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>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>8.4</td>
</tr>
<tr>
<td>2012</td>
<td>3.4</td>
</tr>
<tr>
<td>2013</td>
<td>2.8</td>
</tr>
<tr>
<td>2014</td>
<td>1.9</td>
</tr>
<tr>
<td>2015</td>
<td>1.5</td>
</tr>
<tr>
<td>Obj. 2025</td>
<td>1.2</td>
</tr>
</tbody>
</table>

WHICH WOULD YOU CHOOSE?
PERFORMANCE STARTS AT PROCESSING

Yellowness after molding of PVDF plates at 230°C

<table>
<thead>
<tr>
<th>Comparative PVDF grades</th>
<th>10 minutes</th>
<th>30 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVDF 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVDF 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVDF 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVDF 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVDF 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVDF 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVDF 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVDF 8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Competition

Kynar® 1000 Series

CPI MARKET PRESENTATION
RETENTION OF WHITENESS

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

Yellowness Index (YI)

Comparative PVDF grades

- Before
- After

PVDF 1
PVDF 2
PVDF 3
PVDF 4
PVDF 5
PVDF 6
PVDF 7
PVDF 8
Kynar®
1000 Series

Video: www.[video-url].com

PVDF 1
PVDF 2
PVDF 3
PVDF 4
PVDF 5
PVDF 6
PVDF 7
PVDF 8
Kynar®
1000 Series

Video: www.[video-url].com
CHEMICAL EXPOSURE – WHITENESS RETENTION VS. OTHER PVDF

Extrusion of thick plates

7 days in 96% H$_2$SO$_4$ at 50°C

7 days in 37% HCl at 50°C
ADDITIONAL BENEFITS – SMOOTHNESS & REDUCED BUILD-UP
MANY FLUOROPOLYMERS – ONE STANDOUT

Homopolymers

PVF

F
H
C
C
H
H
H

Kynar® PVDF

PCTFE

F
F
C
C
Cl
F

PTFE

F
F
F

Copolymers

FEP

F
F
F
F
F
F
F
F
F
F
F

PFA

ETFE

E CTFE

F
F
C
C
H
H
H
H
Cl
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>
</tr>
</thead>
<tbody>
<tr>
<td>Density</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>
<td>2.13</td>
</tr>
<tr>
<td>Tensile yield strength (MPa)</td>
<td>48</td>
<td>14</td>
<td>19</td>
<td>15</td>
<td>28</td>
<td>31</td>
<td>40</td>
</tr>
<tr>
<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>
</tr>
<tr>
<td>Dielectric constant</td>
<td>8</td>
<td>1.9</td>
<td>1.9</td>
<td>1.9</td>
<td>2.2</td>
<td>2.5</td>
<td>2.6</td>
</tr>
<tr>
<td>LOI %</td>
<td>44</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>30</td>
<td>60</td>
<td>90</td>
</tr>
<tr>
<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>
</tr>
<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>
</tr>
</tbody>
</table>
CHEMICAL EXPOSURE – WHITENESS RETENTION

7 days | 50°C

Control | 69.8% HNO₃ | 96% H₂SO₄ | 37% HCl

See 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
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**
- Kynar® 1000HD
- Kynar® 9000HD

**Extreme whiteness and performance**

**Kynar® 700 series**
- Kynar® 740
- Kynar® 720

**High Whiteness**

**Excellent performance balance**

**For lower viscosity:**
- 4000 series
- 6000 series

**Kynar® UHM** (Ultra High Modulus) grades available