'TORAY'

Innovation by Chemistry

HYDROLINK™ MEMBRANE

NV

Dramatic Improvement in Dialysis

TORAYLIGHT™ **NV-U** series

The dramatic improvement of biocompatibility

HYDROLINK™ membrane has high level biocompatibility and dialysis performance by using "new membrane reforming technology" focused on "adsorbed water".

Toray developed new membrane reforming technology, and dramatically improved biocompatibility of hollow fiber membrane.

"Improved hydrophilicity and excellent antithrombogenicity."

HYDROLINK membrane has thick flexible layers with high hydrophilicity which was developed by using new membrane reforming technology focused on adsorbed water (Fig.2 and 3).

As the result in improving mobility of adsorbed water existing on surface of hollow fiber membrane, adhesion of proteins to membrane is prevented and stimulation to platelet is reduced (Fig.4).

Consequently, it can be expected that NV-U series performs "excellent antithrombogenicity".

"Suppression of effluent"

Hydrophilic polymer is cross-linked to hollow fiber membranes by gamma irradiation and effluent is suppressed (Fig.5).

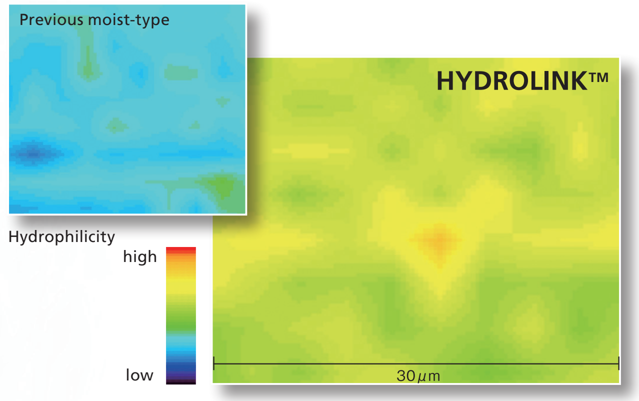

Fig.2 Distribution of hydrophilicity on surface of membranes (two dimensional Attenuated Total Reflection infrared spectroscopy, two dimensional ATR) [2]

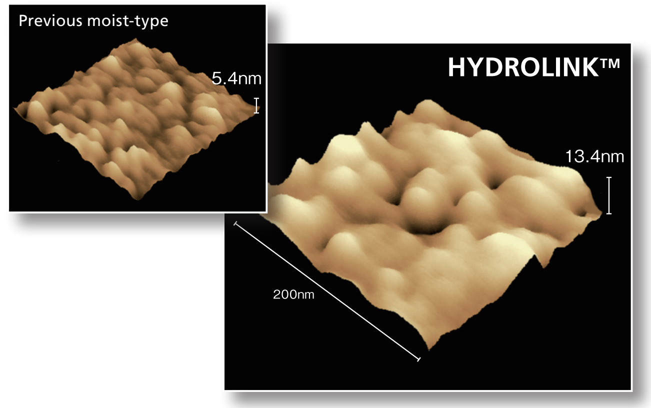

Fig.3 Flexible layers on surfaces of hollow fiber membranes (Images of Atomic Force Microscope) [2]

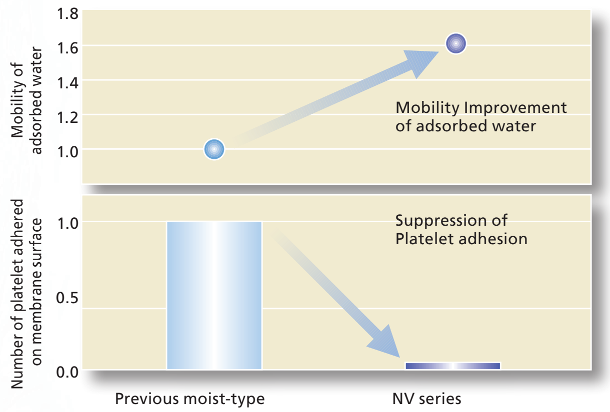

Fig.4 Mobility change of adsorbed water and suppression effects of platelet adhesion [1]

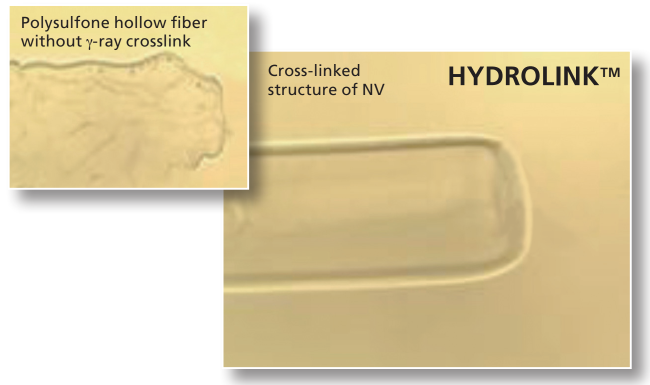

Fig.5 Dissolution images of hollow fiber membranes by N,N dimethylacetamide (DMAc, organic solvent) [1]

What is "adsorbed water"?

There is water, called "adsorbed water", which is different from normal water (free water) and exists on the surfaces of hydrophilic polymer and proteins.

The reaction between hollow fiber membrane with hydrophilic polymer and protein in blood is suppressed when mobility of adsorbed water existing on surface of membrane is increased (adsorbed water is also called "bounding water".) (Fig.1).

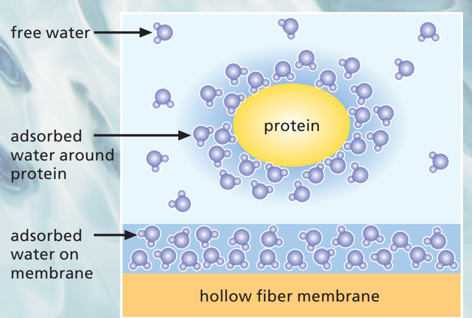

Fig.1 Image of adsorbed water on surface of hollow fiber membrane and around protein[1].

Novel dialysis performances

New membrane reforming technology is also leading to improvement of dialysis performances.

"Sharp fractional characteristic and low fouling"

As the result in membrane reforming, molecular weight fractional characteristic is more sharp in comparison with previous moist-type dialyzers (Fig.6).

Time-dependent change of sieving coefficient of albumin is suppressed by reducing adhesion of proteins to membrane surface (fouling). It can be expected that albumin leakage just after the beginning of dialysis is improved. In other words, the stable removal of uremic proteins can be anticipated for a whole dialysis session (Fig.7).

"Improvement of removal performances"

NV-U series has higher level of removal performances for the uremic toxins from small molecule solutes to low molecular weight proteins (Fig.8).

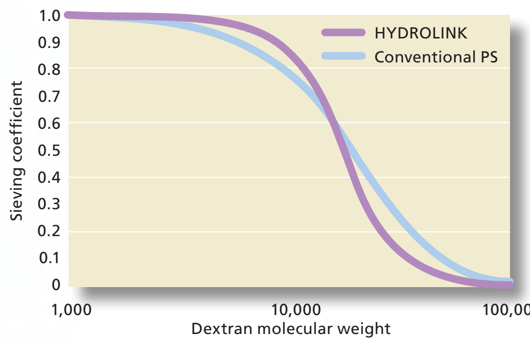

Fig.6 Fractional characteristic of dextran

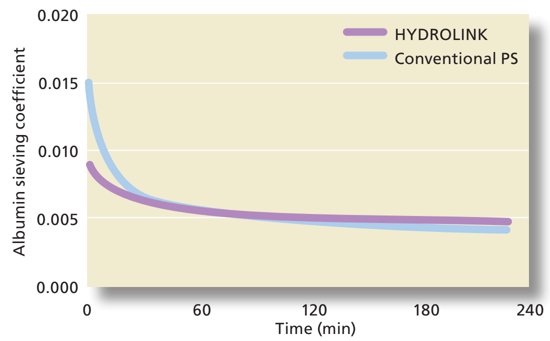

Fig.7 Time-dependent change of sieving coefficient of albumin

Experimental condition
Bovine serum
(Ht=30%, TP6.5g/dL)
37°C
Q_F=18mL/min

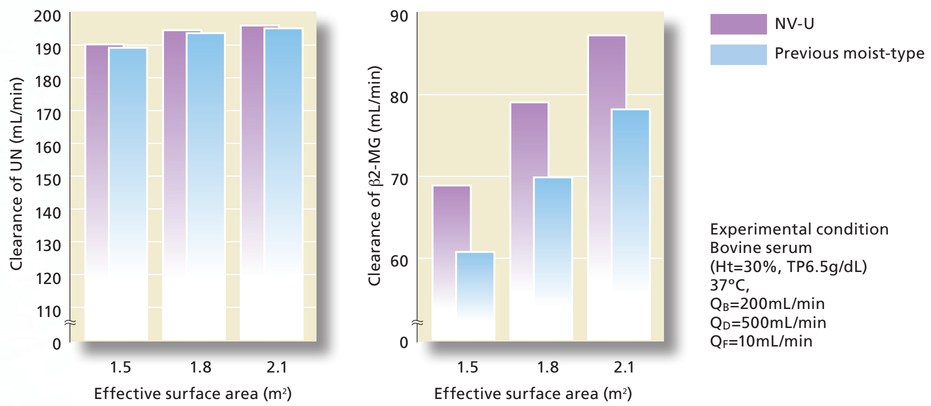

Fig.8 Removal performances of solute

Experimental condition
Bovine serum
(Ht=30%, TP6.5g/dL)
37°C,
Q_B=200mL/min
Q_D=500mL/min
Q_F=10mL/min

References
1. Ueno Y. et al., Development of new anti-thrombotic dialyzer, NV. The 48th Annual Meeting of Japanese Society for Artificial Organs 2010.
2. Yamaka T. et al., Clinical evaluation of Toray hollow fiber membrane dialyzer FS-211 improved in hydrophilicity inner surface of membrane. Kidney and Dial 69 (suppl) High Performance Membrane '10. :123-129 (2010).

Performance (*in vitro*)

Product name		TORAYLIGHT NV-U series			
Type		**NV-13U**	**NV-15U**	**NV-18U**	**NV-21U**
Effective surface area (m^2)		1.3	1.5	1.8	2.1
UFR* {mL/hr/mmHg, at 13.3kPa (100mmHg)}		42	46	51	52
Albumin sieving coefficient		0.005**			
Clearance*** (mL/min)					
	Urea	192	196	198	198
	Creatinine	180	190	192	194
	Phosphate	178	184	190	194
	Vitamin B_{12}	128	151	159	167

* Typical measured data with bovine blood.
Ht: 32 ±2%, TP: 6.0~6.5g/dL, QB: 200 ±4mL/min, Temp.: 37 ±1°C
** Typical data
***Typical measured data with aqueous solution.
Q_B: 200 ±4mL/min, Q_D: 500 ±10mL/min, Q_F: 10 ±2mL/min, Temp.: 37 ±1°C

Specifications

Type		NV-13U	NV-15U	NV-18U	NV-21U
Housing	Material	Polypropylene			
	Length (mm)	289	338	338	338
	Diameter (mm)	39	37	41	44
Potting material		Polyurethane			
Fibers	Membrane	HYDROLINK™			
	Internal diameter (μm)	200			
	Membrane thickness (μm)	40			
	Effective length (mm)	214	263	263	263
Blood volume* (mL)		84	96	111	130
Maximum TMP {kPa(mmHg)}		66 (500)			
Range of blood flow rates (mL/min)		100 – 400			
Maximum dialysate flow (mL/min)		1,000			
Sterilization		Gamma-ray Irradiation			

* Typical data

TORAY

Manufacturer:
Toray Industries, Inc.
1-1, Nihonbashi-Muromachi 2-chome, Chuo-ku,
Tokyo 103-8666, JAPAN

Exporter:
Toray Medical Co., Ltd.
4-1, Nihonbashi-Honcho 2-chome, Chui-ku,
Tokyo 103-0023, JAPAN

EC REP
Toray International Italy S.r.l.
Via Mecenate 86, 20138 Milan, ITALY

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