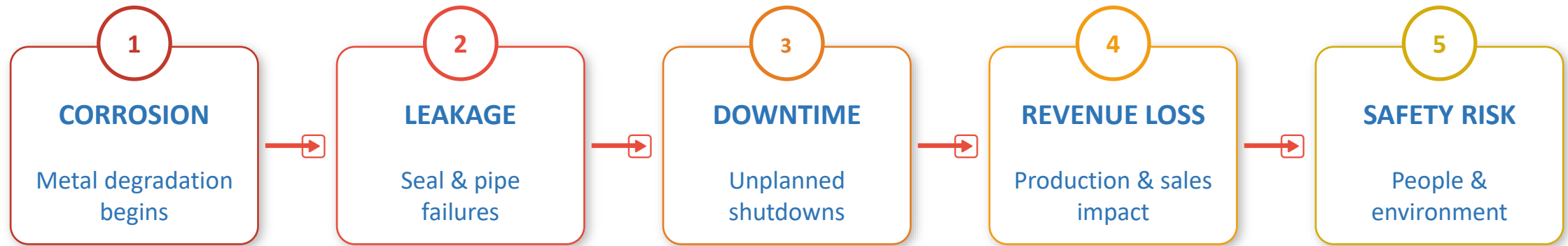


Engineering Confidence with GFL Fluoropolymers

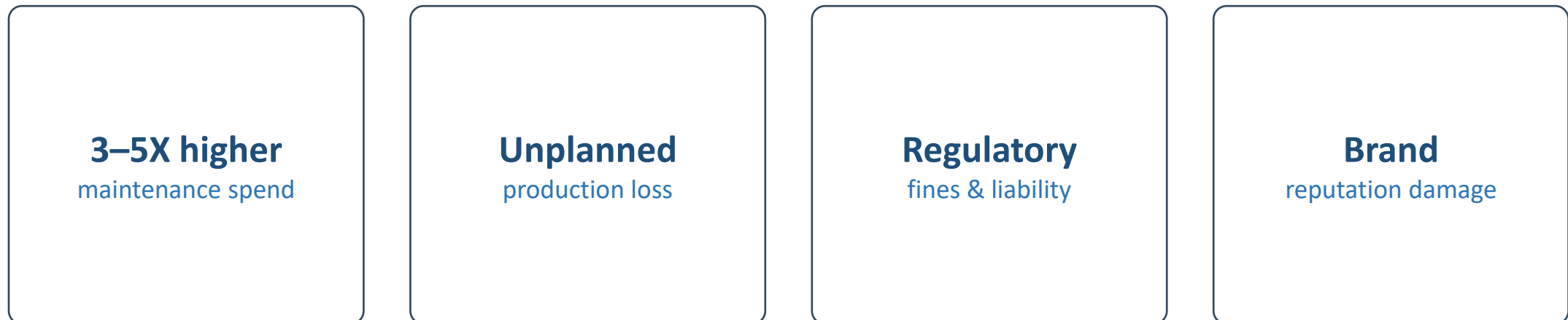
Combating Corrosion - The Silent Threat Hiding In Plain Sight.

THE CORROSION CHAIN REACTION

One failure mode cascades into business-wide consequences



DOWNSTREAM IMPACT



FLUOROPOLYMERS – The Chain Breaker of Corrosion

PROCESS INDUSTRIES



Chemical



Battery Chemicals



Agrochemical



Semiconductor
Chemicals



Pharma



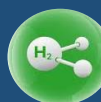
Specialty Chemicals



Petrochemical



Oil & Gas



Green Hydrogen



Fertilizers



ENABLING MATERIALS

PTFE (*Polytetrafluoroethylene*)

- ▶ Excellent chemical resistance
- ▶ High service temperature (–250°C to +250°C)
- ▶ Non-stick in nature, prevents product build-ups & contamination

PFA (*Perfluoroalkoxy Alkane*)

- ▶ Melt-processable, suitable for injection cum transfer molding applications
- ▶ Ultra-high purity for high end applications such as Semicon & Green Hydrogen
- ▶ Excellent transparency and processability for CPI applications

PVDF (*Polyvinylidene Fluoride*)

- ▶ Outstanding abrasion & creep resistance
- ▶ Excellent Mechanical strength
- ▶ UV & radiation resistant

MATERIAL SCIENCE

Why Advance Fluoropolymers Matter ?

*Performance begins
with the raw material.*

The choice of fluoropolymer is not a procurement decision - it's an engineering one. Every downstream property traces back to raw material purity, consistency & transparency.



Chemical Resistance

Withstands aggressive media



High Purity

Ultra-low extractables



Temperature Capability

Stable across extremes



Lower Total Cost

Fewer replacements, less waste



Long Service Life

Durability by design



Enhanced Safety

Lower Operational Risk

Fluoropolymer Material Selection

Property	PTFE (Polytetrafluoroethylene)	PFA (Perfluoroalkoxy)	PVDF (Polyvinylidene fluoride)
Chemical Resistance	Excellent	Excellent	Good
Temperature Range (°C)	-200 to 260	-200 to 260	-40 to 140
Melting Point (°C)	327	310	165
Tensile Strength (MPa)	30	30	45
Elongation (%)	300	300	50-100
Electrical Insulator	Yes	Yes	Yes
UV Resistance	Excellent	Excellent	Good
Transparency	Opaque	Translucent	Opaque
Melt Processability	No	Yes	Yes

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THE MISSING PIECE IN THE INDUSTRY

CURRENT SITUATION

Once installed — *nobody knows:*



Which resin?



Which batch?



Who processed it?



Manufacturing date?



MOC history?



Inspection records?



Maintenance history?



THE CONSEQUENCE



After 5 years everything becomes paperwork.



No traceability when something fails



No accountability across the supply chain



No data to optimize maintenance cycles



No proof of material compliance

New Initiative – QR Code for Traceability

Material Identification & Traceability

QR Code Integration for Lined Pipes System, Fittings, Valves & Pumps



Example:

Item Information	
Client Name/Project Name	ABC Ltd., Dahej
Project PO Number	3001-3252101150 DTD: 19-03-2026
Processor Name	XYZ (P) Ltd
Product Detail	INOFロン GN7040, PTFE Fine Powder
Batch No.	ABCD12345
PO Qty	22500(KG)
Item Description	CS PTFE lined spool pipe (NB100 x 6 mtr long)

QR UNLOCKS



Batch Details

Batch-specific data on scan,
Unique identity to every member
listed in BOQ



Customer Info

Customer Name/Project Name, Plant
name, EPC name, etc.



Order Quantity

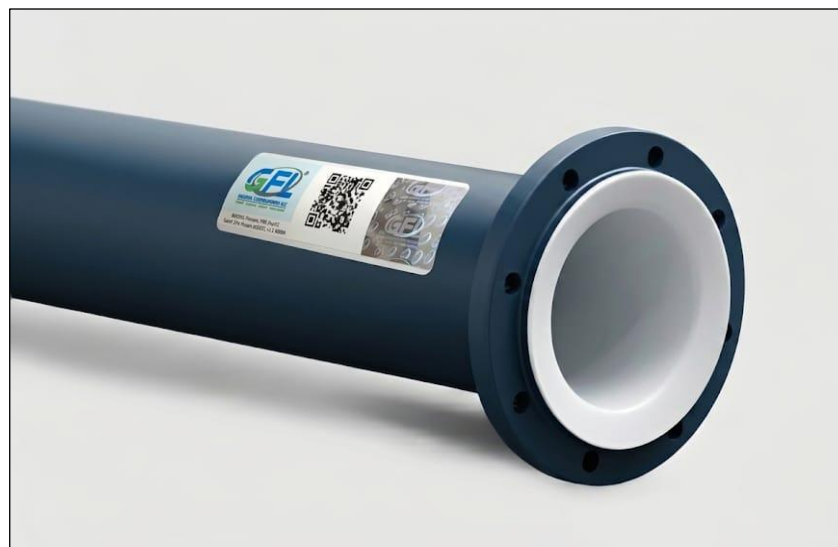
Volume traceability & Integration.



Global Standard

Transparency with relevant data
provided to everyone

Liner Application Resin Requirement

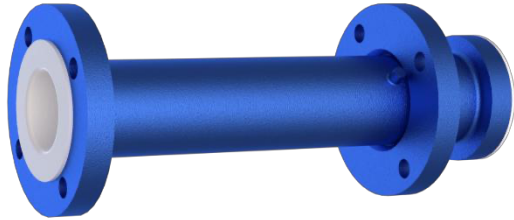


Property	Standard Resin Requirement	INOFLON GN7040 
Fibrillation	Very high	Very High
RR-approximate	20 – 200	20-300
Extrusion Press (400:1)	30 – 40 MPa	~ 35 MPa
SSG	2.140 – 2.19	~ 2.170

Size < NB300 (12")	Size >NB300 (12")
INOFLON GN7040	INOFLON GN7003

Type-1, Grade 2, Class A Property Requirements as Per ASTM D4895

Fluoropolymer Solutions: Examples



PTFE-Lined Spool



PFA-Lined Fitting



PFA-Lined Ball Valves

What Matters

- Pipe Schedule
- Flange Thickness
- Pipe Surface treatment and final finishing
- ASTM's & Grades

PTFE For Pipe Lining

- ✓ Temperature from -29°C (as per ASTM) to 260°C (200°C recommended)
- ✓ Vacuum and/or high pressure service
- ✓ Chemicals Resistance
- ✓ Availability in various size - DN 15 (1/2") to DN 800 (32")
- ✓ Antistatic quality on demand
- ✓ FDA Approved material
- ✓ Reliable piping solution

ANTISTATIC PTFE & PFA

KEY PROPERTIES

- ✓ Surface resistivity < $10^7 \Omega/\text{sq mtr}$
- ✓ Eliminates electrostatic discharge
- ✓ Full chemical inertness retained
- ✓ Operating range: -20°C to $+250^\circ\text{C}$
- ✓ FDA compliant

Properties	Unit	GFL PFA 8003AC
Melt Flow Rate	g/10 min	2.38
Melting Point	$^\circ\text{C}$	305
Tensile Strength	Mpa	30.58
Elongation	%	300
Volume Resistivity	$\Omega.\text{cm}$	1.10×10^6

CRITICAL APPLICATIONS



Fluid Handling

Enables safe and reliable fluid handling in chemical processes by dissipating static charges.



Aggressive Chemical Transfer

Pipes, valves and fittings for HF, H_2SO_4 , HNO_3 and chlorinated solvents with ESD-safe performance.



Explosive Atmosphere Zones

ATEX/IECEx-rated linings and ducting in solvent handling, fuel transfer and powder conveying systems.



Inertness

Conductive carbon addition for ESD properties retains the excellent chemical resistance of PFA/PTFE.



CASE STUDY 1:

CORROSION PROBLEM IN PROCESS PLANTS

Fluoropolymer Linings



- **Challenge:** Traditional materials like steel and rubber used in chemicals plants suffer from corrosion and degradation when exposed to harsh chemicals like chlorine and sodium hydroxide (caustic soda) etc. This leads to frequent equipment failures, production downtime, and safety hazards.
- **Solution:** Replacing metal/MSRL/FRP with fluoropolymer linings provides exceptional chemical resistance to chlorine and caustic soda, significantly extending equipment lifespan.
- **Results:**
 - Reduced maintenance costs.
 - Improved safety.
 - Enhanced sustainability.

Field Examples: MSRL-HE Failure



GFL Collaborates for customized solutions & application development

CASE STUDY 2:

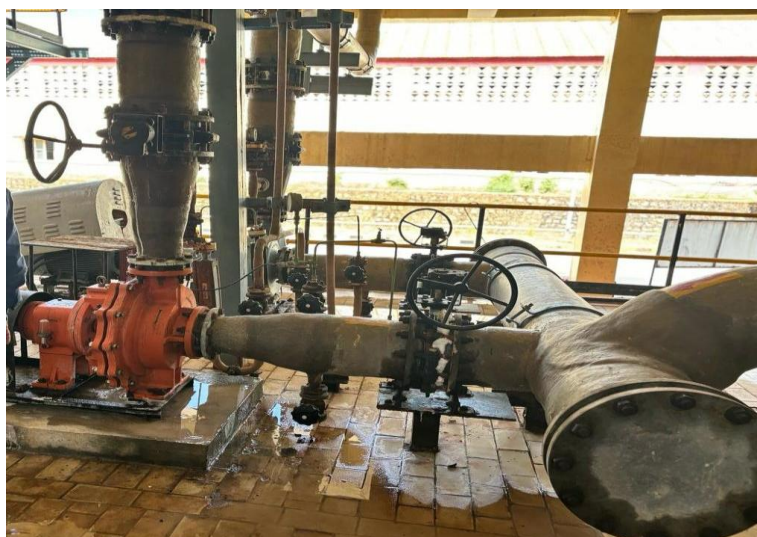
PFA/PVDF LINED PUMPS IN CHLORINATED BRINE APPLICATION

Fluoropolymers Lined Pumps



Application : Pure Brine pump, Lean brine pump, Polished brine pump, Clarified brine pump , Acidified Brine pump , Anolyte brine and Hypo Solution pumps.

Challenge : Traditional Metallic pumps used in Chlorinated Brines are very costly, Required more maintenance, difficult to handle and service support issues leads to operational down time.



Solution : PFA/PVDF lined Pumps meet the process requirements even at high temperature and pressure combinations in corrosive environments. This is cost effective serviceable, easily available.

Result :

- Superior Chemical Resistance
- Lower Permeability
- Withstands High Temperature
- Increased Sustainability

PFA LINED PUMPS

Key Differences (Non-metallic pump)

Feature	Non-metallic Pump	Titanium Pump
Material	PFA & PVDF ,	Titanium
Temperature resistance	Up to 180°C	High temperatures
Cost	Lower	> 50 % Higher cost compared to non - metallic pumps
Weight	Lighter	Heavier (Causing logistic issue)
Maintenance	Requires less maintenance	Requires more maintenance, especially in harsh environments
Applications	All range of highly corrosive chemicals & high solid content chemicals	Corrosive environments, high temperatures, high pressures, etc.
Reliability	Longer	Shorter
Service Support	Immediate	Longer time
Corrosion resistance	Excellent for corrosive environments	Excellent for corrosive environments
Chemical resistance	Excellent for a wide range of chemicals	Excellent for a wide range of chemicals
Delivery (Pump & Spares)	Short lead time	High lead time

CASE STUDY 3:

PFA/PVDF LINED JACKETED PUMPS IN ELIMINATING FLUID CRYSTALLIZATION

Jacketed Non –metallic pump

Raw Material Selection for Polymer Components

- In non-metallic jacketed pump applications, raw material selection for the polymer components is the most critical engineering decision. While the jacket is metallic and thermally robust, the polymer pump body must simultaneously resist chemical attack from the process fluid and withstand the mechanical stresses induced by thermal cycling between the process liquid temperature and the jacket heating medium temperature.
- Polymeric materials expand and contract at rates significantly higher than metals. Under repeated heating and cooling cycles — across every start-up and shutdown — these dimensional changes generate internal stresses at critical interfaces: sealing faces, bearing fits, and casing joints. Inferior polymer grades with inconsistent molecular structures are susceptible to micro-cracking, dimensional instability, and premature structural failure under these conditions.
- Raw material qualification for jacketed pump service must address:
 - Thermal expansion coefficient across the full operating temperature range
 - Dimensional stability under sustained elevated temperature and pressure
 - Resistance to stress cracking under cyclic thermal loading
 - Chemical compatibility with the specific process fluid being handled
 - Long-term creep resistance at operating temperature and stress levels
- Only raw materials of the finest quality — with tightly controlled polymer grades, low void content, and verified performance across the complete thermal duty cycle — can reliably withstand the combined chemical and thermal demands of corrosive, crystallising fluid service.

Example: Non metallic Jacketed Pump



Service (In /Out)- Precise thermal control

Helps to prevent – mechanical stress and chemical attack during process

PROMINENT APPLICATION FLUOROPOLYMERS ROTOLINING

Fluoropolymers Roto Lining

A computerized controlled, metal bonded lining technology using rotational movement of equipment with sintering for excellent corrosion and chemical resistance, longer life, easy service and low maintenance.

Application: Chemical Processing Industries, Pulp and paper processing, Waste water treatment, Metal preparation, Petrochemicals, Food and beverage, Pesticides, General chemical processing, Nuclear waste processing, Pharmaceutical / Biotech

Challenge: Various Glass Lined / Coated equipment's, reactors, process vessels have limitations of lower life , lower wall thickness ,high maintenance in case of any cracks/ peeling off .

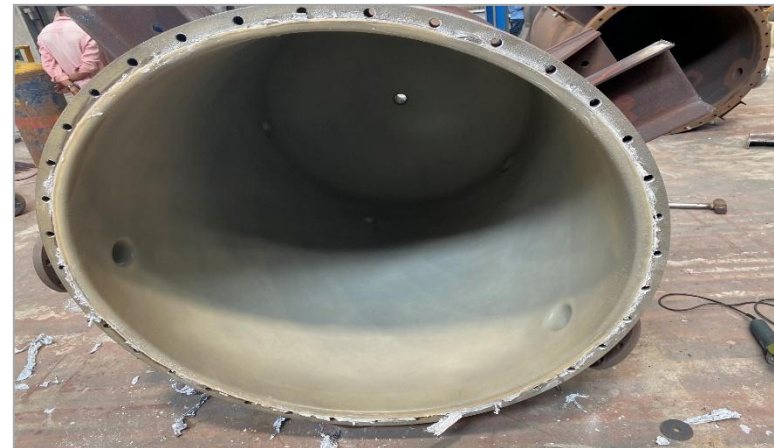
Solution: PVDF based rotolining of such reactors and equipment's creates a metal bonded , seamless and virtually uniform lining having thickness from **0.5mm to 6mm**.

Benefits:

- ✓ Longer Life
- ✓ Outstanding barrier properties
- ✓ Resistant to prominent harsh chemicals
- ✓ On Site Repairs
- ✓ Ease of handling.
- ✓ Quick delivery
- ✓ Suitable for full vacuum application
- ✓ Superior corrosion resistance to condensed bromine.



PVDF Roto lined Tanks, Equipments & Vessels



A photograph of a large industrial facility, likely a chemical plant, at night. The scene is illuminated by numerous bright lights, creating a warm, golden glow. Several tall, cylindrical distillation columns and complex piping systems are visible. In the foreground, there are dark, silhouetted trees and bushes. The sky is a deep blue, suggesting twilight. A semi-transparent white horizontal band is overlaid across the middle of the image, containing the text 'Thank You!'.

Thank You!