What Could Possibly Go Wrong? The Process of Process Change

Barbara Kanegsberg and Ed Kanegsberg
BFK Solutions LLC
(310) 459-3614
info@bfksolutions.com

Surface Finishers Educational Association (SFEA)

November 11, 2021

SFEA Surface Finishers Educational Association

BFK Solutions LLC

Surface Finishers Educational Association (SFEA)

- Serves all surface finishers
  - Electronics, circuit boards, automotive components & accessories, aerospace, hardware, household fixtures, other manufactured goods
- Non-profit
  - education
  - diverse exchange of ideas
- BFK Solutions SFEA involvement
  - Ed Kanegsberg, Media Chair
  - Barb Kanegsberg, Program Chair
- https://www.sfeasc.org

BFK Solutions LLC

To Barbara's Parents – Veteran's Day

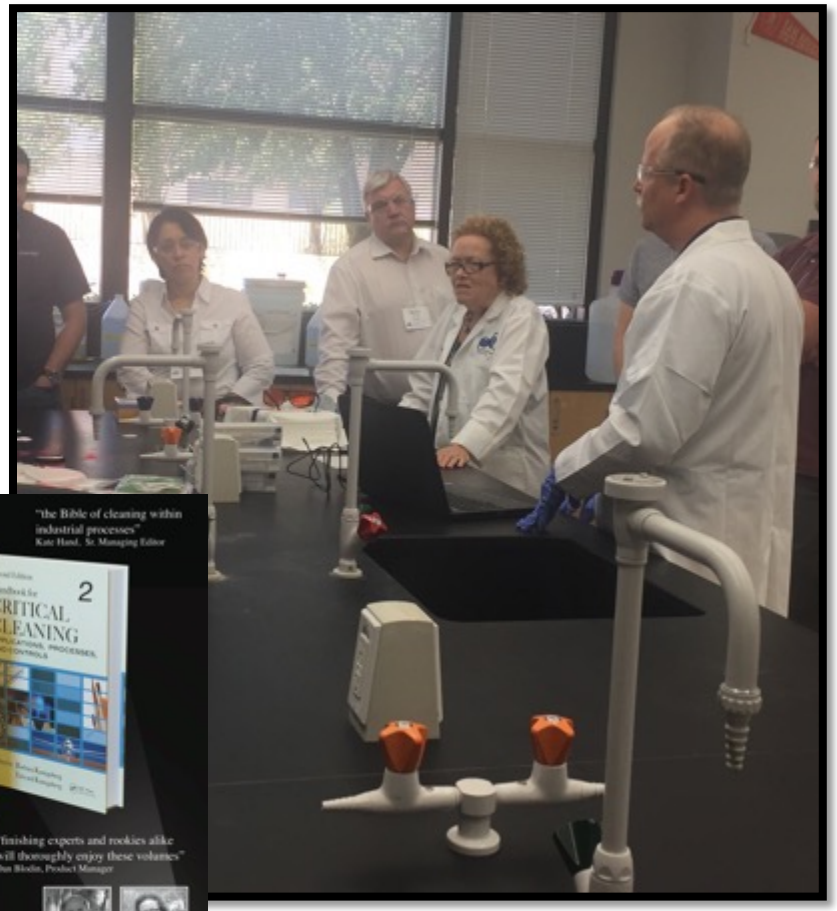
BFK Solutions
Critical Cleaning Consultants, est. 1994

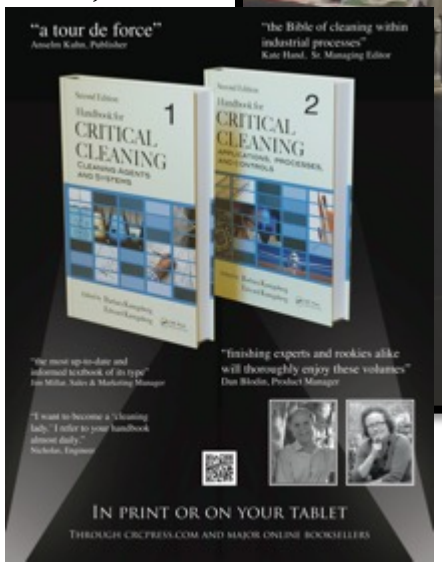
- As the industry leaders, we provide
  - Process improvement, not product sales
  - Experience, expertise, common sense
  - Industry involvement: JS3 (military), IPC, ASTM, U.S. ISO expert, EPA, FDA
- Barbara Kanegsberg, "*The Cleaning Lady*"
  - Biochemist, clinical chemist, manufacturing process
- Ed Kanegsberg, "*The Rocket Scientist*"
  - Physicist, engineer, process evaluation

BFK Solutions LLC

BFK Solutions Educational Resources

- "Clean Source" eNewsletter
  - Free; Sign up!
  - https://bfksolutions.com/subscribe-to-clean-source-newsletter/
- Product Quality Cleaning Workshops & Webinars (PQCW)
  - With Dr. Darren Williams, Sam Houston State University
- Editors, 2 volume "Handbook for Critical Cleaning," CRC Press, 2nd edition, 2011





BFK Solutions LLC

Always question authority - including BFK Solutions

- This presentation represents the views of BFK Solutions
  - We learn from our diverse clients
    - Product manufacturers
    - Providers of cleaning agents & equipment
    - Academic institutions
    - U.S. military
    - Regulatory agencies, including the U.S. EPA
- We make the best effort to provide accurate, up-to-date information
  - Information, especially quantitative information, is obtained from reliable references
  - It's always prudent to reconfirm all technical and regulatory information from the appropriate supplier or regulatory agency
  - SDS (MSDS)
  - Technical data sheet
  - Most recent requirement or regulation
- Presentation contains private and copyrighted material. May be distributed with prior permission of BFK Solutions, LLC

BFK Solutions LLC

Overview: What Could Possibly Go Wrong? The Process of Process Change

- **Dreaded words**
- Scenarios and costs
- More lurking costs
- Update on EPA regulatory actions
- The process of process change – successful critical cleaning

BFK Solutions LLC

Dreaded words from the boss: "We have to change the process – take care of it in your spare time."

Why? How soon?

- The process equipment is 40 years old and breaks down
- There's a PFAS issue
- Customers demand a lower defect rate
  - Or fewer particles, or lower thin film residue
- EPA TSCA may ban chlorinated or brominated solvents in a few years
- Corporate says we can't use our high pH aqueous cleaner
- We need higher throughput
- R&D has a new product; the current process won't work
- There is a supply chain bottleneck
- Our supplier is forced to alter process
- Etc., etc.

BFK Solutions LLC

Our topic: changing the cleaning/surface prep process

- How difficult could it be?
- The obvious factors
  - Pick a cleaning agent
  - Pick a new cleaning machine
  - Voila!
  - Well ……

BFK Solutions LLC

Overview: What Could Possibly Go Wrong? The Process of Process Change

- Dreaded words
- **Scenarios and costs**
- More lurking costs
- Update on EPA regulatory actions
- The process of process change – successful critical cleaning

BFK Solutions LLC

A Few Ideal Scenarios – costs other than equipment, chemicals

- Ideal
  - **everything –**
  - **or almost everything - goes right**
- Scenarios are estimates
- These are NOT case studies
- Based on experience, observations, critical cleaning, surface prep
- Principles apply to ALL process change

Labor, travel, testing costs (USD$)

- Labor (hourly, burdened)
  - Senior Engineer, Manager $125
    - Includes the company president
  - Technician $75
  - Basis: assessment of online information, 2021
- Advisors (hourly)
  - $250
  - Technical, legal, financial, safety
  - Estimate weighted toward safety advisors
- Travel (estimate)
  - $750/day
- Testing, verification, approvals
  - Varies with product line, end-use requirements
  - Estimates obtained from
    - Project managers at test labs
    - Consultants (including BFK Solutions)

BFK Solutions LLC

Tasks to achieve process change; they all cost $$

- Assemble cleaning team
- Team meetings
- Meet with advisors
- Meetings with customers
- Audit suppliers
- Explore cleaning options (web-search, talk to suppliers, webinars, etc.)
- Attend trade shows
- Obtain & review preliminary equipment costs
- Select, obtain & ship representative hardware samples for test
- Meetings with insurance carrier, fire department
- Independent lab cleanliness tests
- Evaluate results, preliminary cleanliness tests (supplier & independent)
- Review findings with upper management
- Address management concerns
- Fine tune equipment and process design
- Site visit at equipment supplier
- Arrange for needed facilities changes
- Address local regulatory issues
- Set up and on-site performance test for new equipment
- Train employees

BFK Solutions LLC

Do NOT roll your eyes at me!!! A team is a good thing

- Process team
  - An effective team saves time
  - Essential: Upper management support and involvement
  - Essential: Buy-in, support from assemblers, techs, operators
- Begin with the end in mind – e.g. how clean is clean enough?
- Communicate
- Coordinate!

BFK Solutions LLC

Put together the process change team!

- **A team leader – you, perhaps**
- **Upper Management**
- **Assemblers/technicians/operators**
- Design engineers
- Key supervisors
- Technical advisors
- Quality Control professionals
- Facilities/maintenance personnel
- **Safety/environmental professionals**
  - In-house or contracted
- Regulatory experts
  - Eg. FDA, NADCAP, Military
- Supply chain
  - **Contract manufacturers**
  - **Customers**
- Regulatory agencies
  - Safety, environmental, performance

BFK Solutions LLC

Ideal Development scenario 1 – General Cleaning

- Moving from a halogenated solvent to an aqueous parts washer; or simply moving from an old aqueous parts washer to a new design
- Primary labor cost: Performance test
- Low cost:
  - Process development
  - Process verification
- No travel, no outside lab costs
- Assumption: they get it right the first time

BFK Solutions LLC

Ideal Scenario 1, General Cleaning, new aqueous: $37,050

Item	Labor hours	Cost USD$	Comments
Assemble cleaning team	4	500	engineer
Team meetings	8	2600	3 people: 2 engineer., 1 technician
Meet with advisors	0	0	
Meetings with customers	6	750	virtual
Audit suppliers	0	0	
Explore cleaning options (web-search, talk to suppliers, webinars, etc.)	32	4000	engineer
Attend trade shows	32	7000	engineer
Obtain & review preliminary equipment costs	20	2500	engineer
Select, obtain & ship representative hardware samples for test	20	4000	engineer +technician
Meetings with insurance carrier, fire department	4	500	engineer
Independent lab cleanliness tests		0	
Evaluate results, preliminary cleanliness tests (supplier & independent)	4	500	engineer
Review findings with upper management	2	500	engineer + manager
Address management concerns	4	500	engineer
Fine tune equipment and process design	20	4000	engineer +technician
Site visit at equipment supplier	0	0	
Arrange for needed facilities changes	4	1000	2 Engineers
Address local regulatory issues	8	1000	engineer
Set up and on-site performance test for new equipment	20	5500	engineer+ 2 technician
Train employees	8	2200	engineer+ 2 technician

Ideal Scenario 2:General Cleaning, Switch from Halogenated Solvent to Non-Aqueous Process

- Move from a halogenated solvent to a solvent-based process
  - Assume a flammable solvent
- More labor, advisory costs. – need to gain familiarity with cleaning equipment & process options
- Medium cost
  - process development
  - Process verification
- No travel, no outside lab costs – a very optimistic assumption!
- Assumption: they get it right the first time
- Remember: **This is in addition to equipment and chemical costs**

Ideal development scenario 2:General Cleaning, Switch from Halogenated Solvent to Non-Aqueous Process $86,150

Item	Labor Hours	Cost USD$	Comments
Assemble cleaning team	4	500	engineer
Team meetings	8	2600	3 people: 2 engineers., 1 technician
Meet with advisors	8	3000	engineer+ advisor
Meetings with customers	6	750	virtual
Audit suppliers	0	0	
Preliminary but unsuccessful exploration of aqueous solution	80	26000	3 people: 2 engineers., 1 technician
Explore cleaning options (web, talk to suppliers, webinars, etc.)	80	10000	engineer
Attend trade shows	32	7000	engineer
Obtain & review preliminary equipment costs	20	2500	engineer
Select, obtain & ship representative hardware samples for test	30	6000	engineer +technician
Meetings with insurance carrier, fire department	8	1000	engineer
Independent lab cleanliness tests		0	
Evaluate results, preliminary cleanliness tests (supplier & independent)	4	500	engineer
Review findings with upper management	4	1000	engineer + manager
Address management concerns	8	1000	engineer
Fine tune equipment and process design	40	8000	engineer +technician
Site visit at equipment supplier	0	0	
Arrange for needed facilities changes	4	1000	2 engineers
Address local regulatory issues	8	1000	engineer
Set up and on-site performance test for new equipment	40	11000	engineer+ 2 technician
Train employees	12	3300	engineer+ 2 technician

Ideal Scenario 3: High Precision

- Move from halogenated solvent to low flashpoint solvent
- Regulatory/permitting issues
- Manufacturer understands processes of upstream supply chain
  - Including soils and cleaning processes
- Manufacturer understands how clean is clean enough
- Customer has specific cleanliness expectations
  - Communicates those expectations clearly

Ideal Scenario 3: Costs High Precision Product: $95,900

Item	Labor hours	Cost USD$	Comments
Assemble cleaning team	8	1000	engineer
Team meetings	8	5200	6 people: 4 engineers, 2 technician
Meet with advisors	8	3000	engineer+ advisor
Meetings with customers	8	1000	virtual
Audit suppliers	80	17500	engineer (2 day each, including travel x 5)
Explore cleaning options (web, talk to suppliers, webinars, etc.)	60	7500	engineer
Attend trade shows	32	7000	engineer
Obtain & review preliminary equipment costs	20	2500	engineer
Select, obtain & ship representative hardware samples for test	60	12000	engineer +technician
Meetings with insurance carrier, fire department	4	500	engineer
Independent lab cleanliness tests		4000	
Evaluate results, preliminary cleanliness tests (supplier & independent)	8	1000	engineer
Review findings with upper management	2	500	engineer + manager
Address management concerns	8	1000	engineer
Fine tune equipment and process design	40	8000	engineer +technician
Site visit at equipment supplier	16	3500	engineer
Arrange for needed facilities changes	4	1000	2 engineers
Address local regulatory issues	8	1000	engineer
Set up and on-site performance test for new equipment	60	16500	engineer+ 2 technician
Train employees	8	2200	engineer+ 2 technician

BFK Solutions LLC

Ideal development scenario 4: Safety/Critical Medical Device

- Safety/Critical Cleaning
  - Failure is not an option
    - Implantable medical devices, some military, advanced automotive, aeronautics
- Evaluating a low flashpoint solvent in a new cleaning process
- **Significant effort for preliminary performance testing and cleaning validation**
- Remember: Equipment & cleaning agent costs are excluded

Ideal Scenario 4: Safety/Critical Medical Device (Hilarious Assumptions)

- Everything goes right the first time
- The final fabricator and key suppliers work seamlessly and harmoniously
- No false starts
- No mistakes (they choose the right equipment, the right cleaning agent, the right process)
- Management has no second thoughts
- The FDA is **deliriously happy** and has no comments or reservations

Ideal Scenario 4: cleaning process development costs: one implantable medical device - $275,500

Item	Labor hours	Cost USD$	Comments
Assemble cleaning team	12	1500	engineer
Team meetings	16	14400	8 people: 6 engineers., 2 technicians
Meet with advisors	32	12000	engineer+ advisor
Meetings with customers	12	1500	virtual
Audit suppliers	120	26250	engineer (2 day each, including travel x 5)
Explore cleaning options (web-search, talk to supplier, webinars, etc.)	80	10000	engineer
Attend trade shows	32	7000	engineer
Obtain & review preliminary equipment costs	40	5000	engineer
Select, obtain & ship representative hardware samples for test	80	16000	engineer +technician
Meetings with insurance carrier, fire department	4	500	engineer
Independent lab cleanliness tests (including pre-validation)		8000	
Evaluate results, preliminary cleanliness tests (supplier & independent)	24	3000	engineer
Review findings with upper management	4	1000	engineer + manager
Address management concerns	16	2000	engineer
Fine tune equipment and process design	80	16000	engineer +technician
Site visit at equipment supplier	24	5250	engineer
Arrange for needed facilities changes	4	1000	2 engineers
Address local regulatory issues	8	1000	engineer
Set up and on-site performance test for new equipment	60	16500	engineer+ 2 technician
Process validation labor	120	15000	engineer
Process validation outside costs		100000	testing for 1 device
Address FDA Concerns (assumes no re-test needed, just documentation)	24	6000	2 Engineers
Train employees	24	6600	engineer+ 2 technician

BFK Solutions LLC

Comments about cost estimates

- This is when everything goes RIGHT!
- Scenarios 1 to 4 are highly idealized and optimistic
- Costs, even for well- planned projects, can be much higher
- Activities cost time and money
  - Meetings
  - Talking to cleaning agent and equipment suppliers
  - Going to conferences (even virtual conferences)
  - Arguing
  - Not understanding cleanliness requirements or production expectations

Summary, ideal scenarios

- The process of process change costs $$$
  - Excluding process chemicals and equipment
- General Cleaning, Aqueous: $37,050
- General Cleaning, flammable non-aqueous: $86,150
- High Precision Cleaning: $95,900
- Safety/Critical Cleaning: $275,500
- These are ideal conditions – get it right the first time
- Usually, conditions aren't ideal

BFK Solutions LLC

What can go wrong if we take shortcuts?

BFK Solutions LLC

Let's revisit Scenario #3 High Precision Cleaning – with "money saving" short cuts

- Company president says
  - "I just played golf with the Vice President of Marketing at 'Wham-0-clean.'"
  - "Wham-O-Clean XL equipment costs $250,000 less than what you were thinking about "
  - "The Rep guarantees it will clean all the soils our customer is worried about."
  - "The Rep says that in last 12 months there have been 200 new 'Wham-0-clean XL' installations across the U.S. They all work perfectly."

BFK Solutions LLC

Short cuts – the boss orders you to

- Don’t bother with a cleaning team
- No advisors – we can do it all!
- Don’t bother about regulatory stuff
- Don’t worry about talking to the customer; we know what our customer needs
- Don’t competitive bid
- Don’t bother with cleaning tests

BFK Solutions LLC

Ideal Development Scenario 3: High Precision Product $95,900 (Excluding equipment and chemicals) – no shortcuts

Item	Labor hours	Cost USD$	Comments
Assemble cleaning team	8	1000	engineer
Team meetings	8	5200	6 people: 4 engineers, 2 technician
Meet with advisors	8	3000	engineer+ advisor
Meetings with customers	8	1000	virtual
Audit suppliers	80	17500	engineer (2 day each, including travel x 5)
Explore cleaning options (web, talk to suppliers, webinars, etc.)	60	7500	engineer
Attend trade shows	32	7000	engineer
Obtain & review preliminary equipment costs	20	2500	engineer
Select, obtain & ship representative hardware samples for test	60	12000	engineer +technician
Meetings with insurance carrier, fire department	4	500	engineer
Independent lab cleanliness tests		4000	
Evaluate results, preliminary cleanliness tests (supplier & independent)	8	1000	engineer
Review findings with upper management	2	500	engineer + manager
Address management concerns	8	1000	engineer
Fine tune equipment and process design	40	8000	engineer +technician
Site visit at equipment supplier	16	3500	engineer
Arrange for needed facilities changes	4	1000	2 engineers
Address local regulatory issues	8	1000	engineer
Set up and on-site performance test for new equipment	60	16500	engineer+ 2 technician
Train employees	8	2200	engineer+ 2 technician

Scenario #3 (High Precision) with shortcuts: $20,700 ~80% Cost Reduction

High Precision cleaning development tasks	Labor hours	Cost USD$	Comments
Assemble cleaning team (smaller team)	2	250	engineer
Team meetings (few meetings)	4	1000	2 Sr engineer.
Meet with advisors (don't need advisors)	0	0	
Meetings with customers (assume you know what they need)	4	500	virtual
Audit suppliers (sole source so don't bother)	0	0	
Explore cleaning options (web-search, talk to vendors, webinars, etc.)	8	1000	engineer
Attend trade shows (Your mind is made up already)	0	0	
Obtain & review preliminary equipment costs (sole source)	10	1250	engineer
Select, obtain & ship representative hardware samples for test at vendor	0	0	
Meetings with insurance carrier, fire department	0	0	
Independent lab cleanliness tests (perfunctory test)		4000	
Evaluate results, preliminary cleanliness tests (vendor & independent)	4	500	engineer
Review findings with upper management	2	500	engineer + manager
Address management concerns	0	0	
Fine tune equipment and process design	20	4000	engineer +technician
Site visit at equipment vendor	0	0	
Arrange for needed facilities changes	0	0	
Address local regulatory issues	0	0	
Set up and on-site performance test for new equipment	20	5500	engineer+ 2 technician
Train employees	8	2200	engineer+ 2 technician

Consequences of short cuts

- Short cuts might work
  - 80% cost reduction
  - Everything works beautifully
  - The customer is happy
- Short cuts backfire (this is far more likely)
  - Start over: More time, more money
  - Lost business
  - Forced to make last minute, “emergency” decision
    - Still may not be ideal
  - Even more $$$

BFK Solutions LLC

Costs of shortcuts – high precision

- Ideal: $95,900
- Short-cuts: $20,700
- Recovering from shortcuts: $213,350
  - Instead of **Saving** 80% of "ideal", wind up **spending** 223%
  - And wasting a lot of valuable time and reputation

BFK Solutions LLC

Development scenario #3 (High Precision) with consequences of shortcuts

Costs more money, lots of time: $192,650 + $20,700 (1st shortcut attempt); total = **$213,350** (Excludes equipment and chemicals)

High Precision cleaning development tasks	Labor hours	Cost USD$	Comments
Assemble crisis cleaning team (more people, more time)	16	2000	engineer
Team meetings (crisis team)	40	46000	10 people (8 engineers, 2 technicians)
Meet with advisors (emergency meetings, 2 advisors)	40	25000	engineer+ advisors
Meetings with customers (calm customers down)	24	3000	virtual
Audit suppliers (search for and audit new suppliers)	80	17500	engineer (2 day each, including travel x 5)
Explore cleaning options (web-search, talk to vendors, webinars, etc.)	16	2000	engineer
Attend trade shows (no current trade show, frantic phone calls to suppliers)	40	8750	engineer
Obtain & review preliminary equipment costs	40	5000	engineer
Select, obtain & ship representative hardware samples for test at vendor	60	12000	engineer +technician
Meetings with insurance carrier, fire department	8	1000	engineer
Independent lab cleanliness tests		12000	
Evaluate results, preliminary cleanliness tests (vendor & independent)	12	1500	engineer
Review findings with management (management is more concerned)	12	3000	engineer + manager
Address management concerns	32	4000	engineer
Fine tune equipment and process design	40	13000	2 engineer +technician
Site visit at equipment vendor	16	3500	engineer
Arrange for needed facilities changes (last minute changes cost more)	20	5000	2 Engineers
Address local regulatory issues	24	3000	engineer
Set up and on-site performance test for new equipment	80	22000	engineer+ 2 technician
Train employees	16	4400	engineer+ 2 technician

Metal Finishing – attempts to replace solvent degreasing

- Mixed substrates
  - Stainless steel, carbon steel, copper, brass, assorted aluminum alloys
- Anodizing, plating, powder coating
- General industrial, automotive, medical
- Pinch point: Removal of heavy oils and polishing compounds
  - Current: degrease in n-propyl bromide (nPB)
  - EPA may restrict or ban nPB

Issues: money and time for testing

- Limited testing, highly alkaline aqueous cleaner
  - By cleaning agent supplier
- Rejected relatively sophisticated system (costs)
  - Immersion, agitation, ultrasonics, multiple rinse
  - No dry
  - Limited testing by equipment supplier
- “Short cut” single-tank ultrasonic system
  - Immersion, ultrasonics
  - No rinse, no dry

Rinse? Water quality? – proposed short cuts

- Initial rinse in hot tap water
- Considered rinsing high pH aqueous degreaser using existing rinse tanks in existing plating line
- Use tap water at all steps
  - Water quality judged excellent

"Bargain" process has not been tested or adopted - What might go wrong?

- Degreasing mixed metals in aqueous is challenging
  - Materials compatibility problems with different cleaning agents
  - Galvanic effects
- Aluminum is a pain in the posterior
  - Alloys behave differently
- Using rinse tanks for more than one purpose is ill-advised
  - Soils in the rinse tank can make a huge mess
    - Cleaning agents, polishing compounds, lubricants
- Process water must be defined, controlled
  - Tap water- variable

BFK Solutions LLC

Short-cuts – bad for business

- Don’t bother with a cleaning team or advisors
  - **Poor, uncoordinated decisions**
- Don’t bother about regulatory stuff
  - **Shutdown, process delay, fines, imprisonment**
- Don’t worry about talking to the customer; we know what our customer needs
  - **Irate customers, lost business**
  - **The competition wins!**

BFK Solutions LLC

Short-cuts – bad for business

- Don't competitive bid
  - **Poor quality process equipment**
  - **Pay too much**
  - **The wrong equipment for the job**
  - **Poor customer support**
- Don't bother with cleaning tests
  - **The process fails**

BFK Solutions LLC

Overview: What Could Possibly Go Wrong? The Process of Process Change

- Dreaded words
- Scenarios and costs
- **More lurking costs**
- Update on EPA regulatory actions
- The process of process change – successful critical cleaning

BFK Solutions LLC

Effective cleaning equipment is not cheap

- Secret to “bargain” cleaning
  - Purchase quality equipment
- Budget for peripherals
  - Filtration
  - Recycling
  - Closed-loop
  - Fixtures

BFK Solutions LLC

Production flow; sizing the equipment

- Product throughput
  - Total parts per day
- Average process rate/day
- Maximum required process rate avoid bottlenecks
- Production peaks, valleys
- Eliminate techniques which do not meet your process flow requirements
- Ask equipment providers to help with equipment sizing
  - Check the math!
  - Assume some “wiggle room”
    - Process glitches
    - Down time
- Size equipment with some room for growth
- Check workspace dimensions (will equipment fit?)
  - Including ceilings!

Productive Equipment Purchases

- Don’t cut corners
- Get it in writing!
  - Design parameters
  - Performance
  - Delivery time
  - Installation
  - Initial training
  - Product support
- If they don’t deliver, don’t pay!

BFK Solutions LLC

Examples: better supplier support needed

- Aerospace company did not use supplier with PERTINENT experience
  - Good vendor, not experienced with equipment design
  - $300K+ poured in to “bottomless pit”
- Supplier said “don’t worry”
  - Requirements & product support not adequately specified in writing
  - Equipment leaked
  - Parts manufacturer had to do trouble-shooting
- Manufacturer had guarantee in writing
  - Plasma Technology Inc. (PTI)
  - Equipment not built optimally
  - PTI had ammunition to get equipment fixed

Manage the supply chain

- Make cleaning process a collaborative decision
- Specify cleaning in the contract
  - Immediate cleaning
  - Make sure suppliers use a cleaning process that works
- Audit periodically
- Cheap, generic suppliers – may cost more in the long run
- Are you part of the supply chain?
  - Become the solution, not the problem
  - Tactfully educate your customers

Partner with your suppliers

- Select intelligent, collaborative suppliers
- Auditing not always feasible
  - Secrecy, intellectual property
  - Limited choices in certain specialized suppliers
- Imposing your cleaning process on them doesn't work
- Include consistent cleaning processes in the contract
  - Get the process cast in concrete
  - Require that they inform you prior to changing the cleaning process

Overview: What Could Possibly Go Wrong? The Process of Process Change

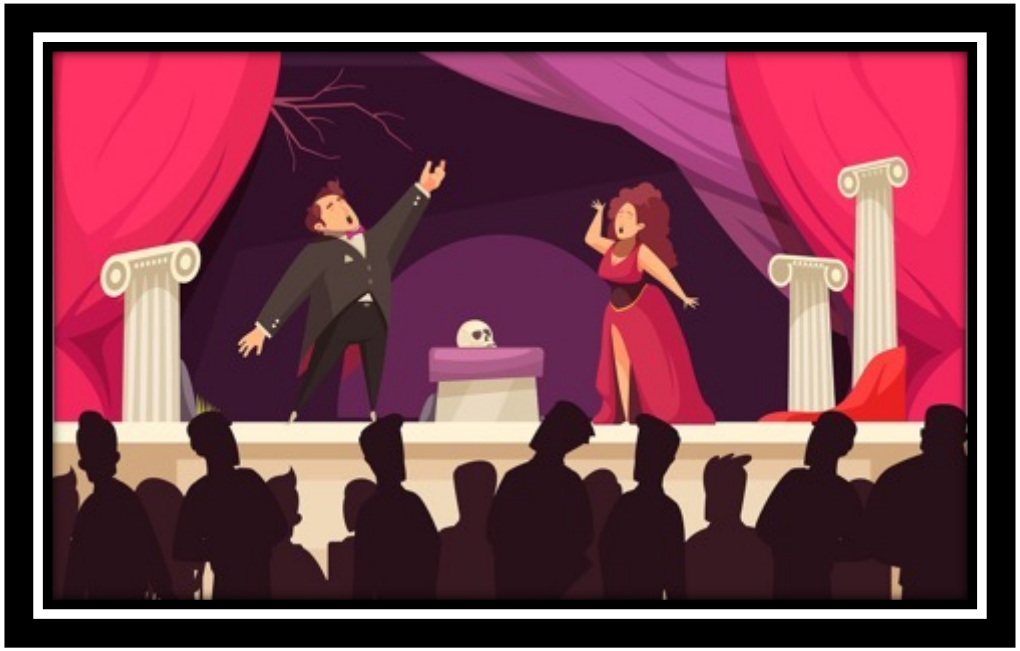
- Dreaded words
- Scenarios and costs
- More lurking costs
- **Update on EPA regulatory actions**
- The process of process change – successful critical cleaning

BFK Solutions LLC

EPA

TSCA

Will solvents be banned?



TSCA may result in drama but it's not an opera!

BFK Solutions LLC

EPA TSCA reform

https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/how-epa-evaluates-safety-existing-chemicals

- U.S. Environmental Protection Agency
  - United States, not just California
- EPA Toxic Substances Control Act (TSCA)
- Sweeping authority – environmental and worker safety (like OSHA)

BFK Solutions LLC

EPA Risk evaluations completed Halogenated cleaning solvents – possible solvent bans

Chemical name	Status	Date posted
1-BP (nPB)	Final risk evaluation	August 2020
Methylene chloride (MC)	Final risk evaluation	June 2020
Perchloroethylene (PCE)	Final risk evaluation	December 2020
Trichlorethylene (TCE)	Final risk evaluation	November 2020

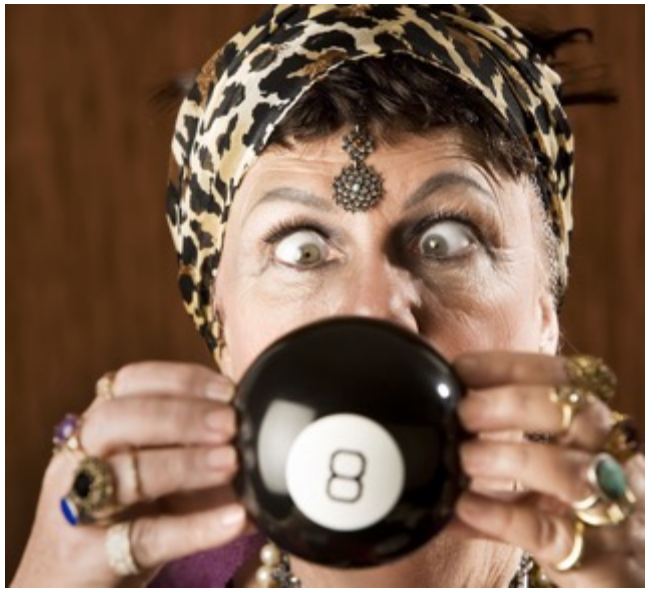
Why is BFK Solutions concerned with EPA TSCA?

- EPA actions can impact our clients in the manufacturing community
  - Cleaning agents, cleaning equipment, costs, evaluation, performance, etc.
- We are a subcontractor to the EPA
  - Provide technical information, risk management
  - Evaluate risks/benefits of alternative chemicals & processes
  - We are NOT involved in risk assessment for chemicals under review

BFK Solutions LLC

EPA Rules? Timelines?

- Ban manufacture, sale or use?
  - Who knows?
  - What if only PCE were allowed ; only in airless cleaning systems ($100K - $1Million+)
- Rules for MC, PCE, TCE, nPB by the end of 2023
- Probably a timeline, not a sudden “cutoff”
- What’s left? Trans-DCE – also under EPA review!



BFK Solutions LLC

Product manufacturers may move to flammable solvents

- Why manufacturers may change cleaning process from halogenated solvent to low flashpoint solvent
  - National (Federal EPA, EU), local local regulatory, corporate/customer policy
  - Aqueous, trans-DCE not always the right choice for the situation
- Manufacturers may move to acetone – not a VOC (ROC)
- Insurance impact: Usually costs went up (anecdotal accounts)
  - Insurance costs increased
  - Costly facilities changes required
  - Insurance not available
  - One coater: insurance obtained for cleaning process using acetone in cold dip tanks followed by high temperature metalizing
    - OUR STANCE: DO NOT USE ACETONE NEAR AN IGNITION SOURCE!!!

BFK Solutions LLC

Insurance costs may increase for flammables

- Insurance – magical mystery tour!
- Resources
  - E&O, liability agent
  - Trial attorney
- Flammable versus carcinogen?
  - Flammable – immediate dramatic & long-term effect

BFK Solutions LLC

Successful cleaning process change without breaking the bank

Coordinate

Communicate

BFK Solutions LLC

LINEAR, STOVE-PIPE APPROACH

- Trip to marble yard, 2002
  - Major remodel
  - Barb brought samples of tile, wood, hardware
- Engineer saw Barb – became agitated
  - "You must hide! My wife can't see you."
  - "I want to pick the tile, then the wood, then the hardware …"
  - "She will want to coordinate!"
- Engineer's wife, traditional sari, saw Barb with samples

THE LADY IN THE SAFFRON SARI – WE MUST COORDINATE

- She's right - successful process change
- Manufacturing, assembly
- Costs
- Quality
- Safety
- Environmental

BFK Solutions LLC

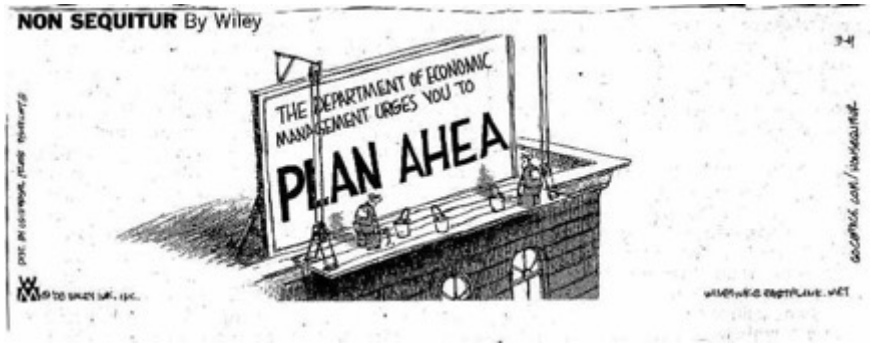
Communicate – this means you!

- Supporting information
  - Brochures
  - Cleaning studies
  - Lab results
  - PowerPoint presentations
  - Excel spreadsheets
- Supporting information is not enough!
- Communicate in simple, short sentences
  - Noun, verb, punctuation
    - Appropriate qualifying words

BFK Solutions LLC

Minimize costs – plan for the unexpected

- Good, educated cleaning team
  - Strong management backing
  - Correct players at the table
    - Including the techs
    - Including advisors
- Solid education/understanding
  - Cleaning options
  - What you need for your application
- Process selection plan
  - Chemicals & equipment
- Process validation plan
- Have a backup plan (or two)



BFK Solutions LLC

Questions?

- Barbara “The Cleaning Lady”
  - barbara@bfksolutions.com
  - Office 310-459-3614
  - Mobile 310-344-2061
- Ed “The Rocket Scientist
  - ed@bfksolutions.com
  - Office 310-459-3614
  - Mobile 310-614-7111
- Clean Source Newsletter
  - https://bfksolutions.com/subscribe-to-clean-source-newsletter/