

Zen and the art of LC-MS maintenance



Introductions

- Jules Phillips – Product Support
- Nathan Eno – Project Manager
- Chris Klein – Product Marketing
- Patrick Batoon – Product Marketing
- Schweta Shukradas – Product Marketing

LC MS Maintenance Agenda

Focus mainly on chemical noise

1. Typical day when urgent important samples need to be run
2. How to diagnose the problem
3. Prevention is better than cure
4. Questions

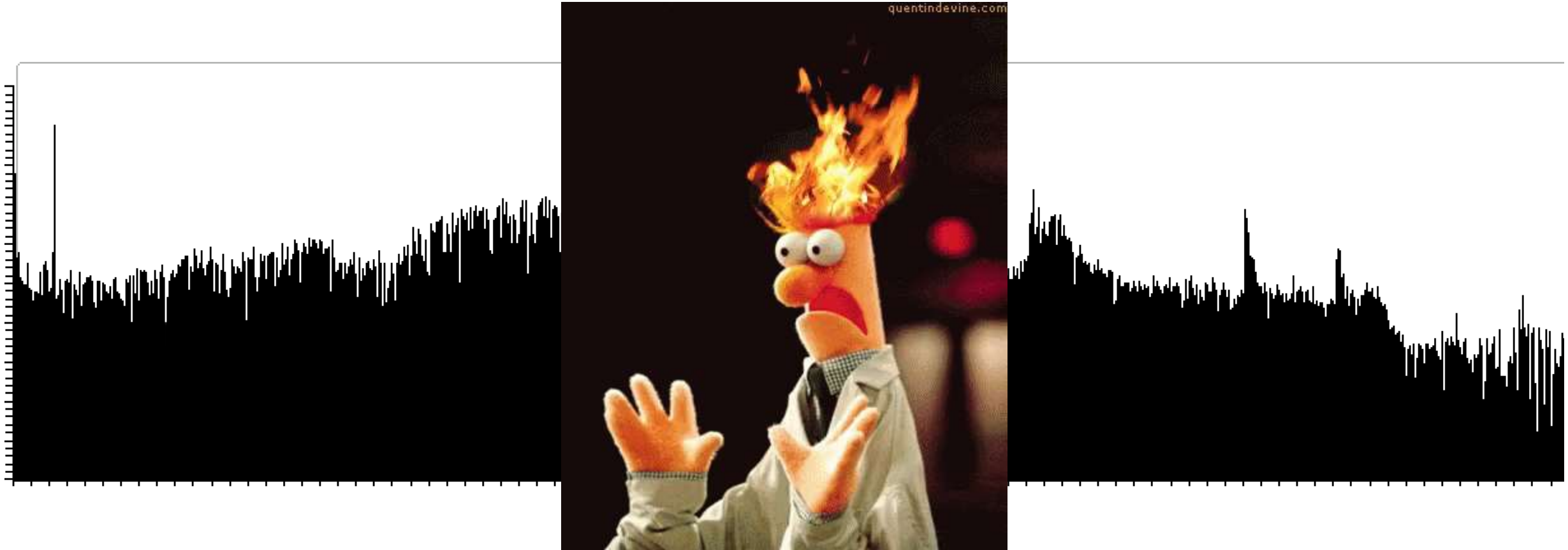
You, yesterday
Everything working perfectly and you calm and content.....



This morning
Your boss asks you to run some vitally important samples (today)



You walk into the lab full of confidence and.....



What do you do now?



Ask the audience (your lab mates)



Divide and Conquer (LC or MS)



Phone a friend (Agilent)

Ask the audience (lab mates)



- Have any samples been run overnight?
 - High matrix?
 - High concentration?
- Have the solvents been changed?
 - Batch to Batch variation
 - LC-MS grade?
- Has the column been changed?
 - New/old column
 - Different size/stationary phase
- Has the instrument been vented/cleaned?
 - Something missing
 - Wire not connected
- Have IT (or Microsoft) pushed a software update?
 - Happens all the time

Is it the LC or the MS?

- Run a check tune
 - Noise goes away – probably the LC
 - Noise still present – probably the MS

Agilent MassHunter Workstation Data Acquisition

File View Tools Help

Layout: Default(sys).lyt

Instrument Status

| Multisampler | Binary Pump | Column Comp. | QQQ |
|--------------|-------------|--------------|------|
| Not Ready | Standby | Not Ready | Tune |

0.00 / 0.00

Method Editor

CAPMRM_IDL_400Sheath.m

Properties DA Multisampler Multisampler Pretreatment Binary Pump Column Comp. QQQ

Method

- Acquisition
- Source
- Chromatograms
- Timetable
- Compound Browser

Convert to dMRM

Tune

- Autotune

Ion source: AJS ESI

Diverter: ☐ LC->Waste ☒ LC->MS

☐ Calibrant on ☒ Collision gas on

Autotune/Checktune

Tune status

Progress: 0%

Method Editor Worklist Sample Run

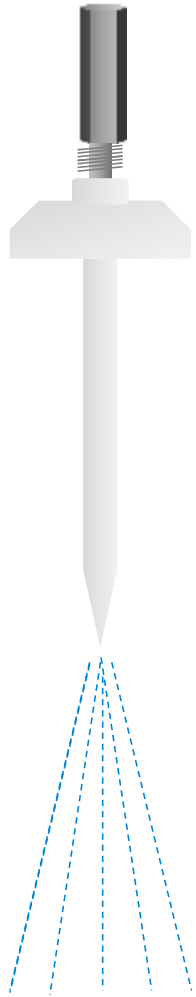
50:50

Probably the MS



- Replace peak tubing
- Change the nebulizer needle
- Clean the spray chamber, capillary cap and spray shield
- Clean the capillary
- Clean the skimmer/ion funnel

Change the Nebulizer Needle



Clean the ion source



Spray Shield



Capillary Cap

Clean the Capillary

- May need to vent the MS
- Instructions are on the resource DVD
- Be careful not to scratch the metallic coating



Probably the LC

- Remove column from line
- Test each solvent individually
- Do a solvent injection



Phone a friend (Agilent)



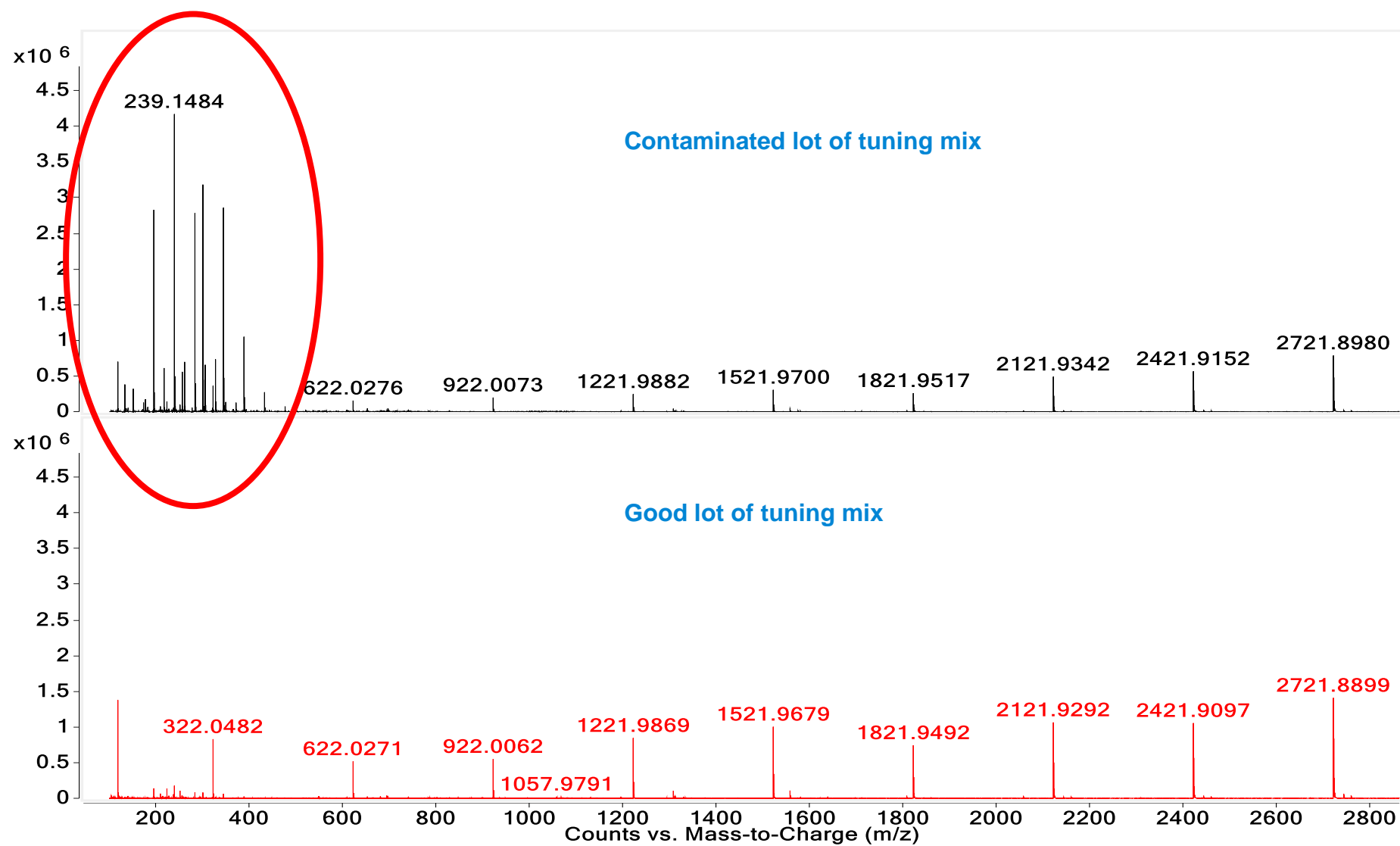
- If after trying yourself you are still having issues – Call Agilent
- Phone support
- Webex
- Service engineer on site

Prevention is better than Cure

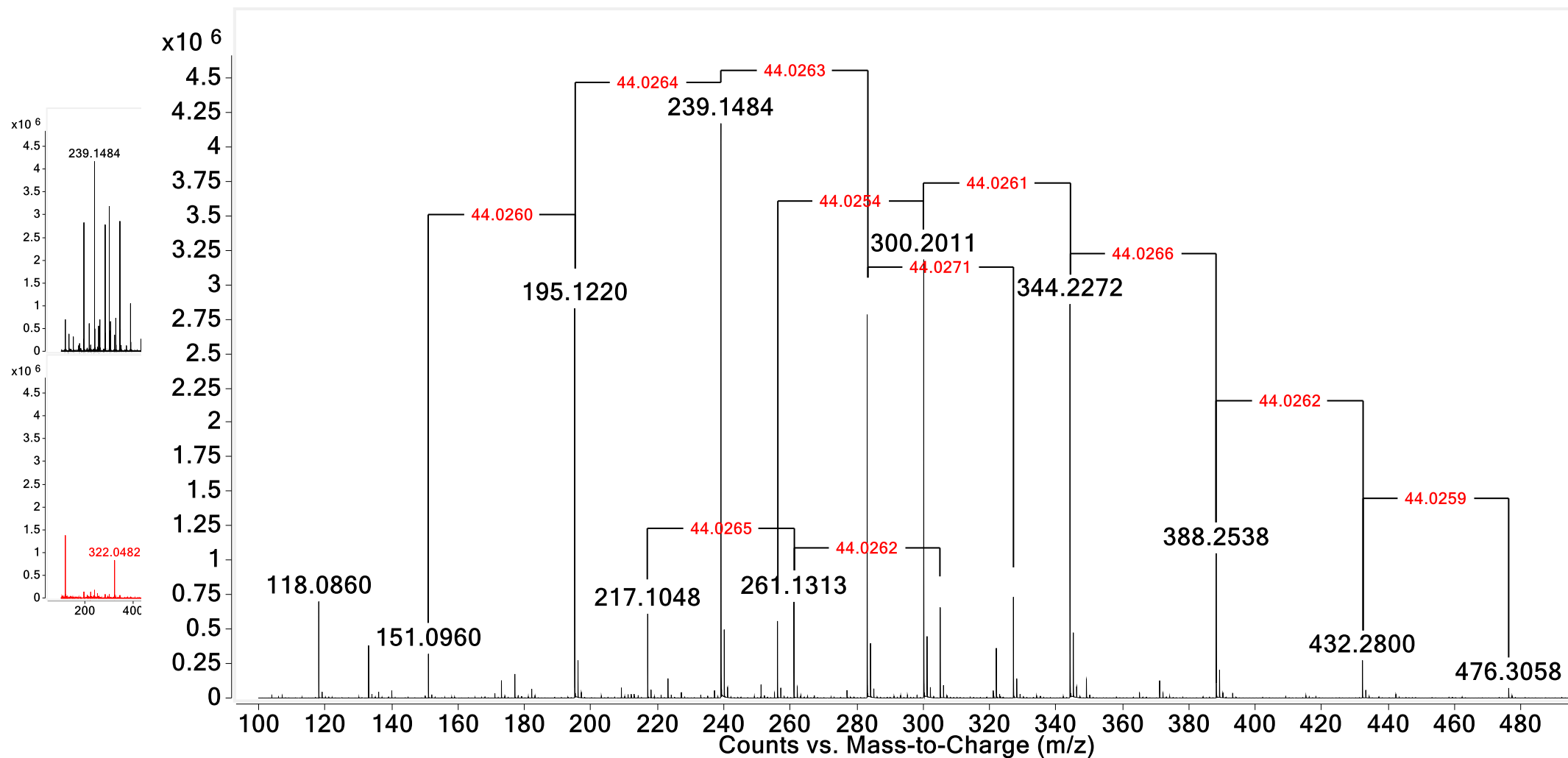
- Contamination comes in many forms
- Where could the contamination be coming from?



Tune Mix contamination

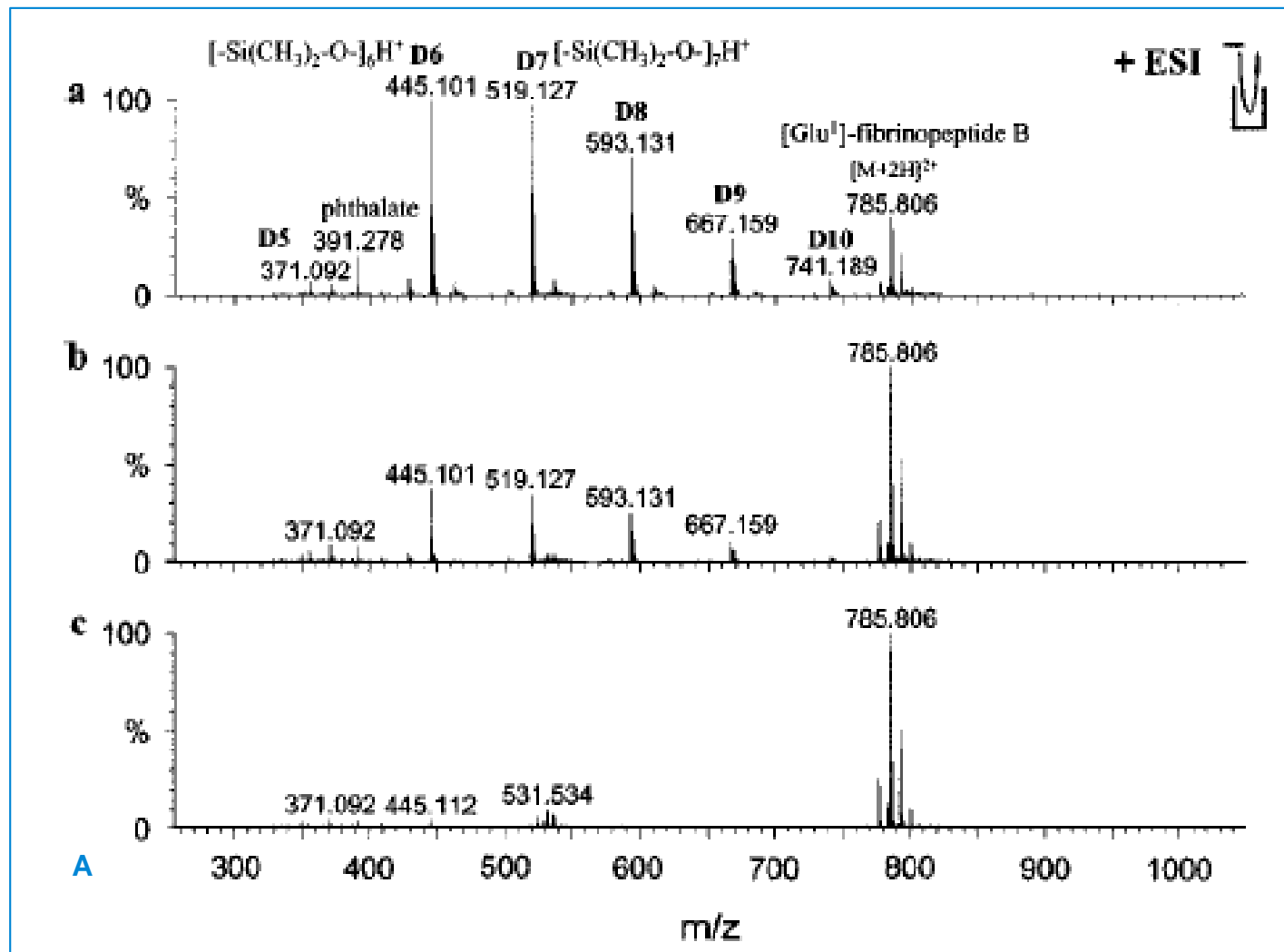


Tune Mix contamination PEG

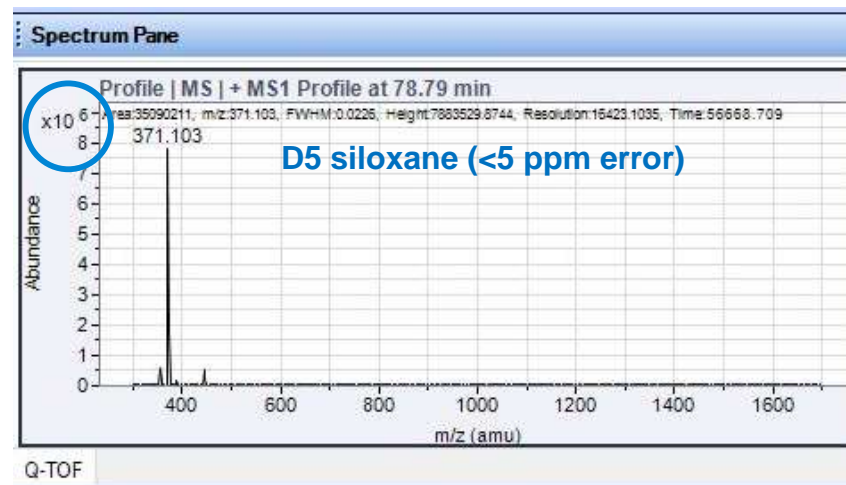
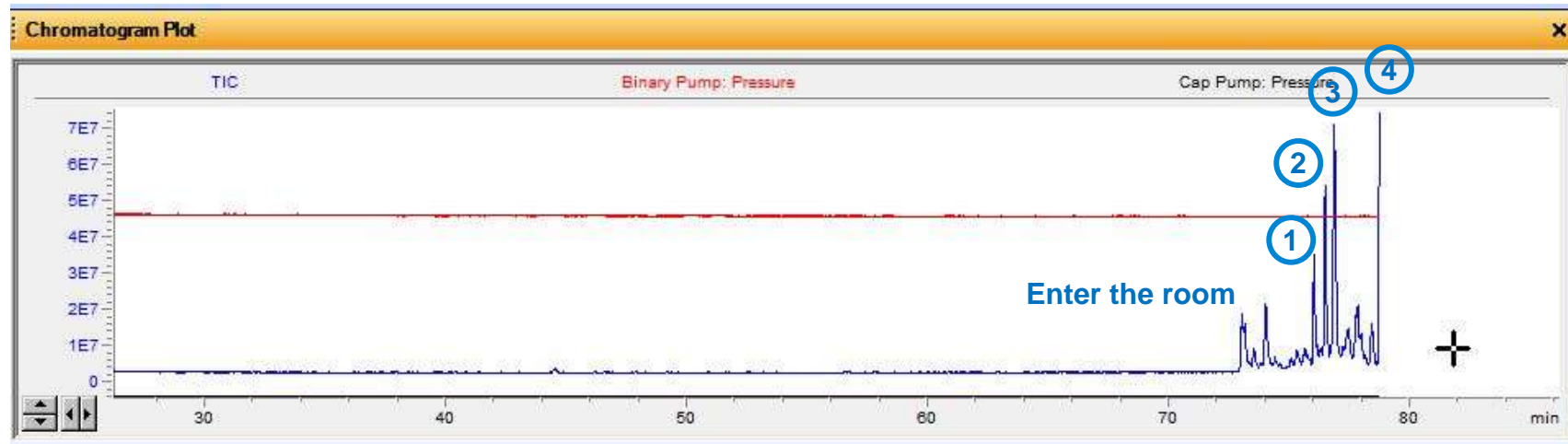


Environmental Contamination

Organic contaminants
Phthalates (m/z 149, 279, 391,...)
Siloxanes (m/z 445, 519, 593,...)
PEGs (m/z 195, 239, 283,...)



Nano-Spray noise



Note NanoSource is sealed

Where did the Contamination come from?

Round up the usual suspects!



Captain Renault, "Casablanca" (1942)



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Where Might Contamination Come From?

Suggestion

Chemosphere **93**, 735-740 (2013) DOI: 10.1016/chemosphere.2012.10.043

A study by cosmetic manufacturers to assess what amounts of personal care products might end up in pristine water (environmental impact); “What goes down the drain?”



Table 1
Antiperspirant products – measured concentration of D5 in wash water from treated and control subjects ($\mu\text{g L}^{-1}$).

| Product | Time | Treated subject mean ($\pm 95\%$ CI) | N | Control subject mean | Residual ^a (%) |
|--------------------|---------|---------------------------------------|----|----------------------|---------------------------|
| Invisible solid AP | Initial | 38020 (± 11750) | 22 | 22.1 | |
| | 8 h | 153 (± 167) | 21 | 8.7 | 0.8 |
| | 24 h | 12 (± 15) | 21 | 0.7 | 0.07 |
| Soft solid AP | Initial | 468500 (± 261750) | 22 | 11.6 | |
| | 8 h | 137 (± 110) | 22 | 20.0 | 0.05 |
| | 24 h | 26 (± 1) | 19 | 0.75 | 0.01 |

^a Based on initial mean and upper 95% CI at time – see Section 5.

Table 2
Skin products – measured concentration of D5 in wash water from treated and control subjects ($\mu\text{g L}^{-1}$).

| Product | Time | Treated subject mean ($\pm 95\%$ CI) | N | Control subject mean | Residual (%) |
|-----------------------|---------|---------------------------------------|----|----------------------|--------------|
| Oil dominant lotion | Initial | 6650 (± 2860) | 3 | 3.1 | |
| | 4 h | 1.7 (± 0.2) | 24 | 0.85 | 0.03 |
| | 8 h | 0.84 (± 0.1) | 22 | 0.75 | 0.01 |
| | 24 h | 1.1 (± 1.7) | 21 | 0.78 | 0.02 |
| Water dominant lotion | Initial | 2480 (± 2960) | 4 | 2.8 | |
| | 4 h | 4.2 (± 0.9) | 23 | 0.95 | 0.21 |
| | 8 h | 2.4 (± 0.45) | 24 | 0.72 | 0.12 |
| | 24 h | 2.3 (± 0.39) | 23 | 1.1 | 0.11 |
| Anhydrous serum | Initial | 24800 (± 19500) | 4 | 4.1 | |
| | 4 h | 1.65 (± 0.2) | 24 | 0.85 | 0.01 |
| | 8 h | 0.92 (± 0.38) | 24 | 0.60 | 0.01 |
| | 24 h | 1.49 (± 0.77) | 24 | 1.0 | 0.01 |

^a Based on initial mean and upper 95% CI at time – see Section 5.

Table 3
Hair products – measured concentration of D5 in wash water from treated and control hair tresses ($\mu\text{g L}^{-1}$).

| Product | Time | Treated tress mean ($\pm 95\%$ CI) | N | Control tress mean | Residual (%) |
|-----------------------|---------|-------------------------------------|----|--------------------|--------------|
| Spray serum | Initial | 22600 (± 16200) | 4 | 1.4 | |
| | 8 h | 2.7 (± 0.41) | 14 | 1.3 | 0.01 |
| | 24 h | 0.79 (± 0.13) | 15 | 0.64 | 0.004 |
| | | | | | |
| Spray styling | Initial | 90200 (± 55000) | 4 | 1.5 | |
| | 8 h | 2.0 (± 0.68) | 15 | 0.93 | 0.001 |
| | 24 h | 0.68 (± 0.08) | 15 | 0.94 | 0.001 |
| | | | | | |
| Gel styling | Initial | 135000 (± 57300) | 4 | 1.8 | |
| | 8 h | 1.6 (± 0.37) | 15 | 0.82 | 0.001 |
| | 24 h | 0.60 (± 0.08) | 15 | 0.48 | 0.001 |
| | | | | | |
| Rinse-off conditioner | Dose | 18400 (± 33700) | 4 | 0.6 | |
| | 3 min | 5730 (± 1530) | 15 | 2.1 | 40 |

^a Based on initial mean and upper 95% CI at time – see Section 5.

Where Did The Contamination Come From?

Possibilities: Health & Human Services Product Database

<https://hpd.nlm.nih.gov/index.htm>

- PEG-4
- PEG-4 Laurate
- PEG-40
- PEG-10 hydrogenated castor oil
- PEG-40 stearate
- PEG-5 cocoamide
- PEG-5 soy sterol
- PEG-5 stearamine
- PEG-5 tallow amide
- PEG-50 hydrogenated palmamide
- PEG-50 Tallow amide
- PEG-55
- PEG-5M
- PEG-6
- PEG-6 caprylic
- PEG-6 Caprylic/capric glycerides
- PEG-6 methyl ether
- PEG-60 (Polysorbate 60)
- PEG-60 almond glycerides
- PEG-60 lanolin
- PEG-65 Lanolin oil
- PEG-7
- PEG-7 Glyceryl Cocate
- PEG-75
- PEG-75 Lanolin oil
- PEG-75 Soy glycerides
- PEG-7M
- PEG-8
- PEG-8
- PEG-8 dilaurate
- PEG-8 Dimethicone
- PEG-8 distearate
- PEG-8 hydrogenated tallow amine
- PEG-8 Propylheptyl Ether
- PEG-11/SMOI copolymer

PEG-4: 11 products

| Products that contain this ingredient | | | |
|--|---------------|--------|---------|
| Brand | Category | Form | Percent |
| Olay Total Effects 7-in-1 Tone Correcting Moisturizer with Sunscreen, Broad Spectrum SPF 15, Fair to-Old Product | Auto Products | cream | |
| Olay Total Effects 7-in-1 Tone Correcting Moisturizer with Sunscreen, SPF 15, Light to Medium-Old Product | Auto Products | cream | |
| Noxzema 2 In 1 Pads Extra Strength-Old Product | Personal care | pad | |
| Olay ProX Eye Restoration Complex Cream-Old Product | Personal care | liquid | |
| Olay ProX Wrinkle Smoothing Cream-Old Product | Personal care | liquid | |
| Olay ProX Wrinkle Smoothing Cream-02/13/2015 | Personal care | cream | |
| Olay ProX Age Repair Lotion with SPF 30-Old Product | Personal care | liquid | |
| Olay ProX Wrinkle Smoothing Cream-Old Product | Personal care | liquid | |
| Gillette Fusion ProSeries Face Scrub, Thermal-Old Product | Personal care | cream | |

PEG-8 (partial list): 49 products

| Products that contain this ingredient | | | |
|---|---------------|--------|---------|
| Brand | Category | Form | Percent |
| Dial NutriSkin Glycerin Bar Soap Plus 7 Bionutrients, White Peach & Shea Butter-Old Product | Auto Products | solid | |
| Kohl Eye Liner | Personal care | pencil | |
| Dial Antibacterial Body Wash, Spring Water-08/30/2007-Old Product | Personal care | gel | 1.0-5.0 |
| Dial for Men Hair & Body Wash, Triumph-Old Product | Personal care | gel | |
| Tone Hydrating Body Wash, Cocoa Butter, Blue Oasis-Old Product | Personal care | liquid | 1.0-5.0 |
| Tone Hydrating Body Wash, Cocoa Butter, Island Mist-05/01/2007-Old Product | Personal care | liquid | 1.0-5.0 |
| Tone Hydrating Body Wash, Cocoa Butter, Wildflowers-Old Product | Personal care | liquid | 1.0-5.0 |

PEG-6 (partial list): 35 products

| Products that contain this ingredient | | | |
|--|---------------|-------|---------|
| Brand | Category | Form | Percent |
| Crest Complete Multi-Benefit Toothpaste, Extra White Plus Scope Dual-Blast, Fresh Mint Blast-Old Product | Auto Products | paste | |
| Crest Pro-Health Clinical Gum Protection Toothpaste, Soothing Smooth Mint-Old Product | Auto Products | paste | |
| Crest Pro-Health Whitening Fluoride Anticavity Toothpaste, Fresh Clean Mint-Old Product | Auto Products | gel | |
| Crest Complete Multi-Benefit Toothpaste, Whitening Plus Deep Clean, Effervescent Mint-Old Product | Auto Products | paste | |
| Crest Pro-Health Sensitive + Enamel Shield Fluoride Anticavity Toothpaste, Smooth Mint-Old Product | Auto Products | gel | |
| Topol Whitening Anticavity Toothpaste, Spearmint | Personal care | paste | |

PEG-10 (partial list): 90 products

| Products that contain this ingredient | | | |
|---|---------------|--------|---------|
| Brand | Category | Form | Percent |
| Dial NutriSkin Glycerin Bar Soap Plus 7 Bionutrients, White Peach & Shea Butter-Old Product | Auto Products | solid | |
| Infusium 23 Shampoo 1 Frizz Controller | Personal care | liquid | |
| Infusium 23 Shampoo 1 Repair & Renew | Personal care | liquid | |
| Right Guard Total Defense 5, 5-in-1 Deodorizing Soaps Bar, Refreshing | Personal care | solid | |
| Aquafresh Advanced 2X Whitening Fluoride Toothpaste, Ice Mint Stain Removing Formula | Personal care | paste | |
| Aquafresh Extreme Clean Whitening Action Fluoride Toothpaste, Mint Blast | Personal care | paste | |
| Aquafresh Toothpaste, Deep Action Extreme Clean With | Personal care | paste | |

What else can I do?

- Use LC-MS grade solvents (including modifiers)
- Use LC-MS vials (wash your vials very well)
- Rinse all washed glassware (a lot)
- Use good quality air filters into your laboratory
- Service your vacuum pump regularly
 - Change the oil and filters every 6 months
- Run a shutdown method
- Keep N₂ flowing through your MS source
- Change your N₂ filters every 6 months
- Use pure gases (Nebulizer and Collision)
- Wear gloves
- Use PCPs judiciously

Prevention is better than Cure

- Contamination comes in many forms
- Where could the contamination be coming from?



Questions

