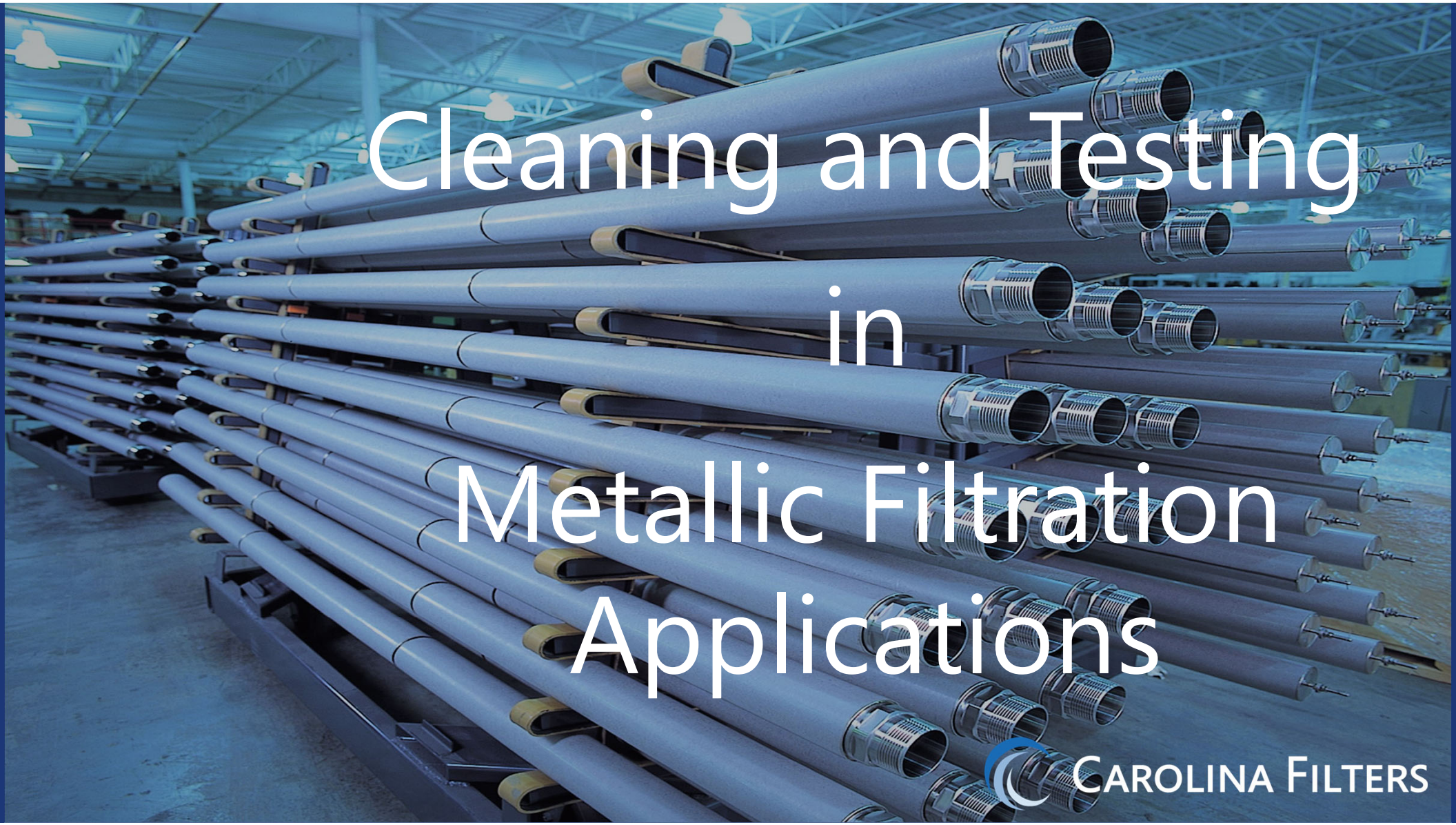
Cleaning and Testing
in
Metallic Filtration
Applications
CAROLINA FILTERS

Who We Are…

Carolina Filters

Employs a Dedicated

- ✓ **Compliance Staff**: Safety, Quality, and Environmental Management Programs are an integral part of all aspects of our business.
- ✓ **Technical Staff:** Engineers and Degreed Chemists support and develop processes.
- ✓ **Customer Support Staff:** Technical Field & Sales Engineers and Customer Service Support personnel communicate and provide client assistance.

Maintains ISO Registration: Registered 20+ years and is ISO 9001:2015 certified.

Uses Computerized Process Tracking Program: Electronic system tracks parts through the process.

Is Committed to Technology Improvements: Investments & installation of new processes & equipment ensures creative solutions and options for expanded client services.

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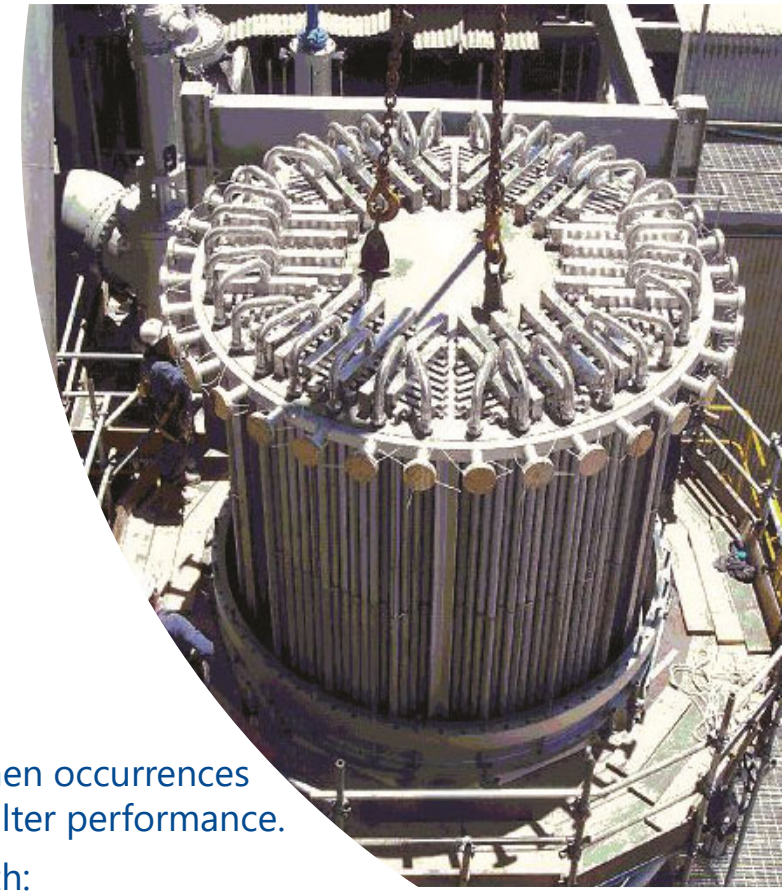
What We Do…



Carolina Filters

- Specializes in technical cleaning & testing of metallic filters and associated process equipment.
- Has designed specific cleaning solutions for filtration processes in
  - FCC Slurry Oil, FCC 3rd and 4th Stage Separators,
  - Heavy Coker Gas Oil,
  - Catalyst Recovery Systems,
  - Other technical applications, such as blowback/backwash systems.
- Offers specially designed ***"Deep"*** cleaning processes that are needed when occurrences such as variations in feedstock, additive mix & process dynamics affect filter performance.

  Potential on-stream performance problems may be associated with:
  - Contaminants such as asphaltenes, organics, salt deposits, residuals agglomerated & embedded within the media matrix,
  - Particle size distribution of contaminants,
  - Process issues & other unpredictable upsets.

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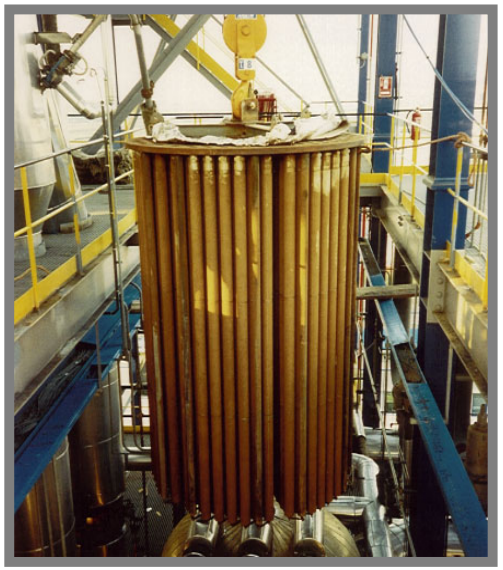
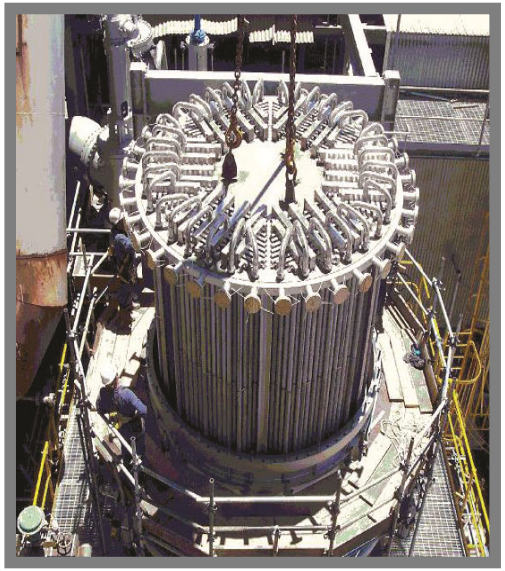
What We Process...



After 5 Years of Service

Filtration Applications

where embedded contaminants have increased clean pressure drop with increased back-flush frequency.



New or Cleaned Filters

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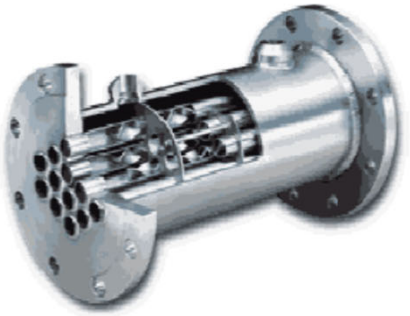
What We Process…



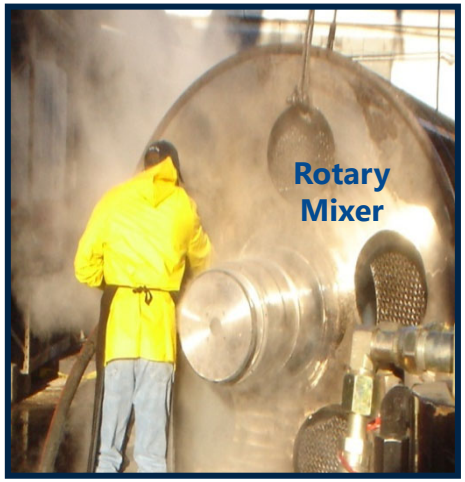
Heat Exchangers & Mixers

Pumps

Typical Parts

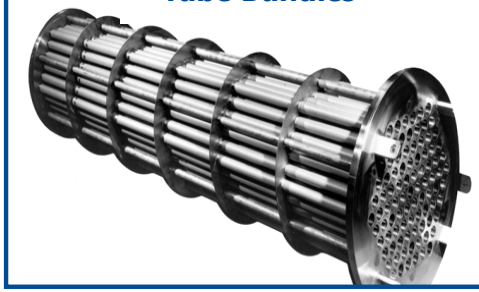
- Process Piping
- Shafts & Gears
- Dies
- Column Packing
- D-Mister Pads
- Tubs/Vessels
- Extruder Screws

Impellers/Mixers



Rotary Mixer

Tube Bundles



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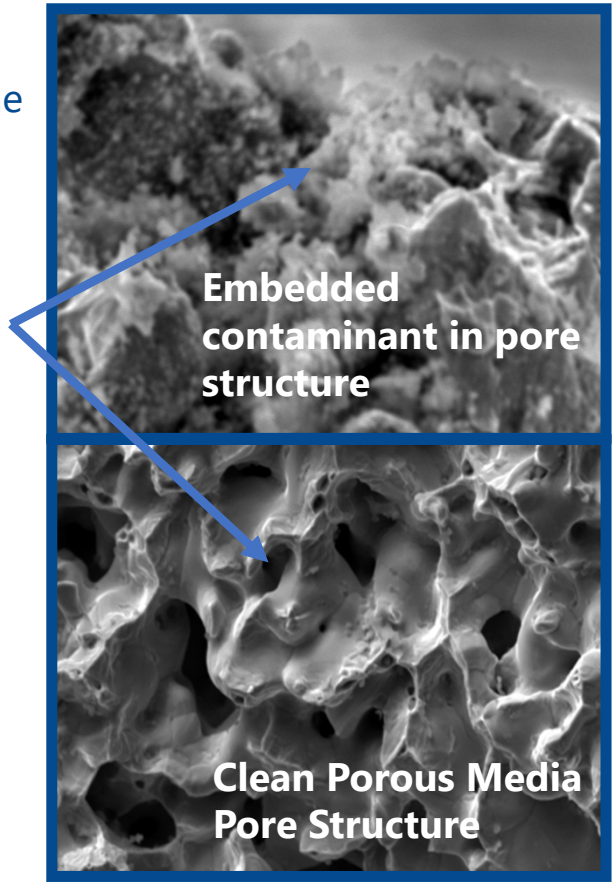
How We Clean…

Gross Contaminant Removal (GCR)
is the removal of loose solids, oils, and materials packing the internals of the filters.

"DEEP Cleaning" methods
are used to remove embedded contaminants
as seen in the cross-sectional views porous metal media.
The embedded contaminants can
result in short filter life, high initial ΔP, & quality issues.

DEEP Cleaning Methods include

- **High Temperature Oxidation (HTO) Cleaning** methods used to remove embedded organics, such as asphaltenes.
- **Chemical DEEP Cleaning** methods used when 'Targeted Chemistries' can solubilize specific contaminants, such as inorganic salts.
- **Physical DEEP Cleaning** methods, such as Ultrasonics and Flushing, used to remove inert particulate and/or to deliver chemicals to embedded contaminants.



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How We Test…

Integrity & Cleanliness Tests
are used to evaluate the condition of the media after cleaning.

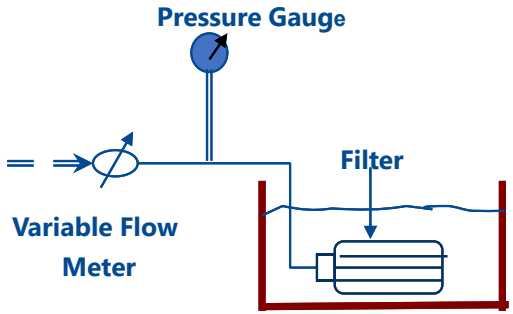
➢ Integrity Tests:

Bubble Point (BP) Test: Measures the pressure required to force the 1st stream of air through the largest pore or opening in the media under a specified depth and wetting medium.

The BP pressure is inversely related to the pore size.

Wetted Airflow (WAF) Test: Provides a measure of overall pore size and condition of the media.

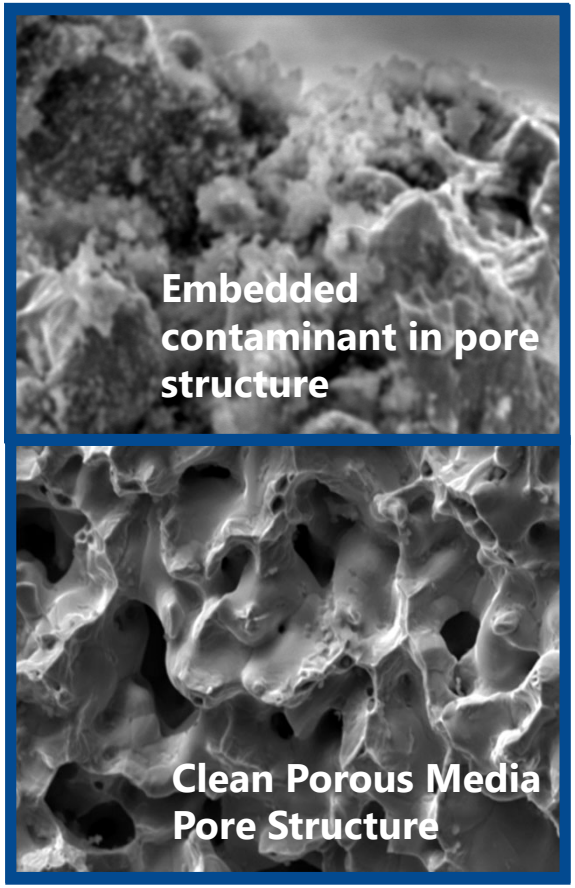
WAF localized flow patterns across the media may indicate issues such as damage or plugged media.



➢ Cleanliness Test:

Dry Air ΔP (DAP) Test: Measures pressure drop created across the media when challenged with a set airflow rate.

*DAP values provide information on the degree of **embedded contamination** within the media matrix and can be used to determine the %Recovery of the media as compared to **new or cleaned media**.*



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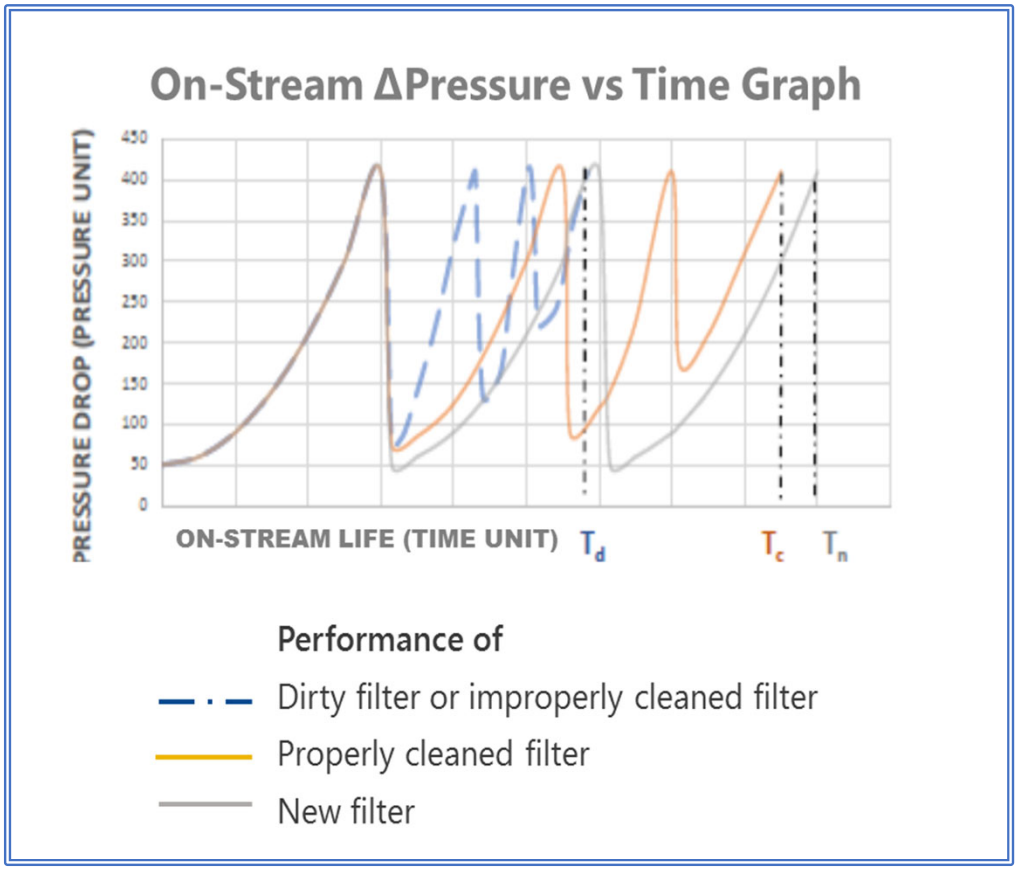
We Provide Process Solutions for Difficult Problems...



Carolina Filters engineers cleaning solutions for the toughest feedstocks & process conditions:

- catalyst and solids filtration in "bottom-of-the-barrel" processes,
- feedstock or process changes that negatively affect on-stream life and product quality.

As illustrated in the graph, proper cleaning can return valuable filter elements to like-new performance.

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Case Studies

Carolina Filters was contacted concerning cleaning issues in DC, FCC and ADN applications. Issues were the same in all three facilities.

ISSUES:

Cleaned filters were exhibiting

- decreased filter life from 3+months to several weeks,
- increased blowback frequency without a return to expected clean pressure drop,
- higher than normal initial clean pressure drop.

Test data gave no indication of issues with the filters.

- plugged or damaged filters were re-installed,
- on-stream performance continued to decay,
- available filters were at a critical level.

Costs associated with the short life included

- new filters purchased to support production,
- extra labor costs & production losses due to unplanned filter changeouts,
- extra cleaning charges due to more changeouts.

RESOLUTION:

Carolina Filters, working with Manufacturer & User:

- ✓ Determined that the filters were being inadequately cleaned.
- ✓ Designed a **DEEP Cleaning Process** that chemically degraded, loosened, & removed embedded contaminants.
- ✓ Provided test data that defined the % Recovery for each filter & noted filters that had been returned to a 'like-new condition'.
- ✓ Recovered many filters designated for disposal.
- ✓ Identified filters that could not be recovered eliminating the installation of low porosity or damaged filters.

RESULTS:

All 3 sites experienced improvements in on-stream life & performance.

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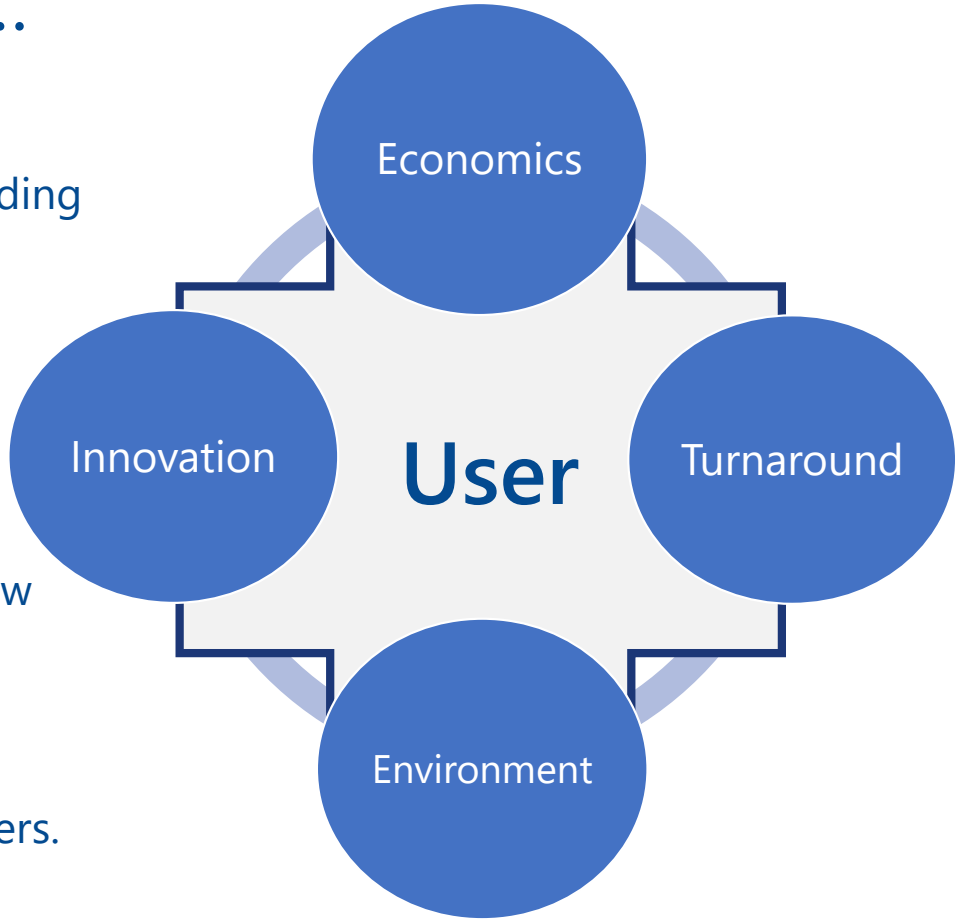
How We Benefit The User…

Innovation: Innovative cleaning technologies leading to improved quality & on-stream performance.

Economics: Filter Cleaning is typically less than 50% of new filter pricing.

Turnaround: Cleaning can be accomplished in ~4 weeks versus up to 16+ weeks to fabricate new filters.

Environmentally Responsible: Cleaning is an alternative to disposal of contaminated metal filters.



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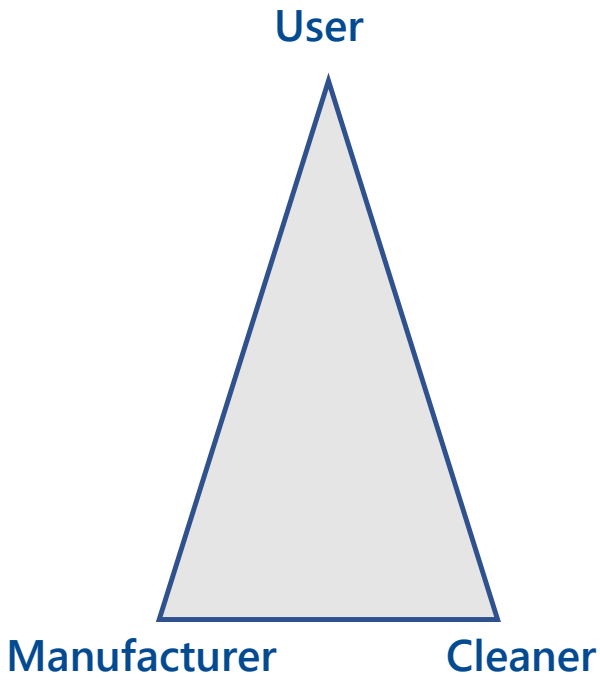
We Use A 3-Part Approach…

User provides information on requirements, filter configuration & specifications, contaminant, issues, etc.

Manufacturer provides knowledge of

- part description & constraints
- metallurgy
- cleaning requirements & restrictions
- integrity criteria

Cleaner provides knowledge of expert cleaning options for specific applications, metallurgies, and contaminants, along with, testing for integrity and cleanliness.



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TECHNICAL EXPERTS. ENGINEERED SOLUTIONS.

For over 50 years, Carolina Filters, Inc. has been providing cleaning, testing, and other services to the filtration industry by:

- Attention to Detail & Quality Service
- Innovative Equipment & Processes
- Creative Solutions to Filtration Issues

Quality Management
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