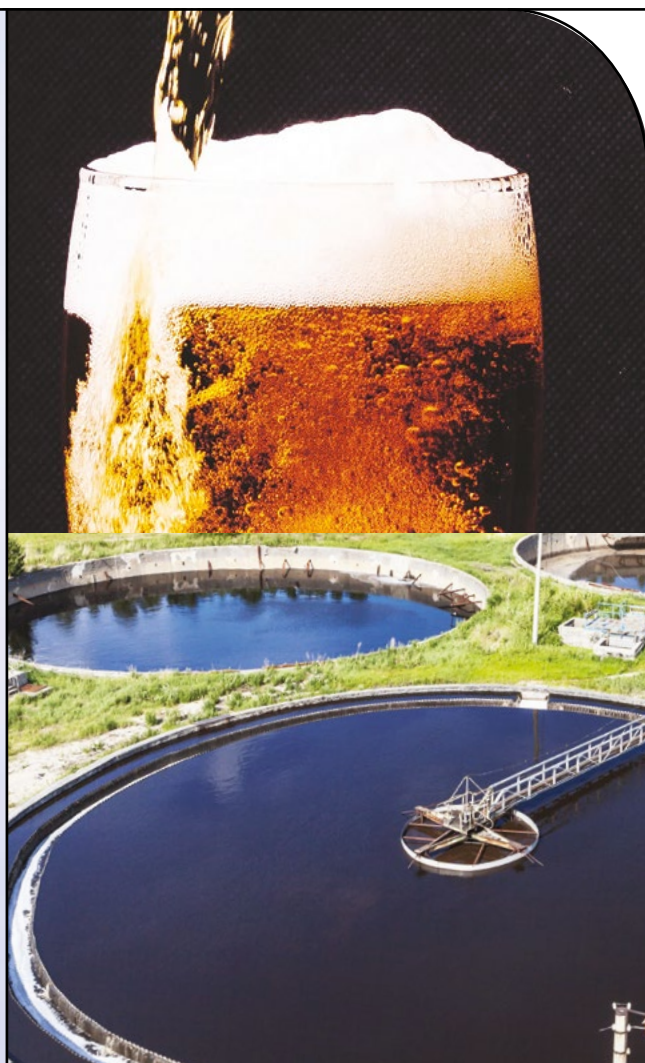
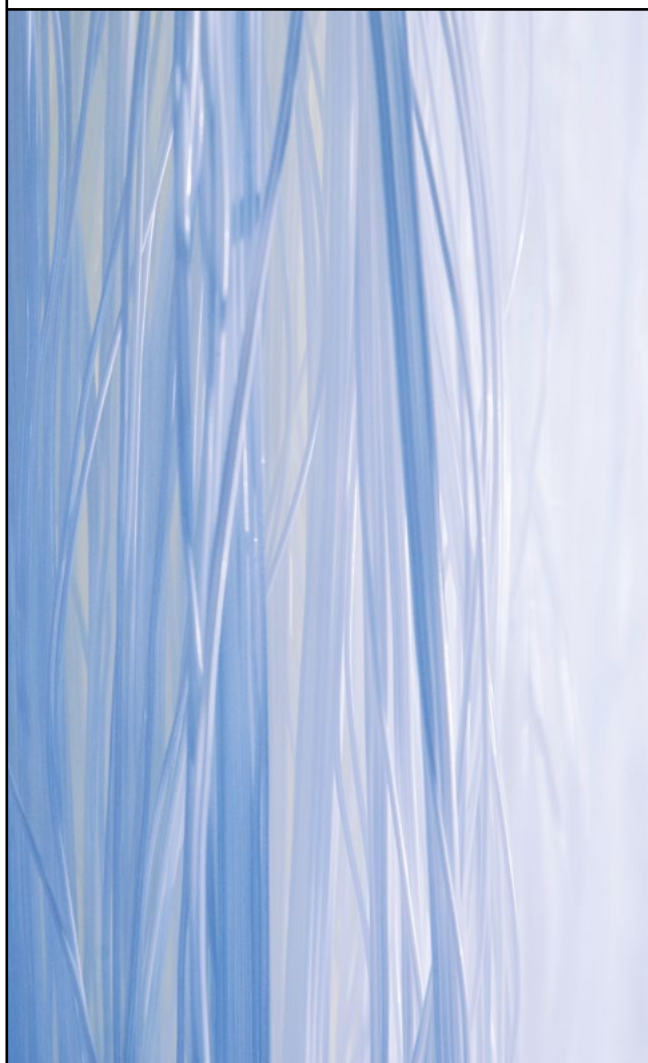


ARKEMA

KYNAR®

INDUSTRIAL MEMBRANES
**KYNAR® PVDF, WHEN HIGH
PERFORMANCE MATTERS**



HIGHLIGHTS & APPLICATIONS

Kynar® PVDF is well established in the chemical processing industry for its excellent chemical resistance, mechanical strength, and long-term durability. These same qualities make this resin a great option for use in microfiltration and ultrafiltration membranes. Kynar® PVDF polymers are soluble in a variety of solvents, allowing them to be solvent-cast by the phase inversion process. Membranes made with Kynar® PVDF may be prepared as flat sheets, hollow fibers, and tubular configurations via the TIPS and NIPS processes.

Select Kynar® PVDF grades are USP Class VI compliant and listed in the federal register, NSF-51 and NSF-61, which allows the resins to be used in food contact and potable water applications. The outstanding chemical resistance of Kynar® resins allows a broad range of applications, including: potable water, high purity water, and wastewater treatment. Medical applications include blood and protein filtration. Chemical filtration applications include food and beverage, biopharmaceutical, dairy, and paint.

KYNAR® PVDF HIGHLIGHTS

50+ YEAR TRACK RECORD in PVDF production

OUTSTANDING CHEMICAL RESISTANCE i.e. ozone, chlorine, bromine, hydrogen peroxide, chlorine dioxide, acids

Homopolymer pH=1-12 Copolymers pH=1-13

Grades available in a **WIDE VISCOSITY RANGE** for both flat sheet and hollow fiber membranes including both TIPS and NIPS processes

Grades that produce highly durable **ANTI-FOULING** membranes

Select Kynar® PVDF grades used in membrane production are **USP CLASS VI, NSF-51, AND NSF-61** compliant

Grades available for **NANOFIBER** production and **NANOFIBER MEMBRANES**

TECHNICAL SUPPORT TEAMS have the ability to prototype hollow fiber, reinforced hollow fiber, and flat sheet membranes

RADIATION RESISTANT and **CAN BE STERILIZED** via conventional methods including gamma, steam, and EtO

KYNAR® PVDF MEMBRANE APPLICATIONS

Food & Beverage filtration

Water filtration (MF and UF pore size) i.e. wastewater, viral rejection, ultrapure, deionized, potable water, membrane bio-reactors

Chemical process filtration (i.e. paint)

Biomedical blood and protein filtration

Biopharmaceutical filtration

Membrane distillation

Separations i.e. liquid/liquid, liquid/gas, gas/gas

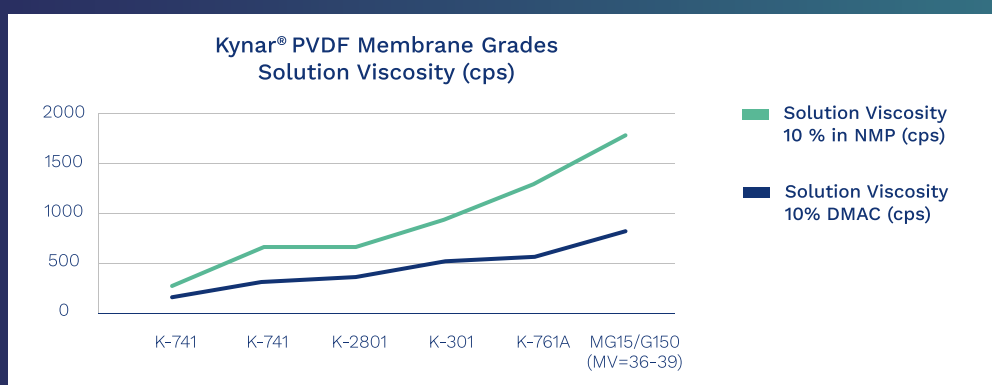
Porous support for coating of specific separative layer(s) for gas/gas or liquid/gas separation

A GRADE FOR EVERY APPLICATION

A range of Kynar® PVDF grades are available to help customers tailor their membranes for specific applications and processing. The **Kynar® 700** series is produced in a range of viscosities, permitting customers to select the optimum product for their membrane process. **Kynar® MG 15** is a new grade designed specifically for hollow fiber spinning.

Kynar® HSV 900 is a very high viscosity grade especially suitable for hollow fiber casting and other applications requiring high gel strength. **Kynar Flex® copolymer** grades offer even higher pH chemical resistance and greater flexibility.

Kynar® resins are supplied in several forms: fine powder, granular, and pellets. Powders are often preferred for ease of dissolution, while our new granular, high bulk density, free flowing G150 allows for easier handling and solubility. See table below.

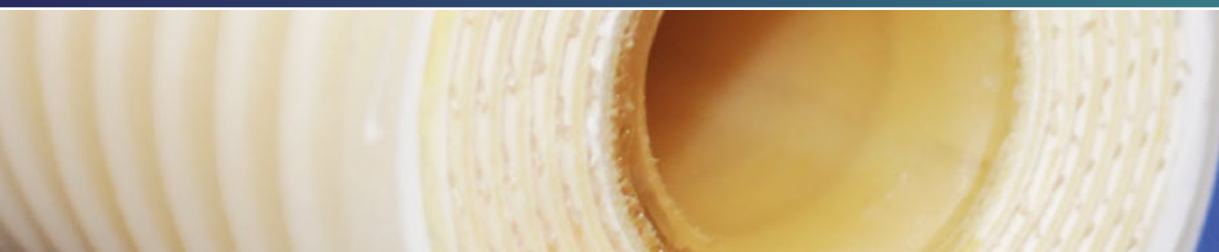


SOLUTION VISCOSITY (25°C @ 10S⁻¹)

Grade	Melt Visc (kp)	Solution Visc. 10% in DMAC (cps)	Solution Visc. 10% in NMP (cps)	Notes:
741	16 -19	100 - 200	200 - 350	Good for TIPS hollow fiber (HF)
761	26 - 29	225 - 350	500 - 800	Good for TIPS hollow fiber (HF)
761A	32 - 35	~ 450 - 650	1000 -1500	Sheet membranes and NIPS HF
MG 15/G150	36 - 39	700 - 900	1500 - 2000	High strength NIPS HF*
HSV900/G800	49 - 52	5000 -7000	10000 -15000	Low solids NIPS HF**
301F	27 - 30	450 - 550	800 - 1000	MF Membranes, supported fibers
2801	25 - 29	~ 300 - 400	500 -800	HFP Copolymer Improved Caustic Resistance & Flexibility

* Specifically designed for robust hollow fiber spinning and producing high strength membranes.

** High viscosity grade that can be spun at low solids levels making it potentially attractive for membrane distillation.



PHYSICAL, MECHANICAL & THERMAL PROPERTIES

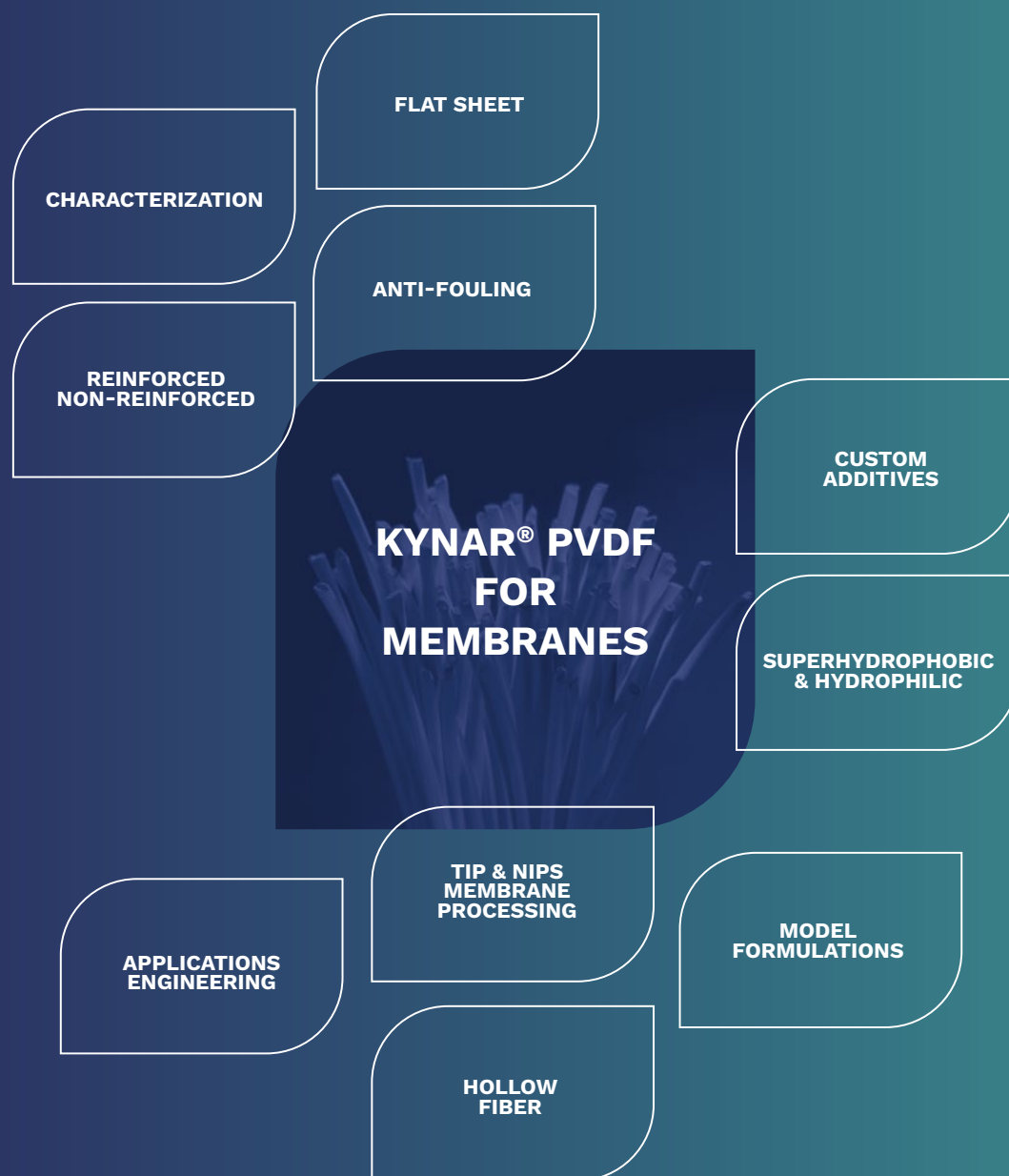
	UNITS	KYNAR® 700 SERIES KYNAR® MG SERIES KYNAR® HSV 900	KYNAR® 301F	KYNAR FLEX® 2801
PHYSICAL PROPERTIES*				
Specific Gravity D792/73°F (23°C)	g/cm ³	1.77-1.79	1.75-1.77	1.76-1.79
Water Absorption % D570/68°F (20°C) Immersion/ 24 Hours	%	0.01-0.03	0.02-0.04	0.03-0.05
MECHANICAL PROPERTIES*				
Flexural Strength @ 5% Strain D790/73°F (23°C)	psi (MPa)	8,500-11,000 (58-76)	7,000-9,000 (48-62)	3,000-5,000 (20-34)
Flexural Modulus D790/73°F (23°C)	psi (MPa)	240,000-335,000 (1,655-2,310)	200,000- 260,000 (1,379-1,792)	70,000-120,000 (620- 827)
Tensile Yield Elongation D638/73°F (23°C)	%	5-10	10-15	10-20
Tensile Yield Strength D638/73°F (23°C)	psi (MPa)	6,500-8,000 (45-55)	5,000-7,500 (34-52)	2,900-5,000 (20-34)
Tensile Break Elongation D638/73°F (23°C)	%	50-200	50-250	200-400
Tensile Break Strength D638/73°F (23°C)	psi (MPa)	5,000-8,000 (34-55)	4,500-7,000 (31-48)	2,500-5,000 (17-34)
Tensile Modulus D638/73°F (23°C)	psi (MPa)	200,000-335,000 (1,379-2,310)	150,000- 200,000 (1,034-1,379)	80,000-130,000 (551- 896)
THERMAL PROPERTIES*				
Melt Temperature D3418	°F (°C)	323-342 (162-172)	311-320 (155-160)	284-293 (140-145)
T _g (DMA) @ 1Hz D7028	°F (°C)	-41- -37 (-40 - -38)	-41 - -37 (-40 - -38)	-42 - -39 (-41 - -39)

* Typical property values. Should not be construed as sales specifications

TECHNICAL SERVICES

ARKEMA, A GLOBAL LEADER IN INNOVATION

LET US SAVE YOU YEARS ON R&D



CONTINUOUS INNOVATION

Arkema, a leader in PVDF, is a global company with the resources to better serve our customers. Our experienced R&D staff and full analytical services provide us with the tools to prototype and test hollow fiber, reinforced fiber, and flat sheet membranes. Our team can provide initial formulations and process parameters for various grades of Kynar® PVDF to enable our customer's development and speed to market.

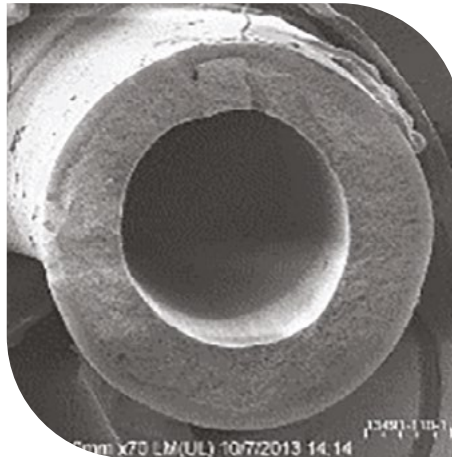
- MODEL FORMULATION
- MEMBRANE SPINNING CONDITIONS
- ON-SITE LAB TRIALS AND TRAINING
- FIELD TECHNICAL SUPPORT
- CHARACTERIZATION
- GLOBAL SUPPORT

- HIGHER STRENGTH MEMBRANES
- DURABLE ANTI-FOULING
- FLEX GRADES

NIPS HOLLOW FIBER PILOT LINE

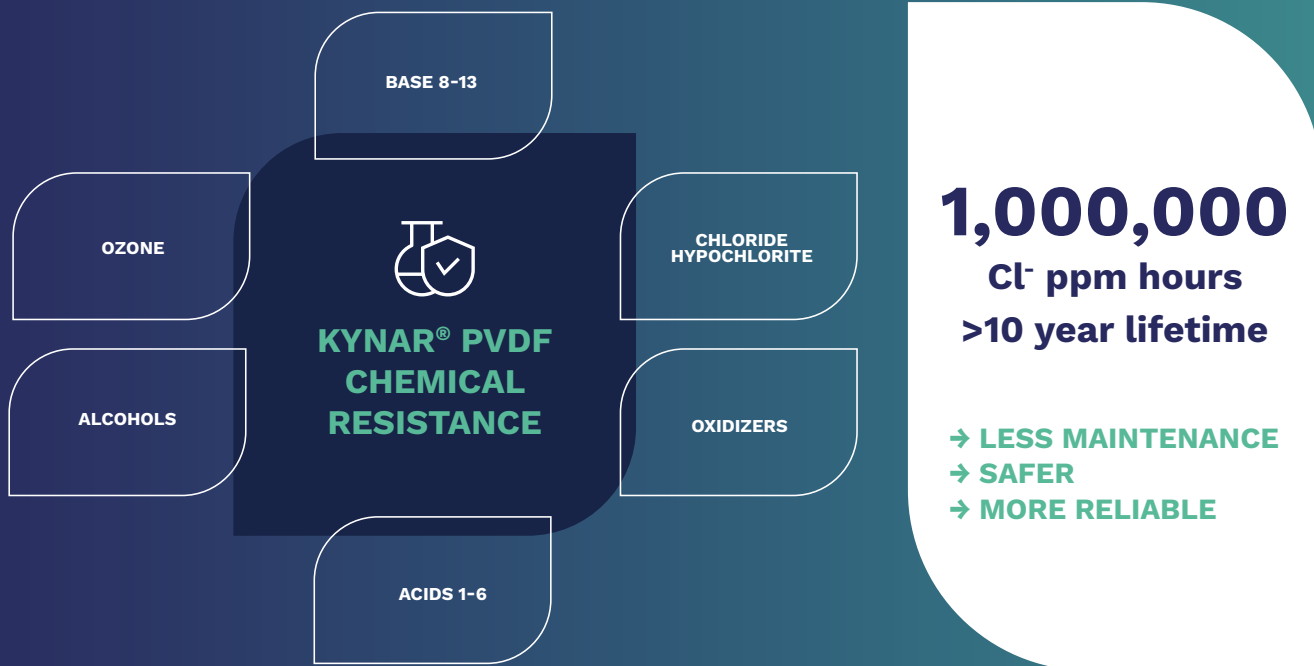


CHLORINE AGING STUDY



NIPS CONCENTRIC HOLLOW FIBER

CHEMICAL RESISTANCE



LONGER LIFETIME & MORE FORGIVING
NEW KYNAR® PVDF – DURABLE/ANTIFOULING GRADES

SOLUBILITY & ADDITIVES



TABLE 3 - Active Solvents

Solvent	Boiling Point °C	Flash Point °C
Dimethyl Acetamide ^a	166	70
N-Methyl-2-Pyrrolidone ^a	202	95
Dimethyl Formamide	153	67
Dimethyl Sulfoxide (DMSO) ^b	189	88
Triethyl Phosphate	215	116
Tetramethyl Urea	177	1165

SOLUBILITY

Kynar® resins have solubility properties suitable for easy processing by a variety of typical membrane forming processes. Table 3 lists active and latent solvents. Generally, Kynar® PVDF is not soluble in aliphatic hydrocarbons, aromatic hydrocarbons, chlorinated solvents, alcohols, acids, halogens, and basic solutions.

^a Most commonly used solvents.

^b DMSO is a product offered by Arkema



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