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Development of reusable draw solution using a stimulus-responsive slurry

刺激応答性スラリーを用いた再利用可能なドロー溶液の開発

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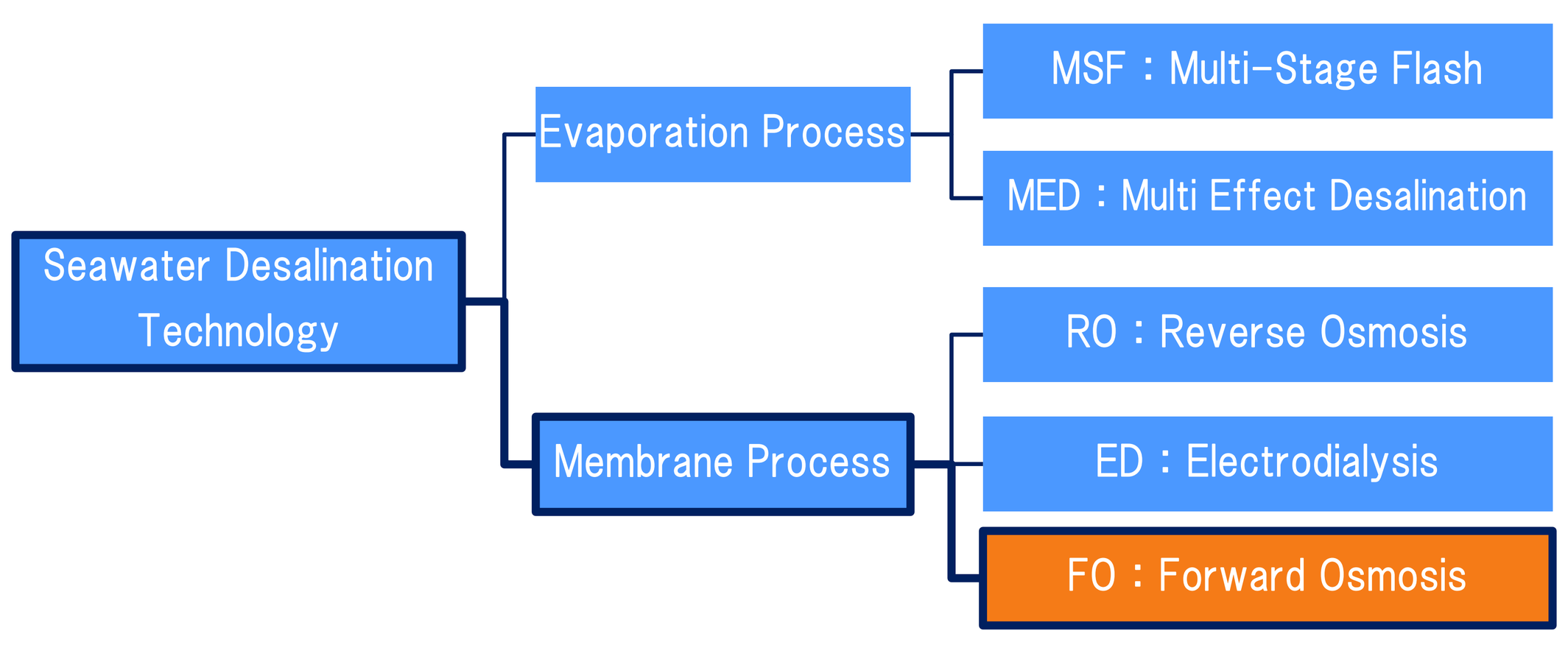
1 . Introduction

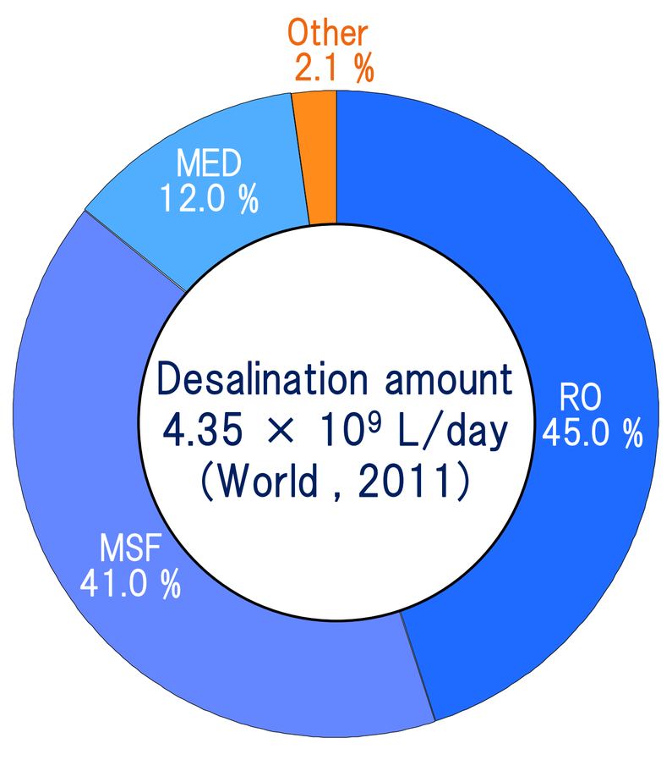
Forward osmosis (FO) attracts considerable attention ,because this technology does not require a large amount of energy. FO is expected to be applied for seawater desalination [1], so various studies [2) 3)] have been reported. However, it hasn't been fully achieved that DS can be reused by a simple method . We tried to develop a easily reuse able DS , that is consisting stimuli-responsive polymer and particles.

Classification of desalination system



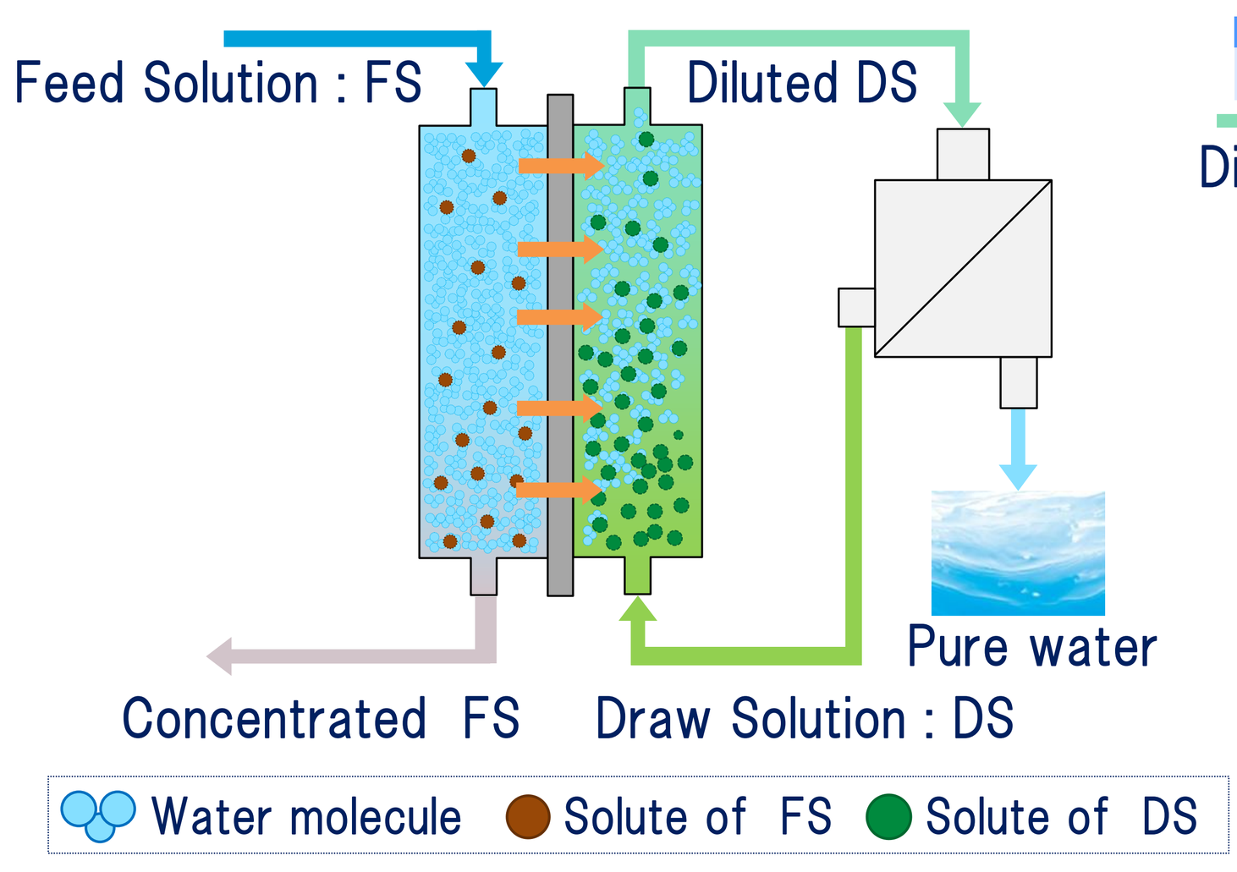
Forward osmosis does not require a large amount of energy.

Seawater desalination facility

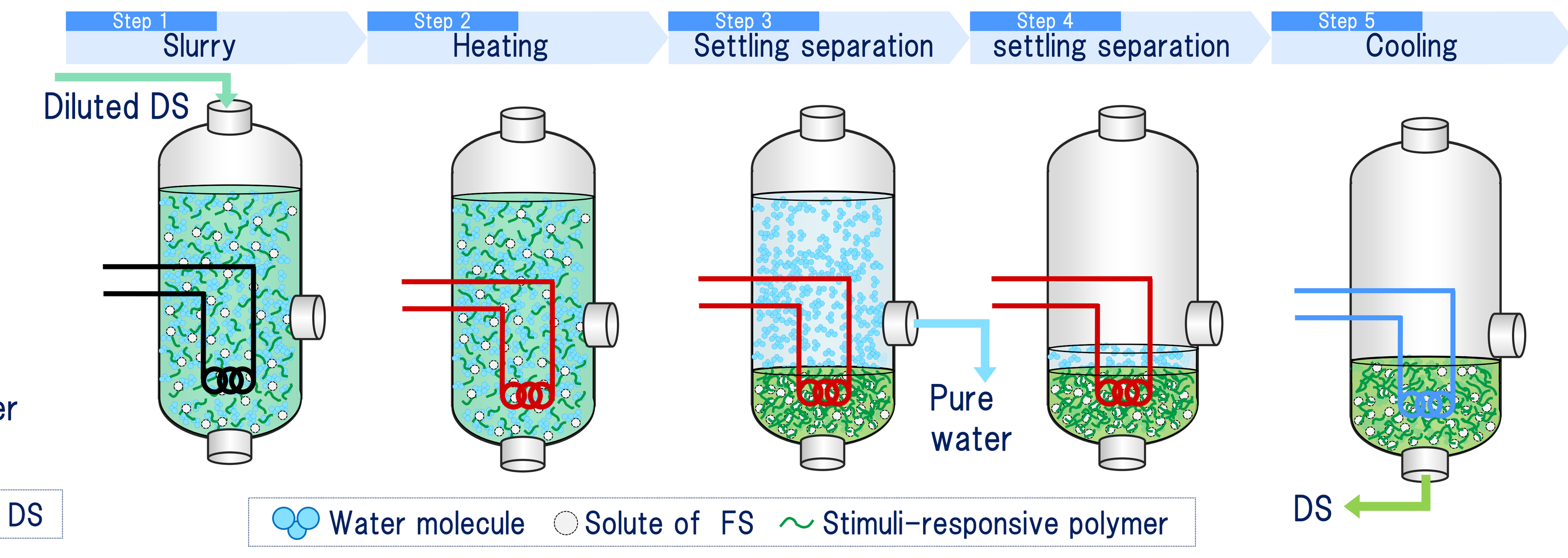


※ Reference : GWI,Desaldata

Schematic of the FO process



Our FO process : DS composed of molecules stimulus-responsive polymer and particles



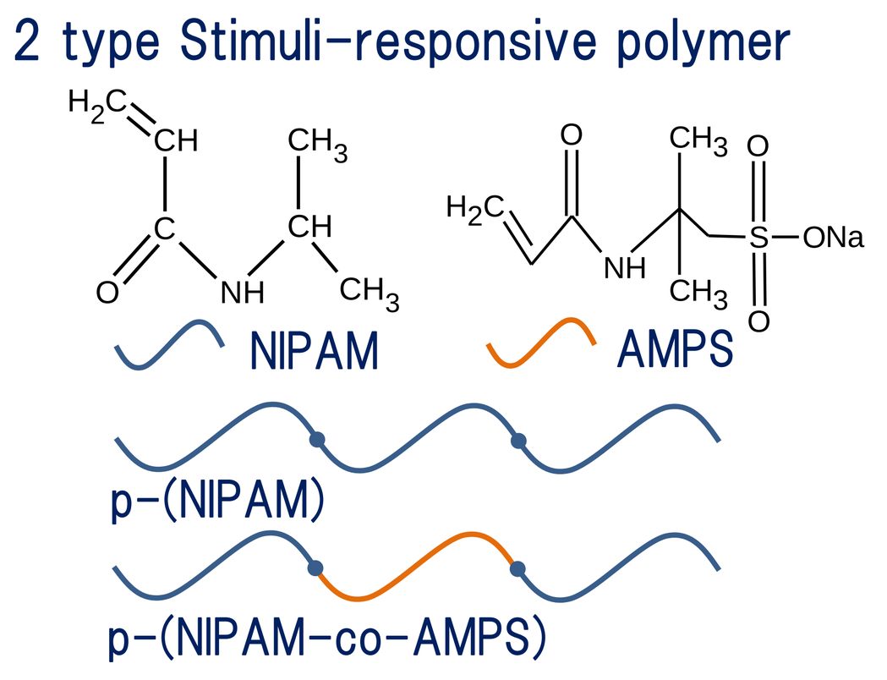
In this study, we examine that "it is possible to repeatedly use the stimuli-responsive slurry" , and "Effects of the mole fraction of AMPS monomer that dissociate the ion on the ability of the water and re-use"

2 . Experiment

We tried two experiments "Stimuli-responsive polymer synthesis" and "Water absorption experiment" . In "Stimuli-responsive polymer synthesis" , It was synthesized p-NIPAM (consisting NIPAM only) and p-(NIPAM-co-AMPS)(consisting NIPAM and AMPS). In "Water absorption experiment" , Water absorption by using the water supply equipment of a batch and 3 times reused .

2.1 Stimuli-responsive polymer synthesis

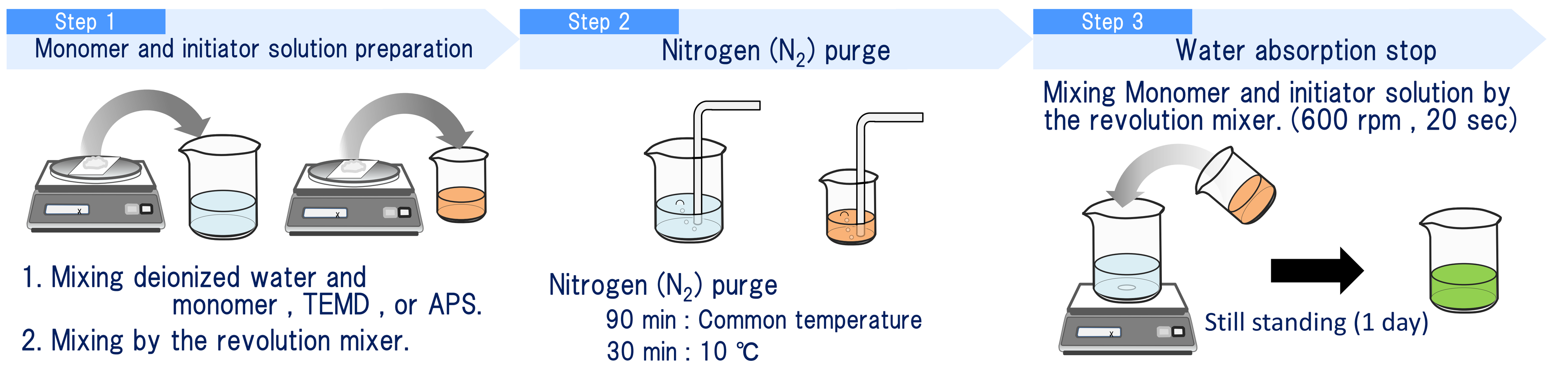
2 type Stimuli-responsive polymer



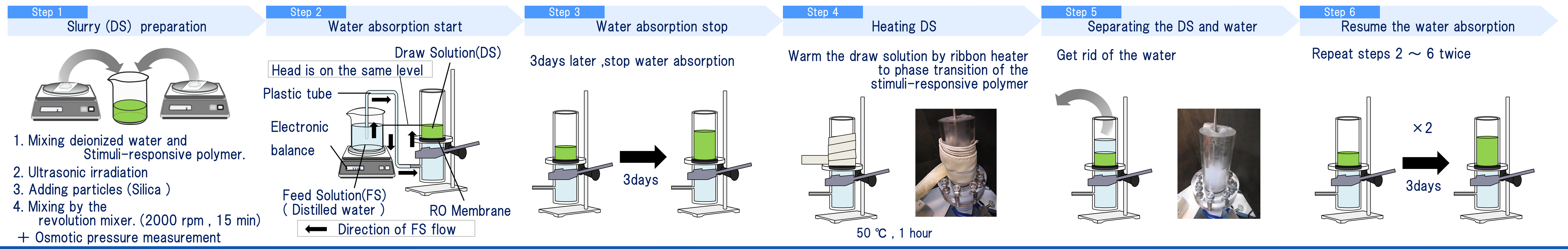
To generate high osmotic pressure

Table Material and ration of mole

Material	Ration of mole (-) A	B	C
N-isopropilacrylamide (NIPA)	1000	1000	1000
2-Acrylamido-2-methylpropanesulfonic Acid (AMPS)	0	15	30
N,N,N',N'-tetramethylethylenediamine (TEMED)	20	20	20
Ammonium peroxodisulfate (APS)	15	15	15



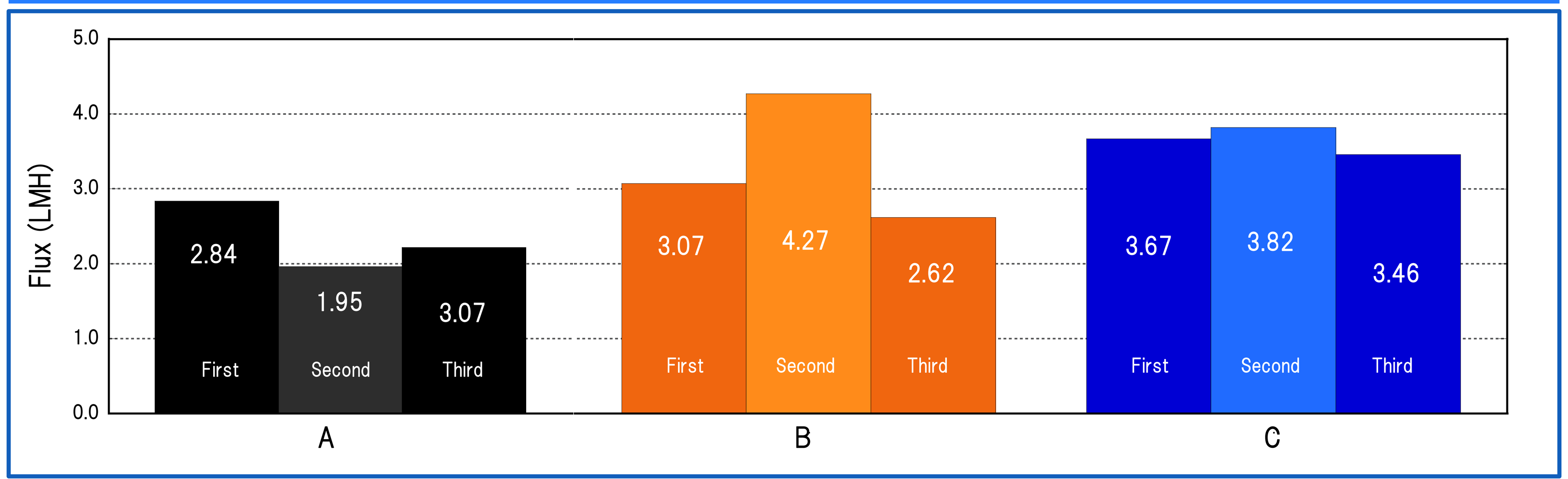
2.2 Water absorption experiment



3 . Results and discussion ①

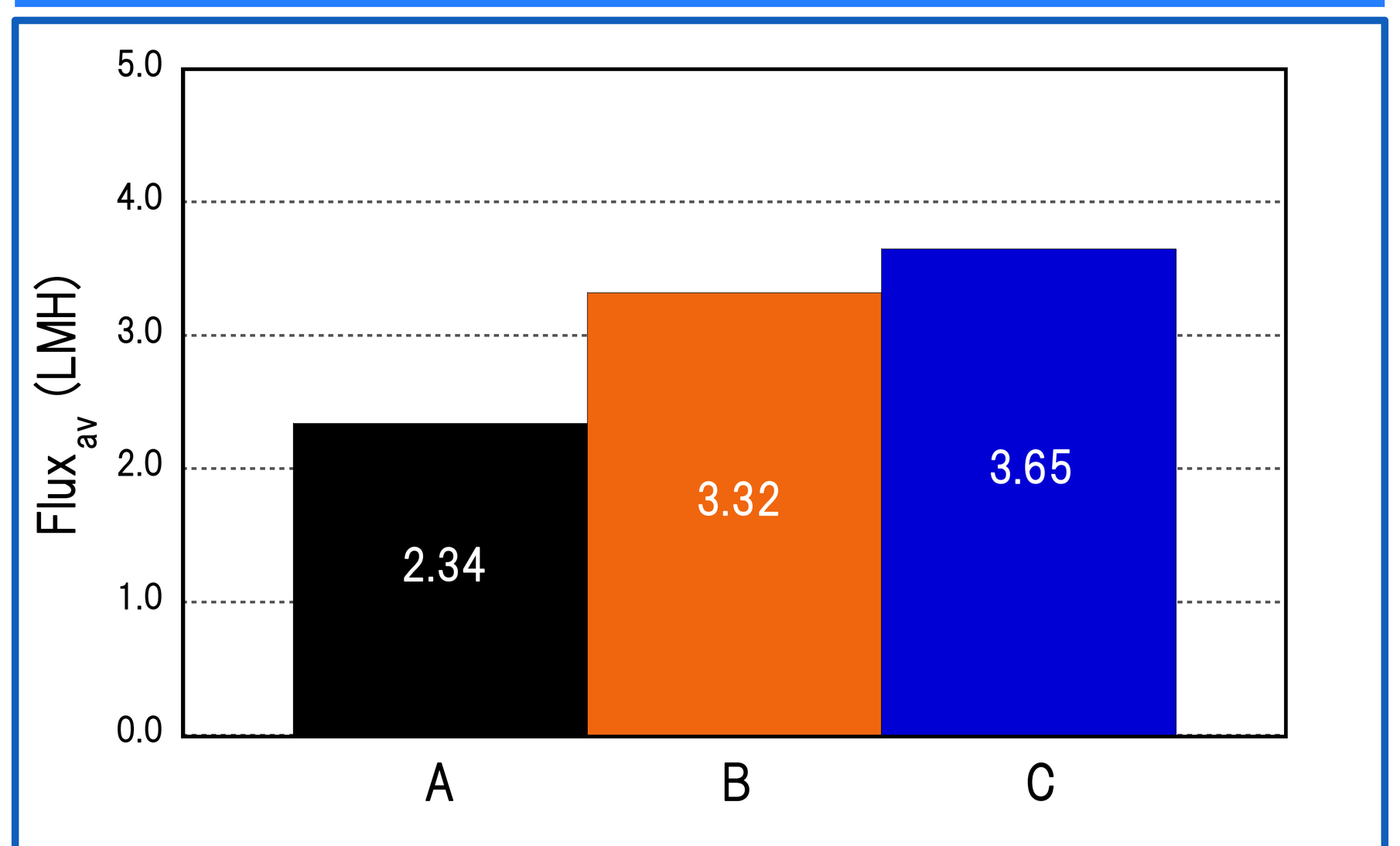
We confirmed the water could be adsorbed and separated at 3 times.
It was possible to increase the osmotic pressure and water absorption flux by amount of AMPS.

Flux of 3 type stimuli-responsive slurry

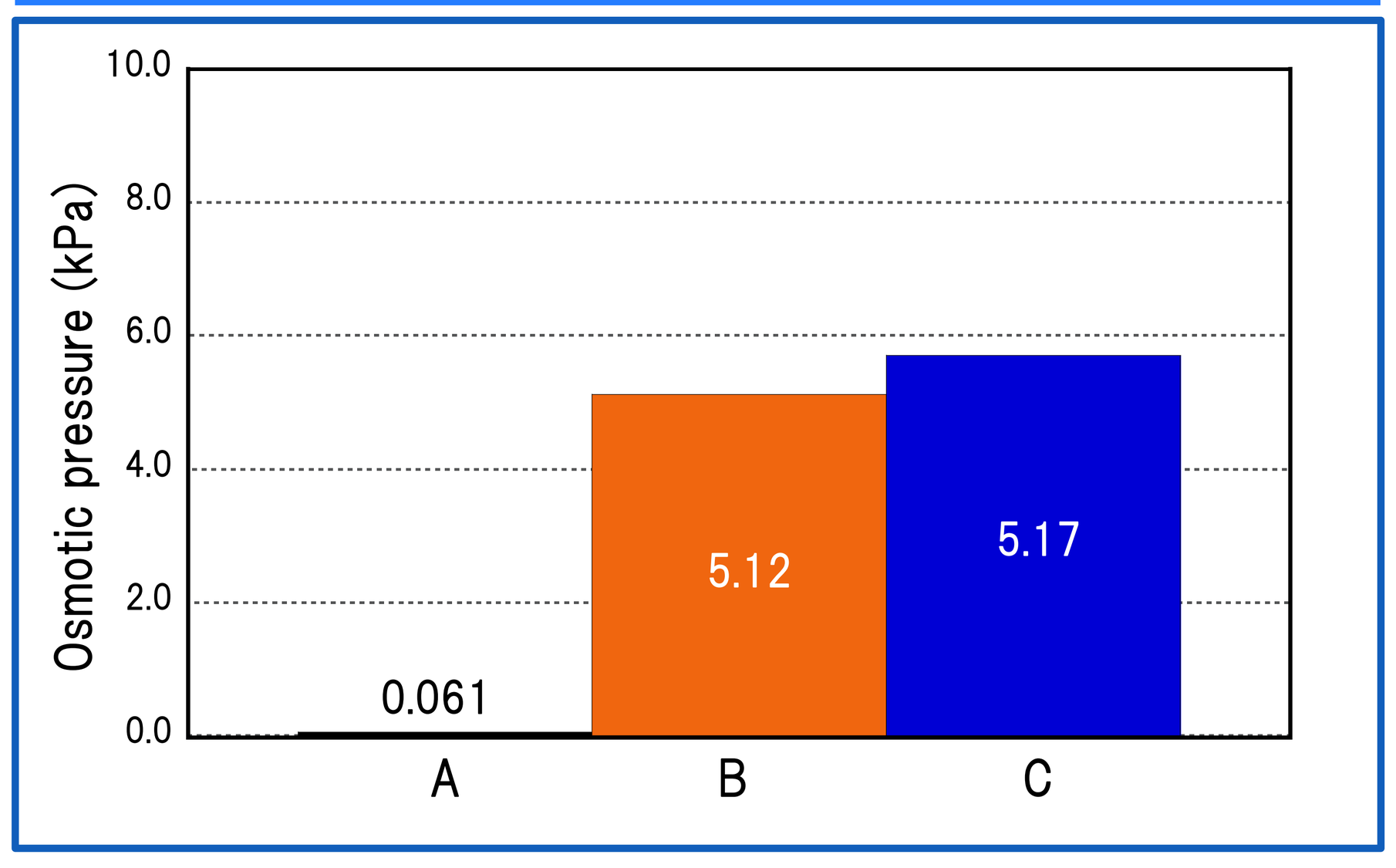


・It is possible to adsorb water repeatedly and separate it by changing temperature.

Flux average of 3 type stimuli-responsive slurry



Osmotic pressure of stimuli-responsive slurry

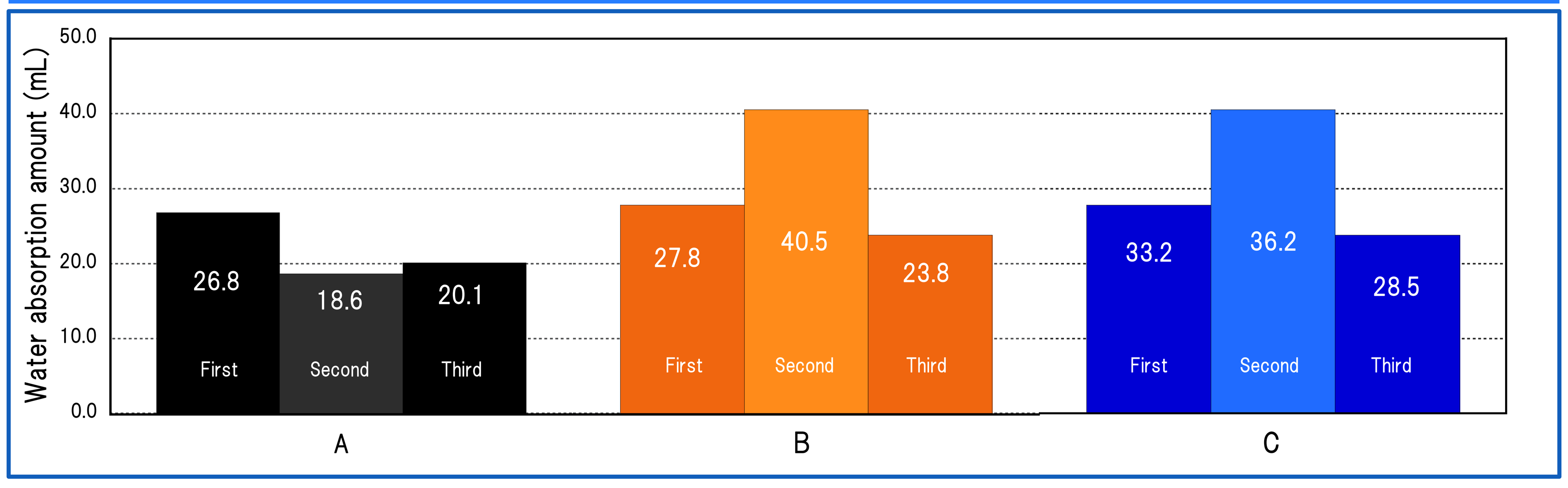


・It was possible to increase the osmotic pressure and water absorption rate by amount of AMPS.

4 . Results and discussion ②

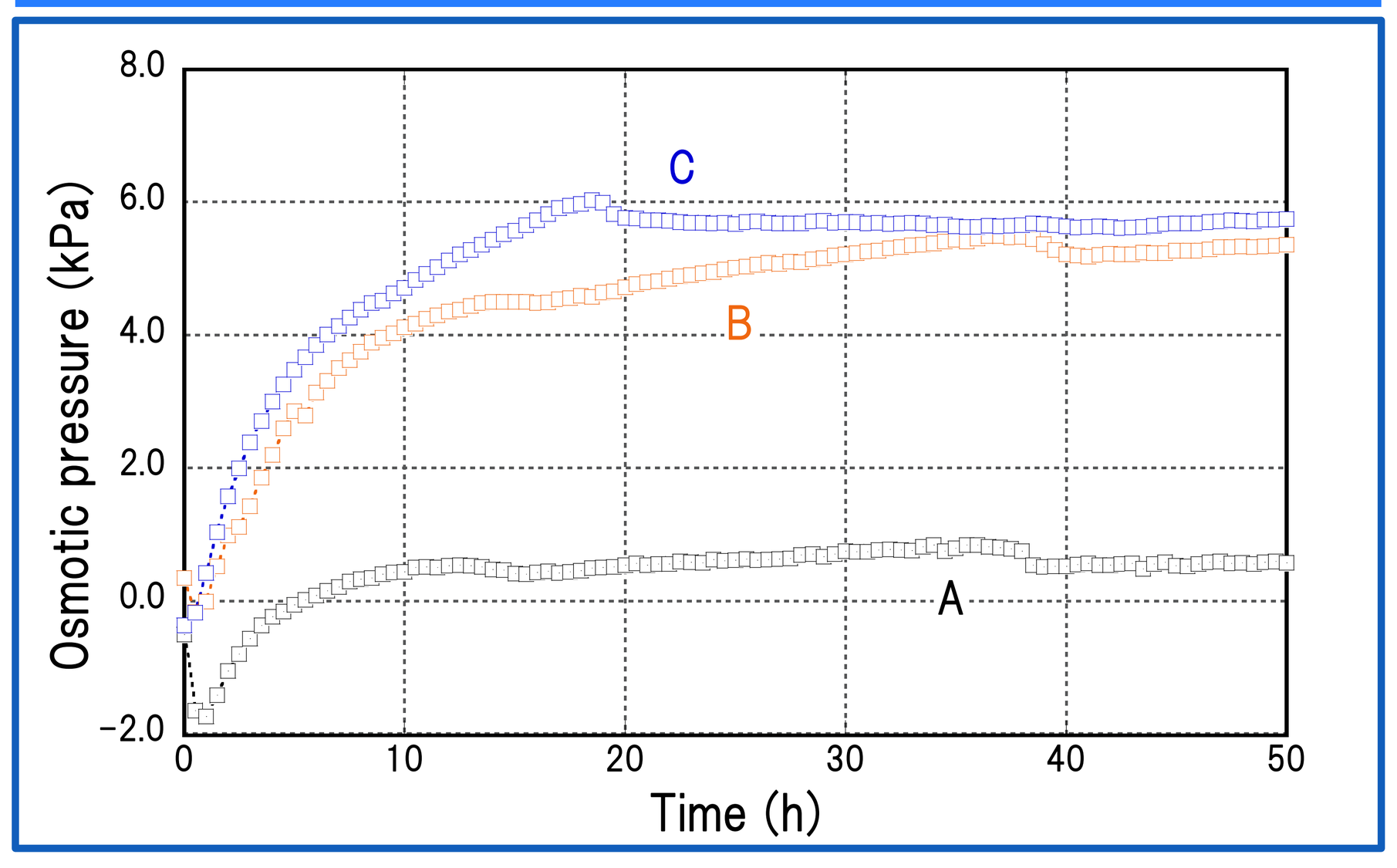
Noteworthy was that LCST of the copolymer is higher than that of p-NIPAM , and it constitute barriers to reduction of energy costs.

Water absorption amount on 3 time Water absorption experiment

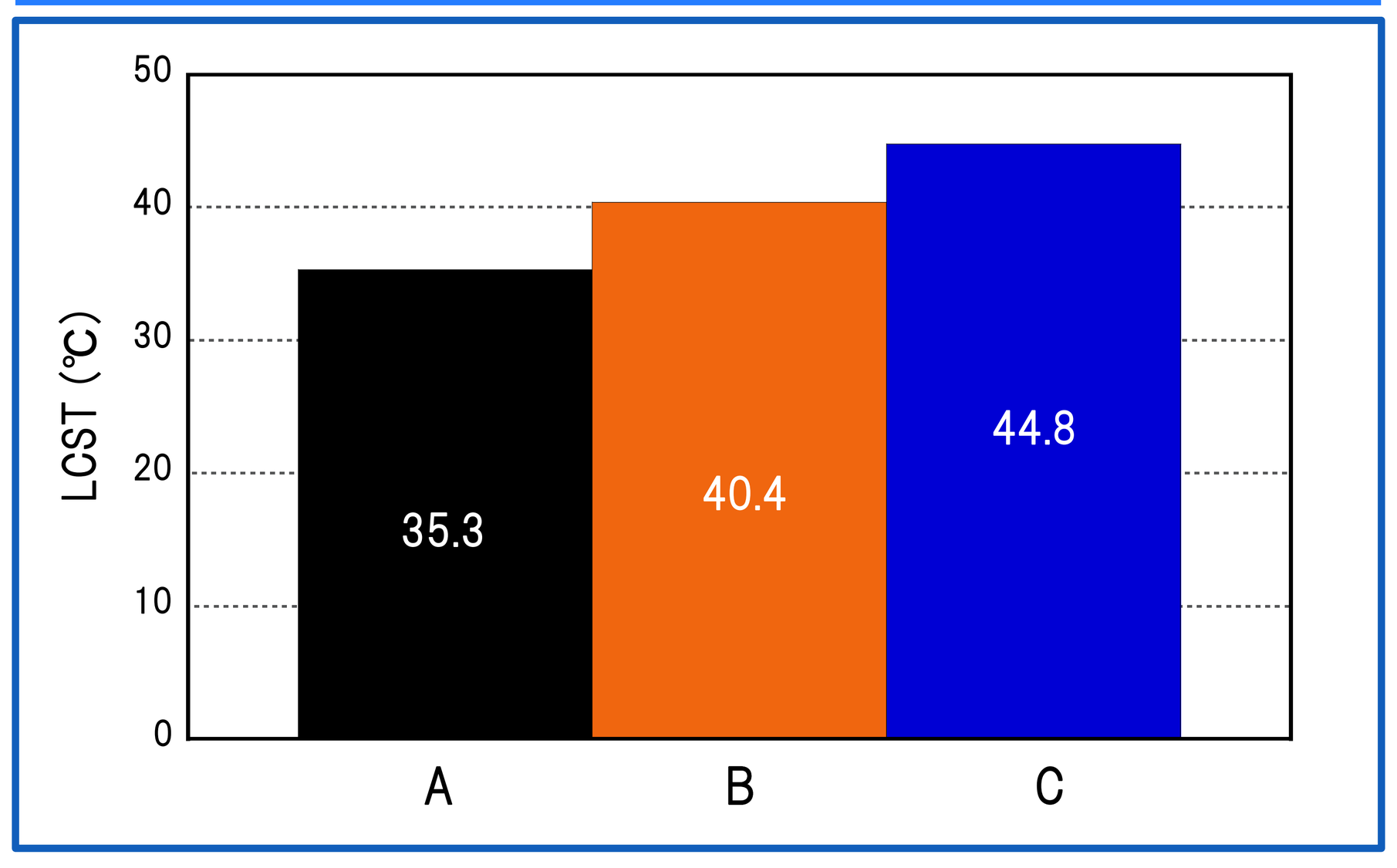


・It is possible to adsorb water repeatedly and separate it by changing temperature .

Aging of the osmotic pressure



LCST of 3 type stimuli-responsive slurry



・Osmotic pressure and the LCST of the copolymer is higher than that of p-NIPAM.

5 . Conclusion

- It is possible adsorb water repeatedly and separate it by using the stimulus response slurry and changing temperature , that is consisting stimuli-responsive polymer and particles .
- It was possible to increase the osmotic pressure and water absorption rate by using copolymer of AMPS and NIPAM.

References

1) S. Zhao and L. Zou, J. Membr. Sci., 396 (2012) 1- 21. , 2) R. Ou et al. , Desalination ., 318 (2013) 48-55 , 3) M.L. Stone et al. / Desalination 312 (2013) 124-129

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