AIChE Singapore Local Section

Separation and Purification Sciences Division

3M Science. Applied to Life.™

Next generation purification method for achieving low trace metals in ultra-high purity chemicals

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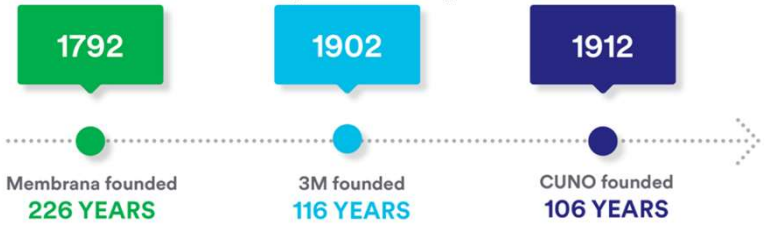
We're building on 100+ years of scientific achievement

- A century of experience and expertise inspires confidence.



Milestones

1927 — Membrana begins producing cellulose film

1946 — Non-metallic disposable filter media developed

1965 — Cuprophan® flat sheet membranes for hemodialysis developed

1972 — 3M™ Zeta Plus™ cellulose filters introduced

1980 — Accurel® synthetic technical membranes launched

1987 — 3M™ Betapure™ water filters introduced

1990 — Filtrete™ water filters introduced

2006 —3M™ Liqui-Flux™ ultrafiltration modules for water filtration introduced

2007 — 3M™ High Flow Product Platform for Industrial BU introduced

2010 — 3M™ Zeta Plus™ Encapsulated System single use capsules introduced

2012 — 3M™ LifeASSURE™ PDA Sterile Filtration Introduced

2014 — 3M™ Betapure™ AUL for Electronics Introduced

2015 — 3M™ Emphaze™ AEX Hybrid Purifier Introduced

2016 — 3M™ ScaleGard™ Blend with WiFi Monitor, first commercialized Internet of Things (IoT) device at 3M

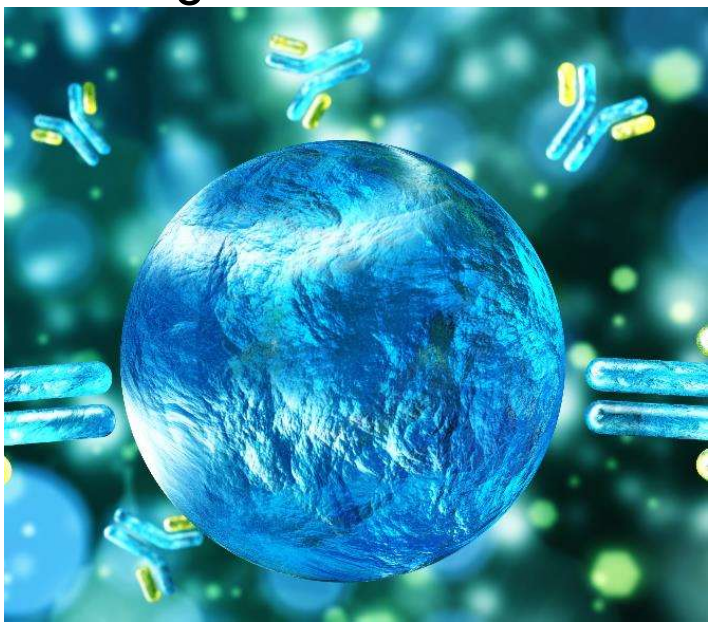
2018 — 3M™ Metal Ion Purifier introduced

2018 — 3M™ Microfiltration for Residential Water with WiFi

A clear advantage for our customers

- We’re advancing our technologies to meet tomorrow’s needs by building on our:

History



Cutting-edge science

Passionate people

Our solutions span diverse industries

- Life sciences

Industrial

Foodservice

Residential water

Known for smart design and superior performance

- Cutting-edge science

Proven reputation

ISO 9001:2015 Registered Quality Systems

Accessible support

Superior performance

Smart design

Global supply chain

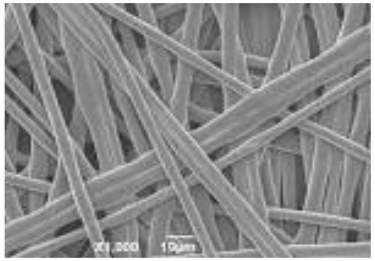
Our strength: Differentiated media + novel filtration modules

- SPSD owns both the media and the engineering for increased synergy.

Filtration media

Carbon

Nonwovens

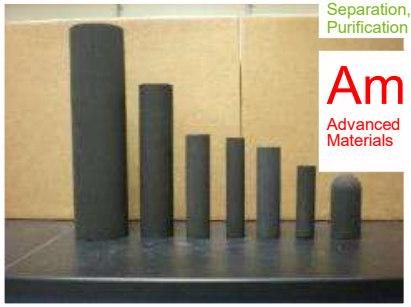


Porous membranes

Filtration modules

Here are some of the 3M platforms we leverage in our work

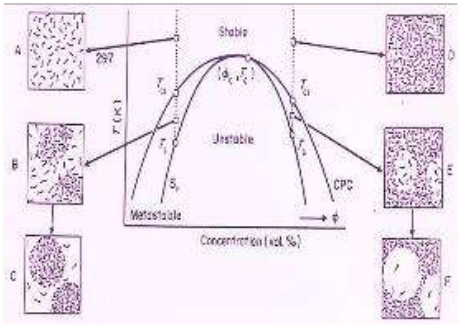
Carbon/Adsorbent technology platform

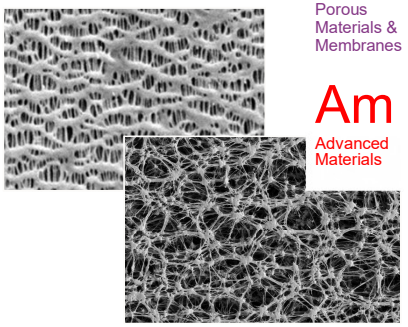


Fs
Filtration, Separation, Purification

Am
Advanced Materials

Porous membranes technology platform

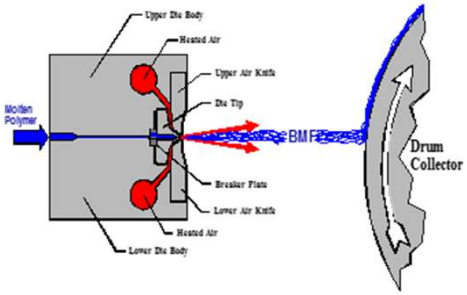


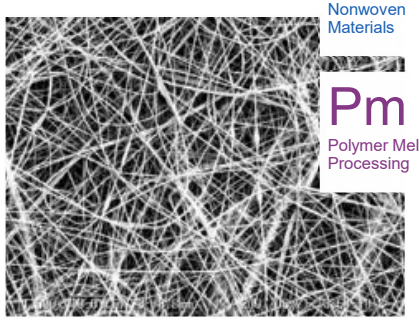


Po
Porous Materials & Membranes

Am
Advanced Materials

Nonwovens & fiber technology platform





Nw
Nonwoven Materials

Pm
Polymer Melt Processing

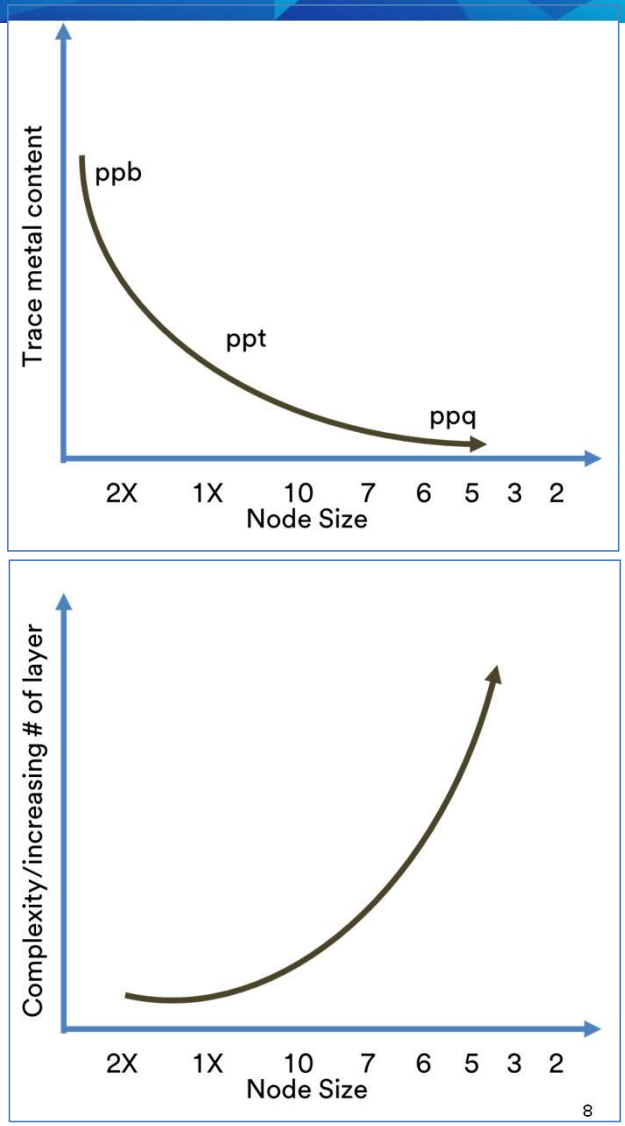
Module & hardware design technology platform

Pe
Predictive Engineering & Modeling

Is
Integrated Systems & Design

Introduction

- The next generation nodes are approaching levels that are unprecedent in size and complexity and need new technologies and materials
- The materials that used in the new processes need to have the highest level of purity to minimize defects and provide highest level of reliability,
- Trace metal contamination in fluids effects device performance and yield
- Problems may also be introduced that could go undetected until after the device has been shipped and built into a system.



IX media and structure

Lab Scale

47 mm diameter disk type

Diameter: 47 mm
Thickness: 5 mm

Pilot Scale

2-inch length cartridge

Commercial Product

10-inch length cartridge

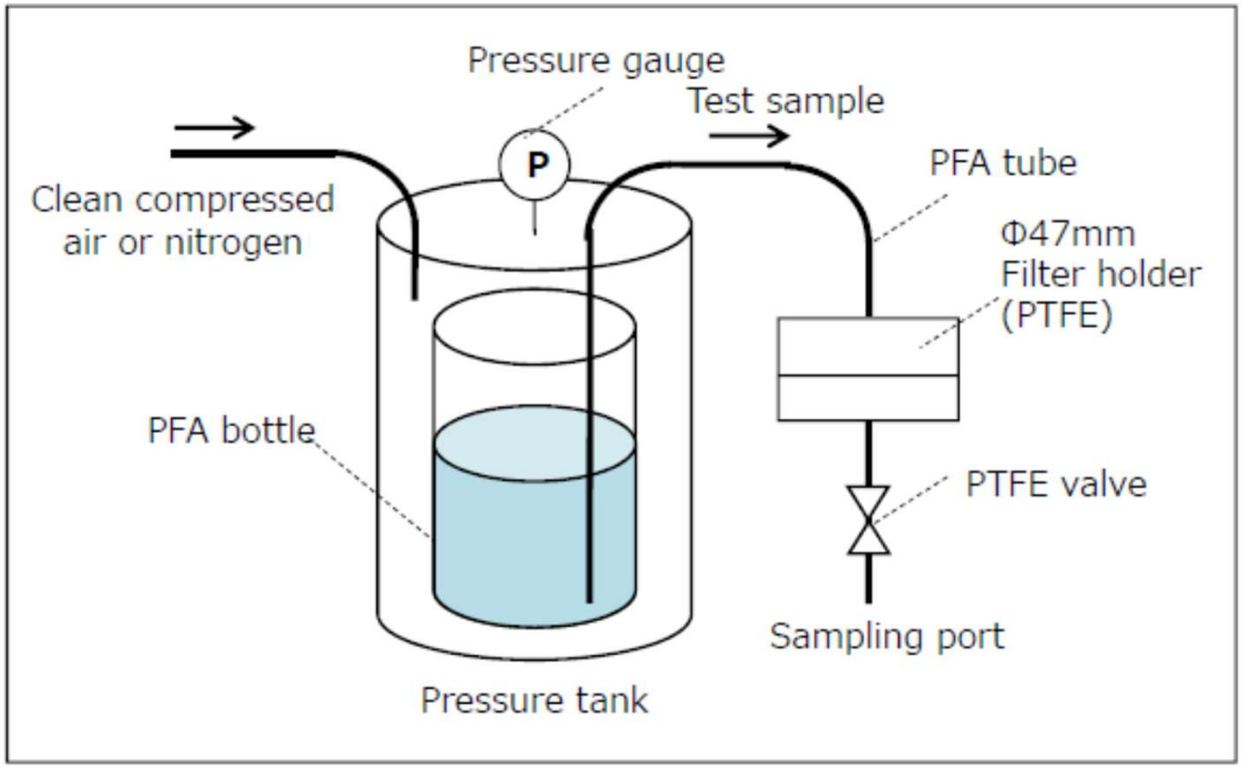
Materials of Construction

- Polyethylene molded components
- Purifier Media
  - Ultrahigh Molecular Weight Polyethylene Binder
  - Ion Exchange Resin
    - *Strong Sulfonic acid (SCP)*
    - *Amino Phosphate Chelating (SPP)*

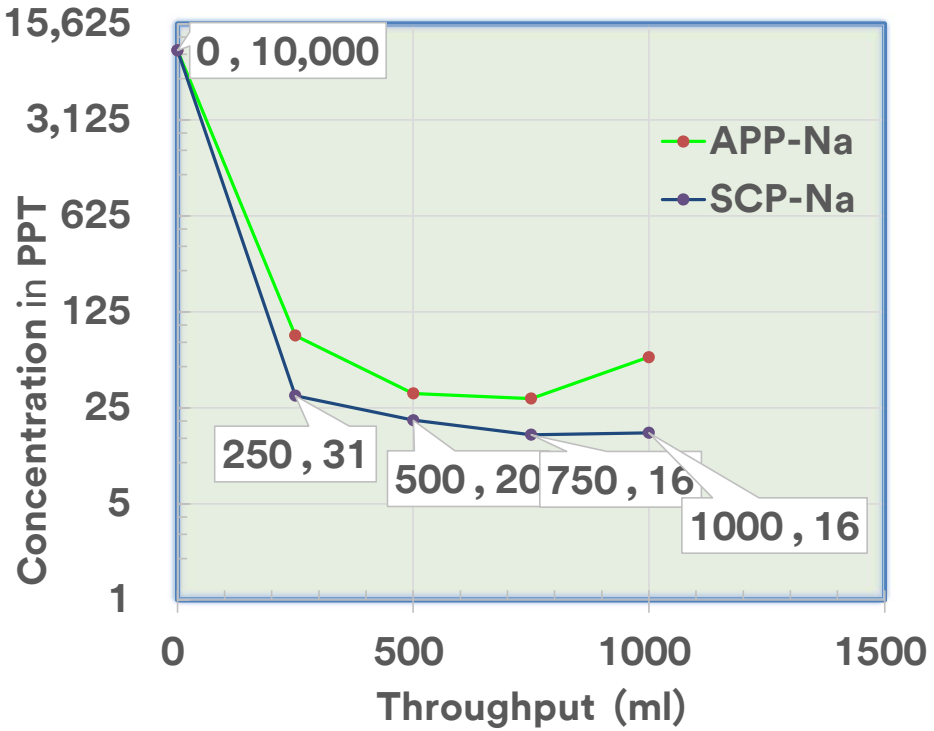
Experimental Method

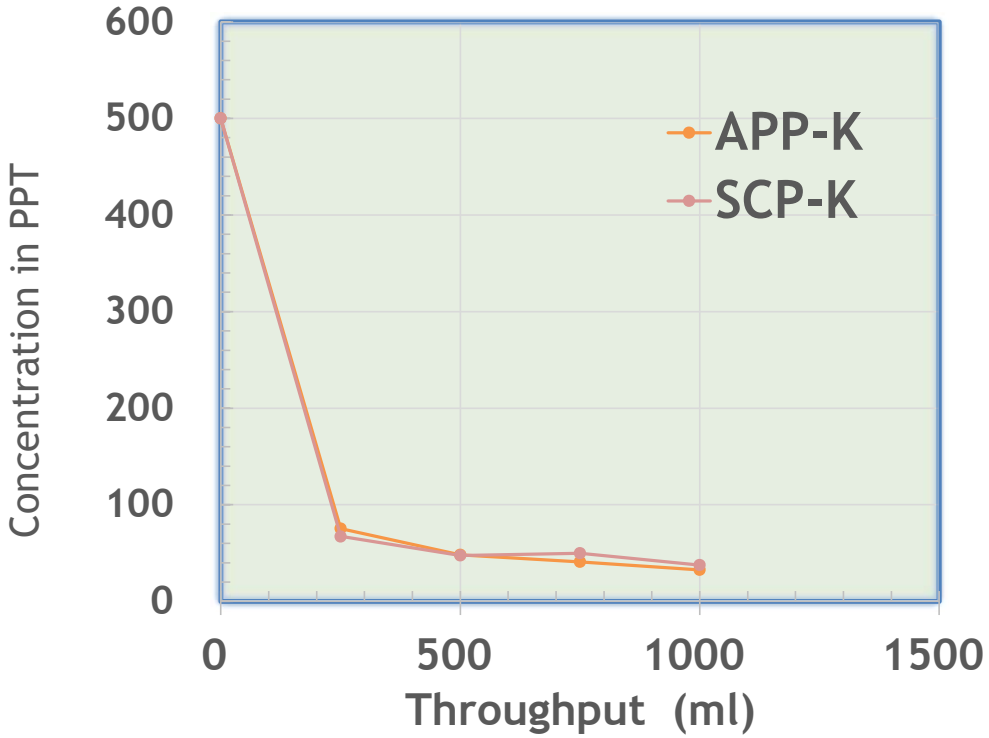
Introduced the solution containing trace metals in PGMEA was passed through IX media at the flow rate of 1 mL/min with the line pressure above 50kPa by adjusting outlet valve.

Samples collected throughout the test and subjected to ICP MS-MS analysis,

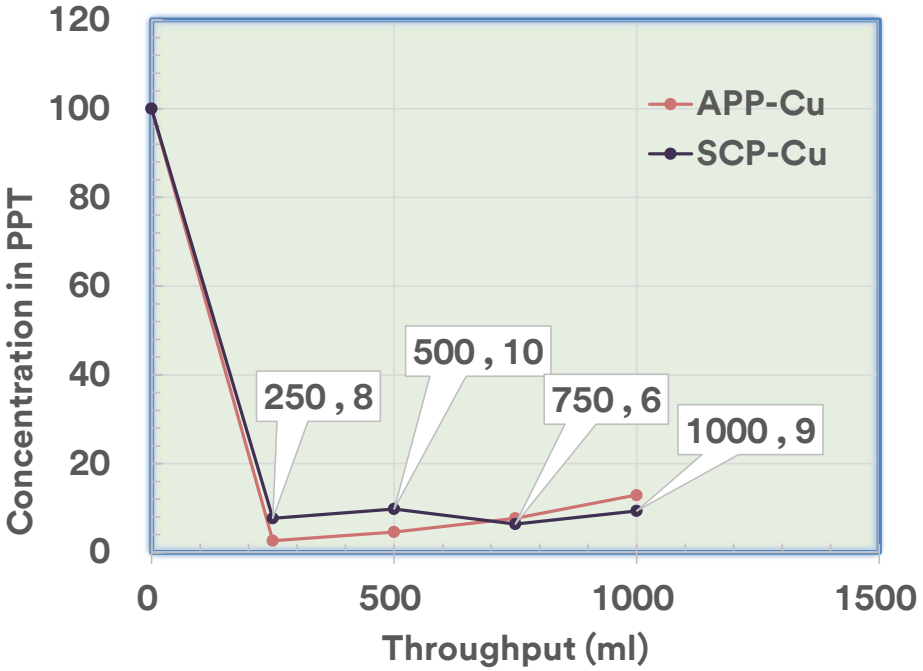


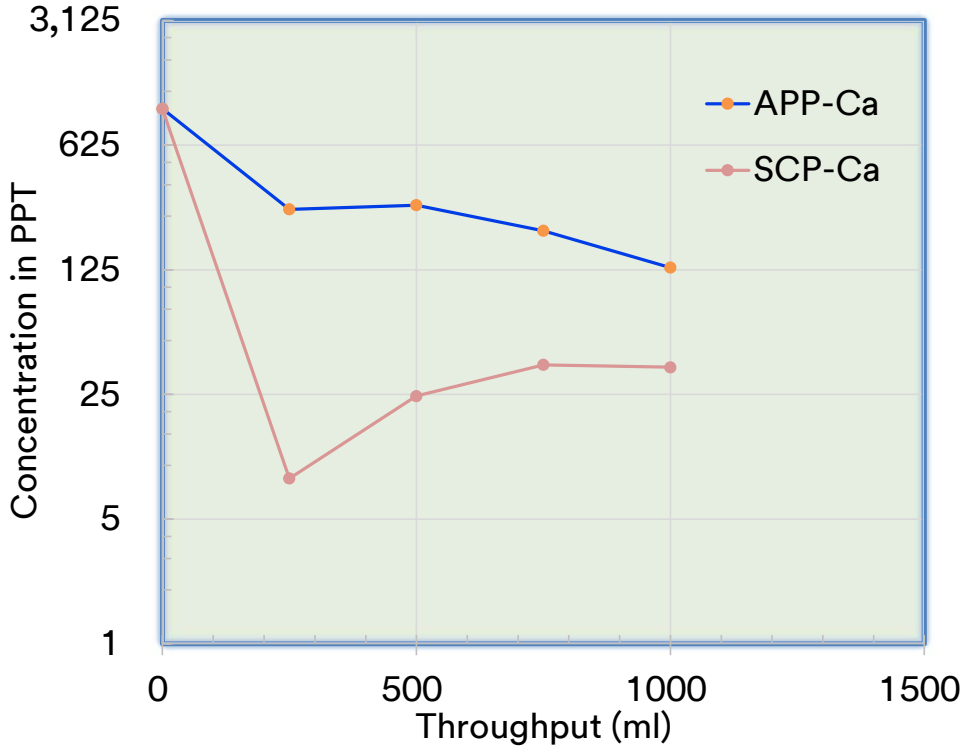
Effect of the IX resin on Na and K reduction



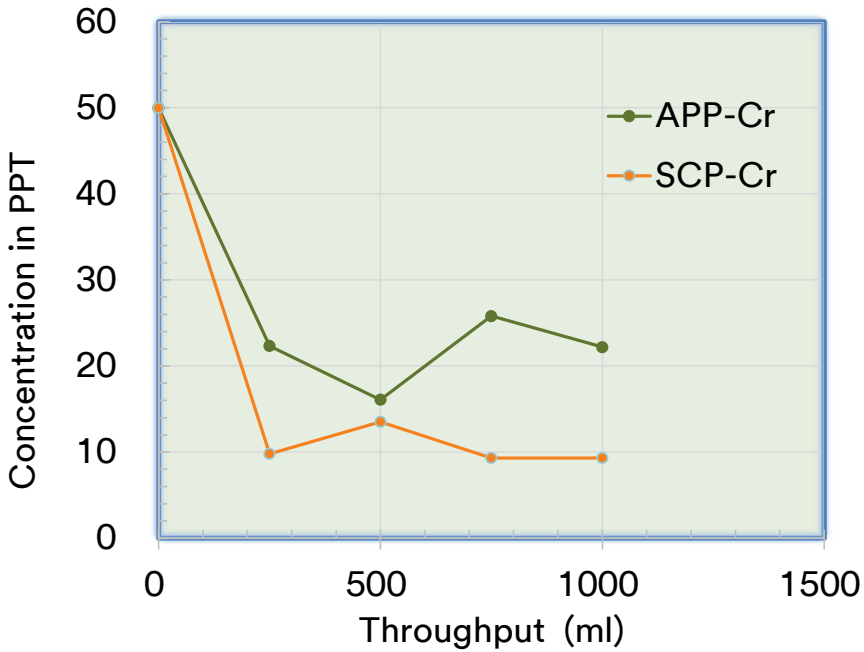


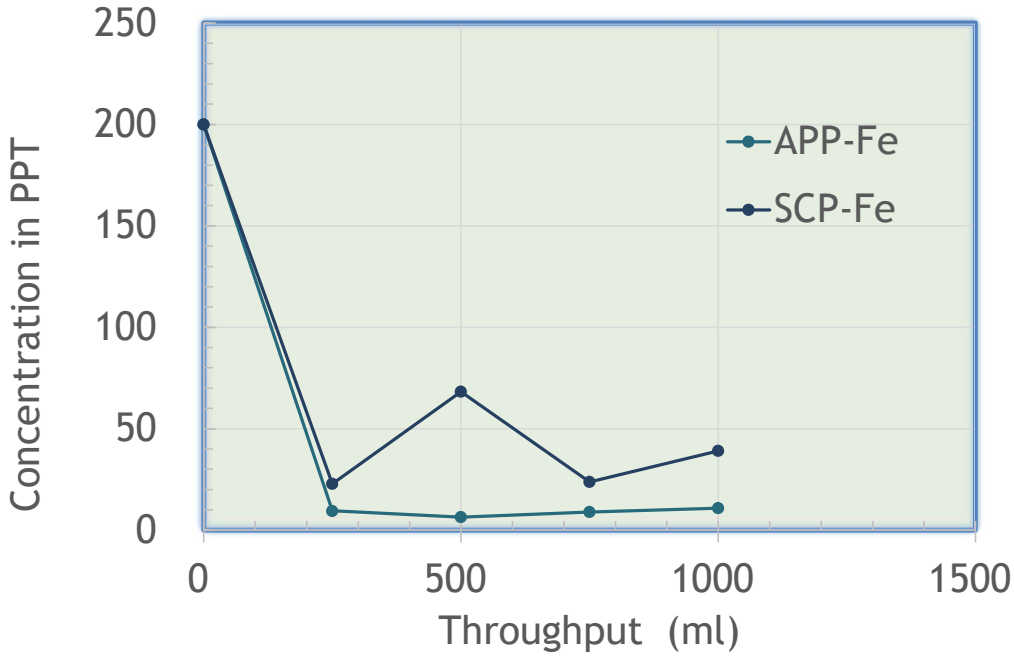
Effect of the IX resin on Cu and Ca reduction



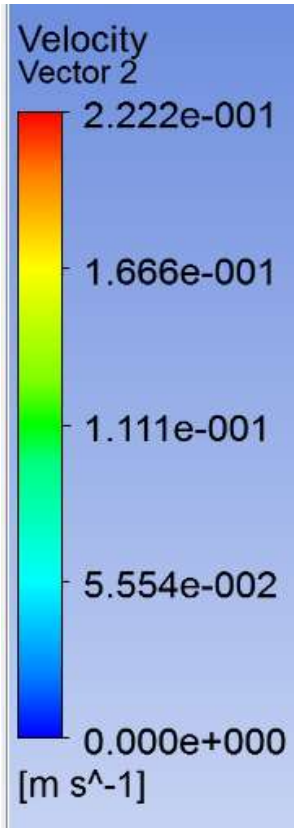


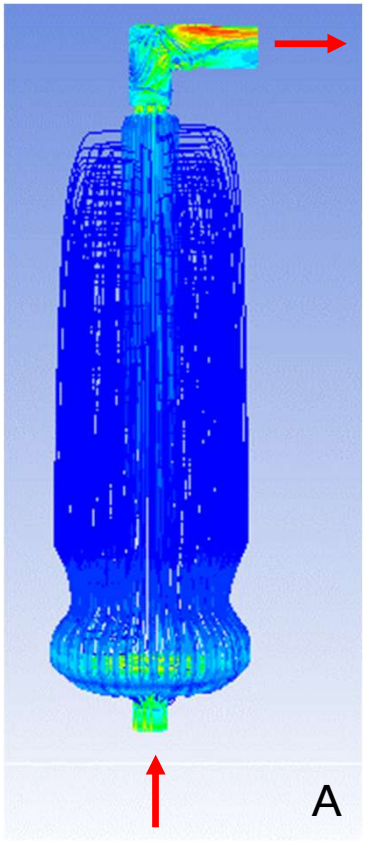
Effect of the IX resin on Cr and Fe reduction

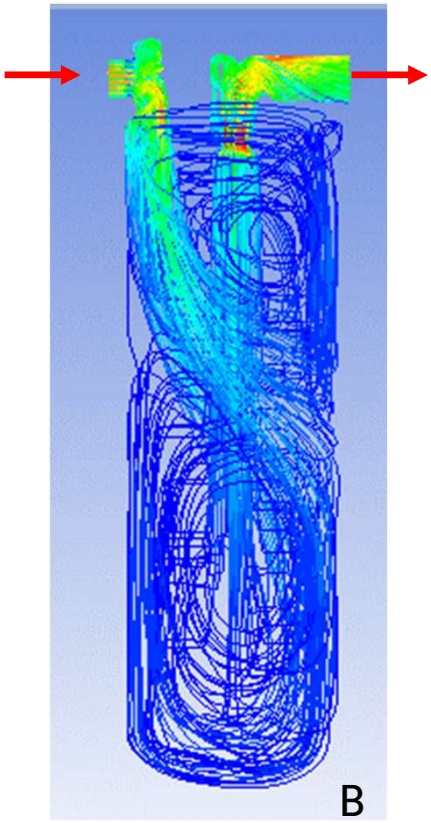


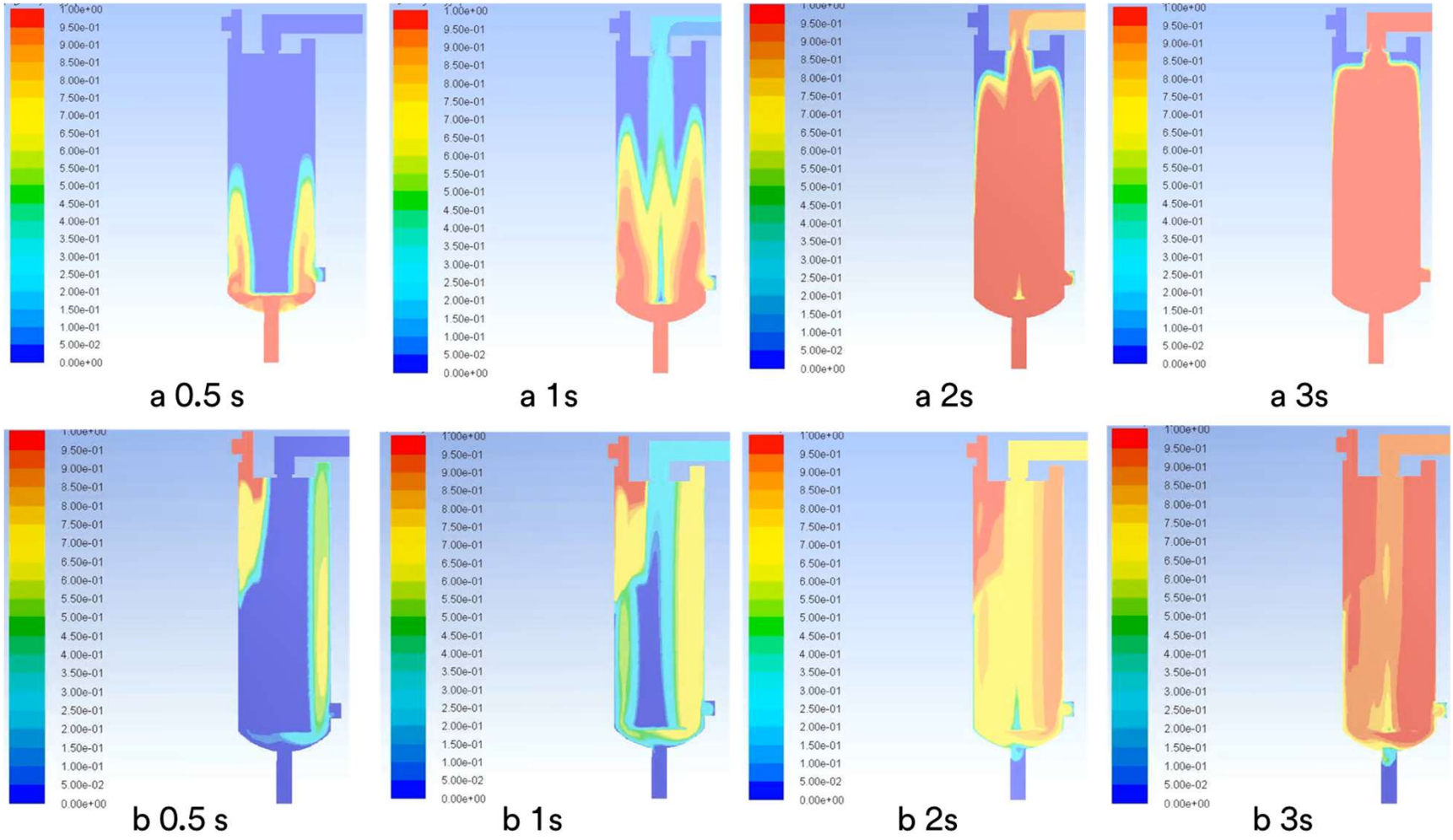


How best to use filtration housings for IX applications









Conclusions

1. The standard filtration housing can be modified to be used for the porous ion exchange media by using the bottom inlet and top outlet

2. The porous ion exchange media can be used to remove metals to single digit ppt levels in high purity chemicals