iFyber®

Trace Impurity Outreach Initiative

For Medical Device Developers

Case studies and our solutions

Trace Impurities in the Medical Device Industry

What They Are

- Extremely small, unintended chemical substances that remain in a material or component after manufacturing, processing, or sterilization.
- Typically present at very low concentrations (often parts-per-million or parts-per-billion).

Where They Come From

- Residuals from the Raw materials.
- Manufacturing processes: lubricants, cleaning agents, processing aids.
- Sterilization: by-products from ethylene oxide, gamma, or e-beam sterilization.

Why They Matter

- Can migrate into the patient or interact with tissues during device use.
- Potential to cause toxicity, sensitization, irritation, or systemic effects.

Case Study 1: Cytotoxic Trace Impurities in a Polymer Device

Customer Problem

- Customer manufactures a polymer-based medical device
- Current impurities are known cytotoxins and must be reduced to acceptable levels
- Customer is actively optimizing their manufacturing and cleaning processes to remove or minimize these compounds
- They need highly sensitive, reliable quantification to evaluate each process change

Case Study 1: Cytotoxic Trace Impurities in a Polymer Device

Our LC-MS System

- Provides ultra-trace quantification of the known impurities
- Detects small changes in impurity levels as process adjustments are made
- Offers stable, reproducible performance for iterative optimization studies

Our Team Expertise

- Applications team develops a targeted LC-MS method for the specific impurities
- Advises on sample prep and workflow design appropriate for the polymer matrix
- Supports data interpretation to correlate impurity levels with process modifications

Current Outcome

- Customer is using our LC-MS workflow to monitor impurity levels across multiple process iterations
- Data is guiding their optimization strategy to reduce cytotoxic compounds
- Results are to support future regulatory discussions and submission readiness

Case Study 2: Residual Antibiotics in a Tissue-Derived Device

Customer Problem

- Tissue-based device contains residual antibiotics from processing
- Customer must quantify these residues to ensure regulatory compliance
- Biological matrix is highly complex, making selective detection a critical requirement

Case Study 2: Residual Antibiotics in a Tissue-Derived Device

Our LC-MS System

- High selectivity separates antibiotic residues from endogenous tissue components
- Sensitivity supports low-level quantification, important with required safety limits
- Multi-analyte capability enables measurement of several antibiotics in one run

Our Team Expertise

- Sample-prep and LC-MS workflow optimized for the complex sample matrix
- Guidance provided on validation parameters for regulatory acceptance

Current Outcome

- Customer requires a reliable LC-MS method for advancing their program

Additional Use Cases

- Sterilization residuals (e.g., ethylene oxide byproducts)
- Early-stage extractables / leachables screening
- Degradation product profiling (stability studies)
- Cross-contamination investigations

Trace Impurity Analysis: Key Pain Points & How Our LC-MS Workflows Solve Them

- **Low-abundance impurities that are lost in matrix noise**
  → Nano-flow sensitivity from Vanquish Neo + high-resolution Excedion Pro BioPharma with FAIMS can detect impurities previously lost in the noise.
- **Challenging to detect unknown impurities without predefined targets**
  → High-resolution, accurate-mass Excedion Pro BioPharma enables untargeted full-scan acquisition; FAIMS reduces spectral clutter, making unknown species easier to detect and characterize.
- **NanoLC instability and high maintenance**
  → Vanquish Neo provides stable, low-dispersion nano-flow with robust plumbing and precise flow control—reducing clogging, drift, and operator intervention.
- **Isobaric or near-identical impurities unresolved**
  → Excedion Pro BioPharma delivers high resolving power and accurate mass; FAIMS adds orthogonal ion mobility separation to reduce spectral congestion.
- **Poor reproducibility across runs or studies**
  → Vanquish Neo's retention-time precision + Excedion Pro BioPharma's stable mass accuracy support consistent impurity profiling suitable for development and QC.
- **Frequent troubleshooting and slow method development**
  → Cleaner spectra, reduced suppression, and stable nano-flow performance minimize failed runs and accelerate optimization.
- **Co-eluting species causing suppression or missed impurities**
  → NanoLC improves chromatographic separation; FAIMS filters co-eluting noise; HRMS resolves overlapping ions—revealing impurities conventional LC-MS misses.

Summary

- Trace impurities are common contributors to early-stage failures
- Typical concentrations: pg/mL → ng/mL
- LC-MS + FAIMS + nanoflow/microflow LC provides:
  - Detection
  - Identification
  - Quantitation
  - Ultimate Sensitivity and Selectivity
- Platform supports both untargeted and targeted workflows in complex matrices