- Visual surface appearance
- Ambient light
- Black light
- Microscopes
- Gravimetric
- Water drop/wetting
- Contact angle
- pH
More simple tests – what if the part is complex?

Get creative

- Eg: blind holes, long tubes, fine bores
- Wetting test
- Expose complex parts to stronger solvent; apply force
  - Deposit on a white cloth
  - Evaporate on a mirror – look for residue
Visual and UV (Black Light)

- **Fluorescence (using blacklight or UV)**
  - Can reveal soil that is invisible to the eye
Visual and UV (Black Light)

- UV and blacklights can track the soil removal
- Very gentle wipe dragging method.
WETTING

- Surface tension and viscosity impede penetration (wetting)
- Cleaning parts with holes can be problematic

- Demonstration of wetting in part with 1mm dia. holes
  - Water (dyed blue)
  - trans-dichloroethylene (DCE) (clear)
  - Aqueous surfactant (dyed yellow-green)
  - Digital microscope used to capture images
Water only

- No penetration through hole (high surface tension)

View from below
DCE

• Rapid penetration (low surface tension, low viscosity)
aqueous surfactant added to water (lowers surface tension)
Implications of wetting

- Is wetting too low? Employ TACT
  - Temperature (increased temperature decreases viscosity)
  - Action (force; e.g. spray, ultrasonic cavitation)
  - Chemistry (higher wetting agent)
  - Time

- Rinsing aqueous cleaners is a challenge
- High wetting does not necessarily mean high solvency
- Cleaning interior of long tubes or cannulas? Very challenging
  - Need good wetting, aggressive cleaning & rinsing
  - Check residue with an aggressive solvent
Small-scale cleaning tests

Test the interactions with your soils
- Aqueous
- Solvent (liquid/vapor degreasing)

Simple observations
- No interaction with soil
- Wetting of the soil
- Wetting and softening of the soil
- Wetting and movement of the soil
- Dissolving and removing the soil

Water does not interact with hydrocarbon grease

TCE slowly dissolves hydrocarbon grease
Small-scale cleaning tests

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Small-scale cleaning tests

Water and alcohols showed little interaction with hydrocarbon grease

Strong solvents interacted well with hydrocarbon grease
Test samples

- Coupons don’t tell the whole story
- Need relevant Size/Shape/configuration
- Materials of construction
  - Combination of materials in component
  - Materials with potential compatibility issues
    - Polymeric
    - Reactive metals (eg. Aluminum, Magnesium)
- Controls
  - Clean sample
  - Soiled sample
Samples, Controls

**Clean control**
- What does clean look like?
  - Visual – thin film, particles, residue, surface appearance
- Clean in current process
- Compare with new process

**Soiled samples**
- Apply soil
- Clean using current process
- Clean using new process

Aluminum weigh pans are great for gravimetric cleaning tests
Challenge: Soiled samples reflective of actual conditions

- **Too easy**
  - Eg. Rub metalworking fluid on part
  - Easy to wipe off

- **Too difficult** ➔
  - Charred soil
  - Nothing may remove it!

- **Charred soil, Product Quality Cleaning Workshop (PQCW)**
Soiled sample should reflect

- Actual soils
- Actual method of application
  - Machining
  - Reflow (for fluxes)
- Heat, aging
- Unrealistic conditions:
  - apply so much soil that all cleaning processes fail
  - (including your current process)
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Running the cleaning process - options

- At your facility
- With another customer
- With a supplier (cleaning agents, cleaning equipment)

Coordinated approach is essential
- Not just cleaning equipment
- Not just cleaning chemistry

Cleaning is a process
- Chemistry
- Temperature
- Time
- Physical force

Cleaning process has steps
- Wash, Rinse, Dry
What cleaning process or combination of processes will be tested?

- Aqueous
- Solvent (liquid/vapor degreasing)
- “Non-chemical” cleaning
  - E.g. CO₂, Steam, Plasma
- Semi-aqueous
- Co-solvent
- High-boiling solvent

- Understand the chemical and the process
  - Benefits
  - Limitations
  - Cost
  - Regulatory

- Decide what cleanliness tests will be needed
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Use appropriate tests

- You don’t have to have an ASTM or ISO test - make up something convenient, consistent that your team can use
- What are your cleanliness tests?
  - White glove
  - White cloth
  - Black cloth
  - “Huff” test
  - “Irving, the 85 year old lead tech suspects a problem” test
Document the tests

• Define the cleaning test
  • Get Irving to describe how he senses trouble

• Write down the simple test procedure
  • Get everyone to agree

• Keep records
  • The camera is useful
  • A digital microscope is useful
  • Note date, time, parts tested

• Work with your team
Product Quality Cleaning Workshop

- May 13-14, 2020
- 2-Day Workshop
- Comprehensive hands-on and classroom training in precision and critical cleaning

www.shsu.edu/pqcw
Many thanks to

- Max Sever, Assistant at BFK Solutions, Engineering Student
- The Cleaning Research Group at SHSU - Ashlyn Everhart, Diana Chavelas, Shannon Miller, Logan Aimone, and Matthew Peavy

Come see us at Booth 2100, 2102

More questions?

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