



The Optimization of Condensate Polishing Precoat Septa, Connection Hardware and Prefilter Elements

EPRI Filter Users Group

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» **Power Generation Products**



In the Beginning...

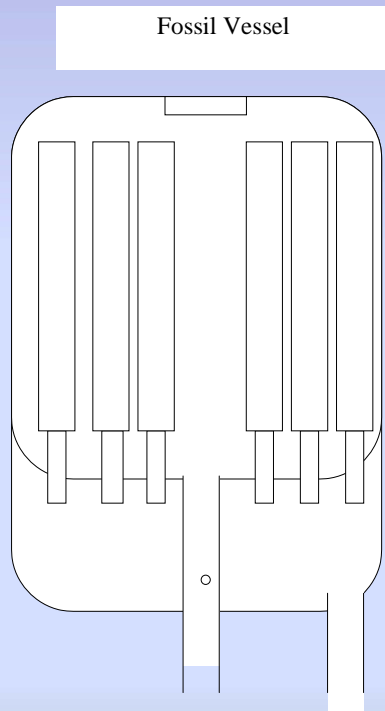
The innovators (Levendusky, Ryan, Lane, Salem) of powdered resin condensate polishing design never could/would have imagined that the excellent water quality now being attained using this technology would be possible.

Powdered resin condensate polishers were designed to be 90% efficient in removing dissolved and suspended impurities with the lowest effluent values being in the PPB range.

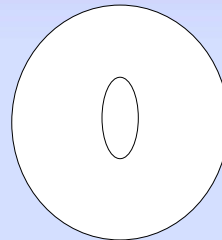
Today, powdered resins systems obtain efficiency ratings of >99% for suspended solids and dissolved solids effluents in the PPT range!

In the Beginning...

Bottom Tubesheet/Graver



Top View



12" X 14'
or
14" X 18
Internal Manway

Top Tubesheet/DeLaval

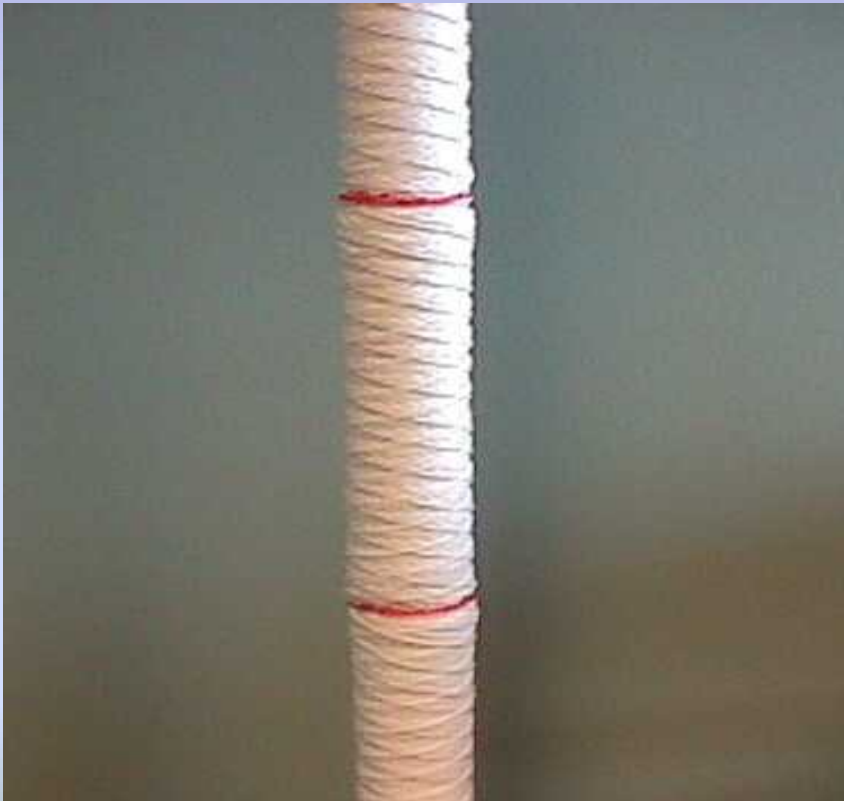


There were two basic designs ...

Initial Septa Design

10" Wound Cartridges Cemented to Proper Length with SS Core

Stainless Steel Screen Wrapped and Tack Welded to Core



The Industry Saw a Need to Upgrade the Initial Element Design

Wound Elements

- Even when pressure drops of filter matched, precoats could be uneven.
- Overall length of elements was difficult to maintain because of thickness of glue joints
- Gasket could be dislodged during installation

Metallic Elements

- Resin bleed through would not meet industry standards.
- O-rings could slip off element and become damaged.

Next Generation Septa were Developed

Continuous Wound Element



Porous Metal Element



Next Generation Septa Improvements

PLC Controlled Continuous Wound Element

- By computer controlling the winding process, irregularities could be eliminated.
- Multiple porosity winding patterns could be used to improve both precoats & backwash characteristics.

Porous Metal Septa

- Required frequent chemical or mechanical cleaning usually outside the vessel.
- Hold pump rate was too low to keep resin in place.

Current Generation Septa Design

PLC Controlled Continuous Wound Element



1" Continuous Wound Element



Today , wound septa are currently used in both 1" and 2"+ applications to prevent precoat bleed through and provide optimum ion exchange performance on the condensate polishers.

Hardware Design Considerations for Next Generation Improvements

- Make element assembly more *user* friendly with fewer components.
- Don't Block Service or Backwash Flow
- Don't restrict open area of tubesheet fitting
- Reduce field time to reassemble and install elements to reduce radiological exposure in nuclear installations.
- Reduce radwaste generation.

Original Guide Rod Based Hardware

Fossil/PWR



Nuclear/BWR



No Guide-Rod Design

Wound Element on SS Core



Wound Element on Poly Core



Also a Need to Upgrade Connection Hardware

- Solid v-bar blocked flow especially backwash flow.
- Many components increased possibility of installation error.
- Opening in tubesheet fitting was reduced by guiderod locking mechanism.



No Guide-Rod Design

- Minimized number of pieces that need to be reinstalled when assembling new element assemblies.
- Minimized flow restrictions in tubesheet fitting connections.
- The SealFast element was not ALARA friendly due to number of turns necessary to thread element into tubeheet adapter connection.

Enter the Element on a Full Flow Hardware



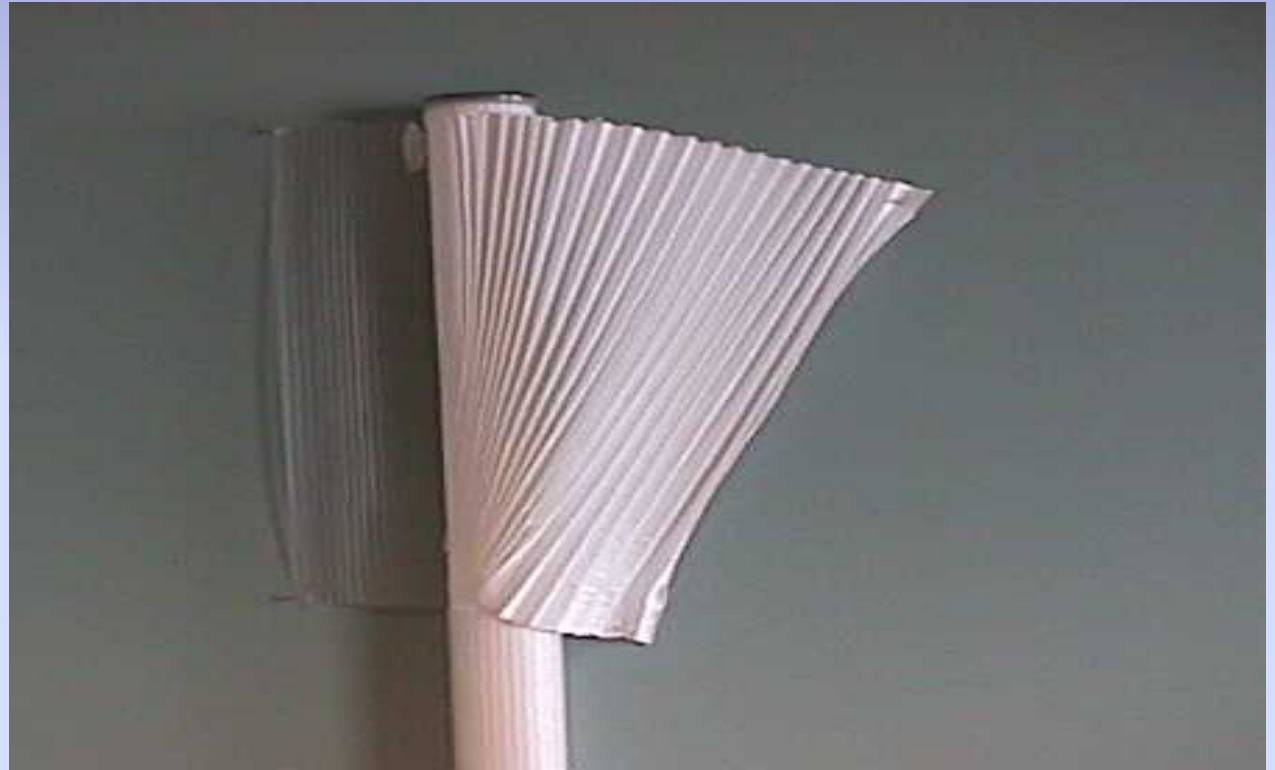
Graver's Full Flow Guide Rod

- After initial installation only one part to remove.
- All work can be performed external to vessel.
- Disassembly can be performed under water to minimize exposure to radiation.
- Locking mechanism on top of element so there is no reduction in tubesheet opening.
- Compatible with all element designs as well as other manufacturers designs.

Advanced Septa Design

- Reduce Radwaste Volume
 - Less precoat
 - Eliminate metal components for incineration or other volume reduction method
- Finer secondary filtration
- Power Uprate
- Desire to operate Septa nude as a filter or as a prefilter to a deep bed condensate polisher

Most Advanced Filters are Based on Pleated Filter Media Technology



Basic Types of Advanced Septa

Pleated Septa for Prefilter Service



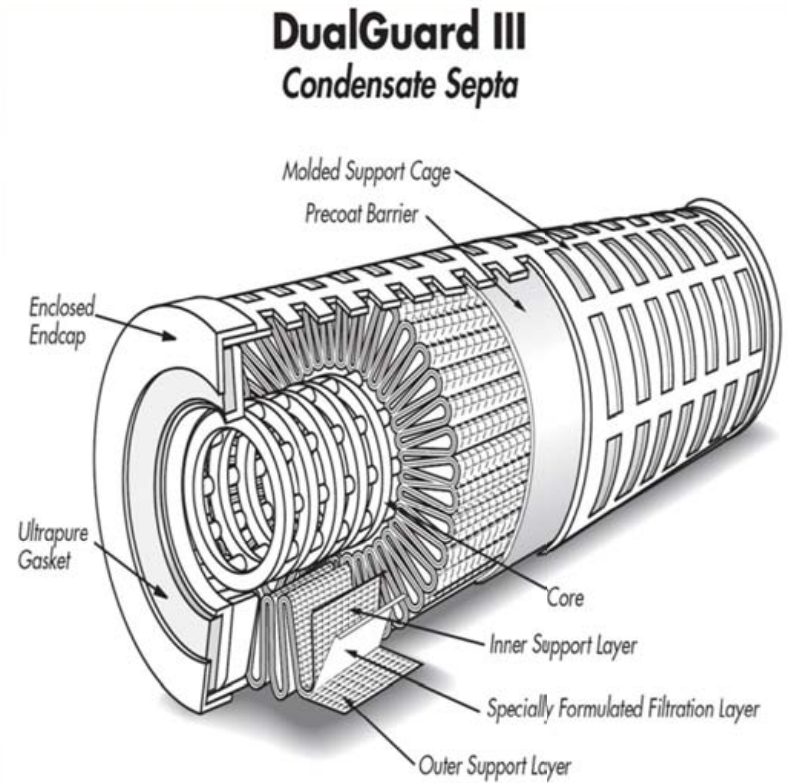
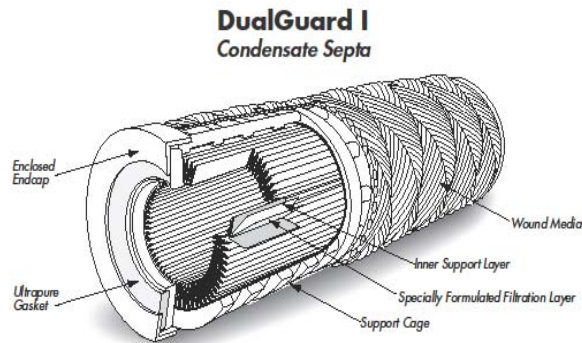
**Dual Media Septa for
Precoat/Nonprecoat Service**



Styles of Dual Purpose Elements

Used when ion exchange terminates run cycles.

Used when differential pressure terminates run cycles.



Major Components of Advanced Septa

Prefilter Septa

- All polypropylene construction (except gaskets)
- Upstream and downstream support of filter cloth
- Internal core and external cage to protect media and configuration
- Available in many micron ratings

Precoat/Non Precoat Septa

- Precoat barrier to support uniform precoating.
- All polypropylene construction (except gaskets)
- Upstream and downstream support of filter cloth
- Internal core and external cage to protect media and configuration
- Available in many micron ratings

Industry conversions to the advanced septa designs, while successful, have not always been smooth. There have been many lessons learned along the way.

Lessons Learned

- All rubber no matter how it is cured contains sulfur which can leach into the fluid stream. Select a non sulfur containing gasket material.
- Don't forget the basics of precoat technology, i.e., you must have a uniform coating of precoat material on your septa at the right thickness for ion exchange to occur. With some of the new designs, element spacing has been reduced preventing anything but minimum thickness precoating which gives little or no protection for cycle upsets or for restarts after outages.

Lessons Learned (cont.)

- New systems designed with advanced septa were adaptations of original systems designed with septa with filter area approximately 1/10 of the advanced septa. Surface area of elements will need to be carefully matched to the system to prevent short septa life. It is essential to have the right flow patterns and prevent any back pressure during backwash steps.
- Systems designed with wound filters will perform better with wound filters or a combination of yarn windings over pleated material especially if ion exchange is essential for maintaining water quality.

Lessons Learned (cont.)

- Advanced precoat systems and flow distribution is only necessary if run cycles are terminated on ion exchange endpoints.
- Advanced septa designs are needed at plants which require excellent ion exchange in addition to iron removal.
- **Don't fool with Mother Nature**
 - The coefficient of thermal expansion for polypropylene is 10 times greater than for stainless steel. Connections that are tight at ambient temperature will be loose at 120F.
 - Polypropylene and other plastics soften with increased temperature. Some support will be required if septa temperature exceeds 140F.

In the End...

Selecting the right septa, connecting hardware and backwash and precoat procedures will allow a plant to reach its water chemistry goals while minimizing operating costs.

