THE WORLD PRODUCES
2.8 MILLION TONS OF
HIGHLY CORROSIVE HCl EACH YEAR

To foster the progression and safety of the CPI market there is a need for extreme chemical resistance and long standing performance paired with high temperature performance.

The world is becoming more extreme™
CPI APPLICATIONS AND RELEVANT CHEMICALS

- **Pulp & Paper**
  - Bleaching chemicals

- **Metal Preparation**
  - High temperature acids

- **Petrochemicals**
  - Alkylation acids, hydrocarbon mixtures

- **Food & Beverage**
  - FDA listing, steam cleaning, acidic foods

- **Waste Water**
  - Chemical mixtures, outdoor exposure

- **Pesticides**
  - Halogen resistance, low permeation

- **General Chemicals**
  - pH <1 to 13.5

- **Semi-Conductor**
  - High purity water, acids, ozone

- **Pharmaceutical / Biotech**
  - Ozone, steam cleanable, FDA acids

- **Plenum Pipe**
  - Acid waste drainage
CHEMICAL PROCESSING ≠ EASY

- EXTREME →
- Temperatures
- Regulations
- Corrosion

Chemicals:
- Hydrochloric acid
- Sulfuric acid
- Bromide

Maintenance is costly → both time and money
SAFETY IS ALWAYS FIRST

Top 4 causes of accidents in chemical plants:

- Human Error
- Improper Training
- Manufacturing Defects
- Improper Maintenance

Arkema is a partner committed to safety

Arkema TRIR

<table>
<thead>
<tr>
<th>Year</th>
<th>TRIR</th>
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<tbody>
<tr>
<td>2006</td>
<td>8.4</td>
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<tr>
<td>2012</td>
<td>3.4</td>
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<td>2014</td>
<td>1.9</td>
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<td>Obj. 2025</td>
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PERFORMANCE STARTS AT PROCESSING

Yellowness after molding of PVDF plates at 230°C

Comparative PVDF grades

- PVDF 1
- PVDF 2
- PVDF 3
- PVDF 4
- PVDF 5
- PVDF 6
- PVDF 7
- PVDF 8
- Kynar® Series

- 10 minutes
- 30 minutes

Yellowness Index (YI)
**RETENTION OF WHITENESS**

Whiteness of plaque before/after 990h at 130°C

Comparative PVDF grades

- **Before**
- **After**

PVDF 1  PVDF 2  PVDF 3  PVDF 4  PVDF 5  PVDF 6  PVDF 7  PVDF 8  Kynar®

Series 1000

`t = 0`  `t = 990h`
CHEMICAL EXPOSURE – WHITENESS RETENTION VS. OTHER PVDF

- Extrusion of thick plates

7 days in 96% $\text{H}_2\text{SO}_4$ at 50°C

7 days in 37% $\text{HCl}$ at 50°C
ADDITIONAL BENEFITS – SMOOTHNESS & REDUCED BUILD-UP

50µm

50µm
MANY FLUOROPOLYMERS – ONE STANDOUT

Homopolymers

PVF

Kynar® PVDF

PCTFE

PTFE

Copolymers

FEP

PFA

ETFE

E-CTFE
**MANY FLUOROPOLYMERS – ONE STANDOUT**

Kynar® PVDF has the best balance of mechanical properties and melt processability among all the fluoropolymers.

<table>
<thead>
<tr>
<th>Property</th>
<th>Kynar® PVDF</th>
<th>PTFE</th>
<th>PFA</th>
<th>FEP</th>
<th>ETFE</th>
<th>ECTFE</th>
<th>PCTFE</th>
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<tbody>
<tr>
<td>Density (g/cm³)</td>
<td>1.79</td>
<td>2.18</td>
<td>2.15</td>
<td>2.14</td>
<td>1.76</td>
<td>1.68</td>
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<td>Tensile yield strength (MPa)</td>
<td>48</td>
<td>14</td>
<td>19</td>
<td>15</td>
<td>28</td>
<td>31</td>
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<td>Flexural modulus (MPa)</td>
<td>2000</td>
<td>550</td>
<td>600</td>
<td>620</td>
<td>1100</td>
<td>1700</td>
<td>1500</td>
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<td>Dielectric constant</td>
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<td>2.2</td>
<td>2.5</td>
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<td>LOI %</td>
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<td>90</td>
<td>90</td>
<td>30</td>
<td>60</td>
<td>90</td>
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<td>Decomposition (°C)</td>
<td>340</td>
<td>400</td>
<td>400</td>
<td>~300</td>
<td>360</td>
<td>~320</td>
<td>320</td>
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<tr>
<td>Tm (°C)</td>
<td>170</td>
<td>342</td>
<td>305-307</td>
<td>275-295</td>
<td>270</td>
<td>240-247</td>
<td>214</td>
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</table>
CHEMICAL EXPOSURE – WHITENESS RETENTION

Control

69.8% HNO₃

96% H₂SO₄

37% HCl

7 days

50°C

Complete chemical resistance chart for Kynar® PVDF here
CHEMICAL EXPOSURE – WHITENESS RETENTION

- Longtime whiteness retention
- Retention even at high temperatures
- Strong retention of mechanical properties
- Improve performance
- Reduce maintenance costs

KYNAR®

BY ARKEMA
CPI – BY THE APPLICATION

Stock Shapes (rods, sheets)

- Kynar® 1000HD
- Kynar® 740

Tubing, Molding, Plenum Pipe

- Kynar® 1000HD
- Kynar® 9000HD
- Kynar® 740
- Kynar® 720

Tower Packing, Filters, Compounds

- Kynar® 9000HD
- Kynar® 720

Stock Shapes picture: courtesy of Simona AG
CPI – KYNAR® PVDF SOLUTIONS

Kynar® 1000 series

Extreme whiteness and performance

For lower viscosity:
4000 series and 6000 series

Kynar® 700 series

High Whiteness

Kynar® 1000HD

Kynar® 9000HD

Kynar® 740

Kynar® UHM
(Ultra High Modulus) grades available

Excellent performance balance
KYNAR® FLUOROPOLYMER FOCUS
AN EXTREME WORLD NEEDS EXTREME MATERIALS