

## 3.2 Parameter Comparison -- TIPS vs. NIPS

### 3.2.1 Thermally Induces Phase Separation (TIPS)

Scinor Membrane employs the most advanced thermally induces phase separation (TIPS) technology;

1. **Major membrane manufacturers race against each other on the research of TIPS technology**, because:
  - The TIPS method, requiring high crystallinity and high purity of PVDF raw material, produce membrane fibers of high mechanical strength, stable chemical properties, improved flux and uniform pore sizes;
  - Easy-to-control and automated TIPS manufacturing guarantee high speed, high quality, high raw material efficiency, high acceptance testing passage (99.5% for Scinor, and 95% for other membrane technology);
2. **Only a couple of manufacturers in the world have mastered the TIPS technology**, because:
  - Discovery of a new diluent recipe is difficult;
  - The production line is built to a high spec, and it must use PVDF as its raw material and patented diluent;
  - The above facts result in a technical barrier of the TIPS technology;
3. **Currently, only 3 companies in the world actually own the technology and products:**
  - Asahi Kasei (Japan), Toray (Japan), Scinor use the TIPS method;
  - All other UF manufacturers adopt the non-solvent induced phase separation method (NIPS) or combined thermal induced phase separation (C-TIPS);

Scinor's high-tech products have a multitude of invention patents related to TIPS ultrafiltration membrane;

- Scinor Membrane stems from the national-level Membrane Materials Research Center of the Department of Chemical Engineering at Tsinghua University with a

focus on R&D and industrialization. Scinor Membrane has independently developed a large number of key technologies and attained numerous invention patents (including international ones):

Core production lines are custom-made and imported from Japan. Scinor Membrane is the only company that has TIPS production lines in China;

- Currently, only Japan has the capability to manufacture TIPS spinning production line; the NIPS spinning technology can be found everywhere in China;

Scinor Membrane has been using Solvay PVDF, the world's top brand, since its establishment

- Solvay provides the best PVDF, and the price is twice that of local products

### 3.2.2 TIPS fiber features

**Superior fiber strength and low breakage rate** ensure filtered water quality and long-term stability

- Cross-linked spongy TIPS fibers deliver strength 3 times higher than NIPS with less than 0.25% of annual fiber breakage within warranty period

**High flux** significantly reduces operating cost

- Scinor Membrane's operating flux is 10-30% higher than that of NIPS in water reuse applications, which normally reaches 60 LMH or above

**Strong chemical and fouling resistance** accepts a wider range of water quality and renders little production decay within warranty period

- Scinor Membrane's products are able to withstand 5,000 ppm of sodium hypochlorite and 1-13 pH range; NIPS can endure 2,000 mg/L sodium hypochlorite and 1-12 pH range
- Cross-link structure enhances anti-fouling performance, the fiber can be cleaned thoroughly once clogged

**Table 3.2 TIPS vs. NIPS**

Item		TIPS	NIPS
Manufacturing	Raw Material	Require narrow molecular weight distribution and high purity	Low requirements of molecular weight distribution
	Manufacturer Equipment	Require high accuracy	Mass production, easy manufacturing
	Production Efficiency and Reliability	Continuous production and high stability	Batch production, hard-to-control quality and easy to form large pores
	Ingredients	High requirements of molecular weight distribution, only a couple of manufacturers have proprietary ingredients and technology.	Low requirements of raw material, easy-to-get and simple ingredients
	Process	High pressure and temperature, full-process accurate control	Temperature controlled at a certain range to dissolve raw material
	Cost	Relative high (higher purity)	Low (purity less than 30%)
Operational Conditions	Cross Section	Isotropic structure and narrow pore size distribution	Filtration layer, loss of filtration capacity abrasion
	Supporting Structure	Spongy-like structure	Large finger-shaped structure
	Pure Water Flux	>1200LMH/Bar	200-500LMH/Bar
	NaClO Tolerance	5000 ppm	200-2000 ppm
	CIP pH	1-13	1-11, low tolerance for caustic conditions
Filtrate Quality	SDI <sub>15</sub>	< 3	< 3
	Turbidity (depending on the feed quality)	< 0.1 NTU	< 0.1NTU