

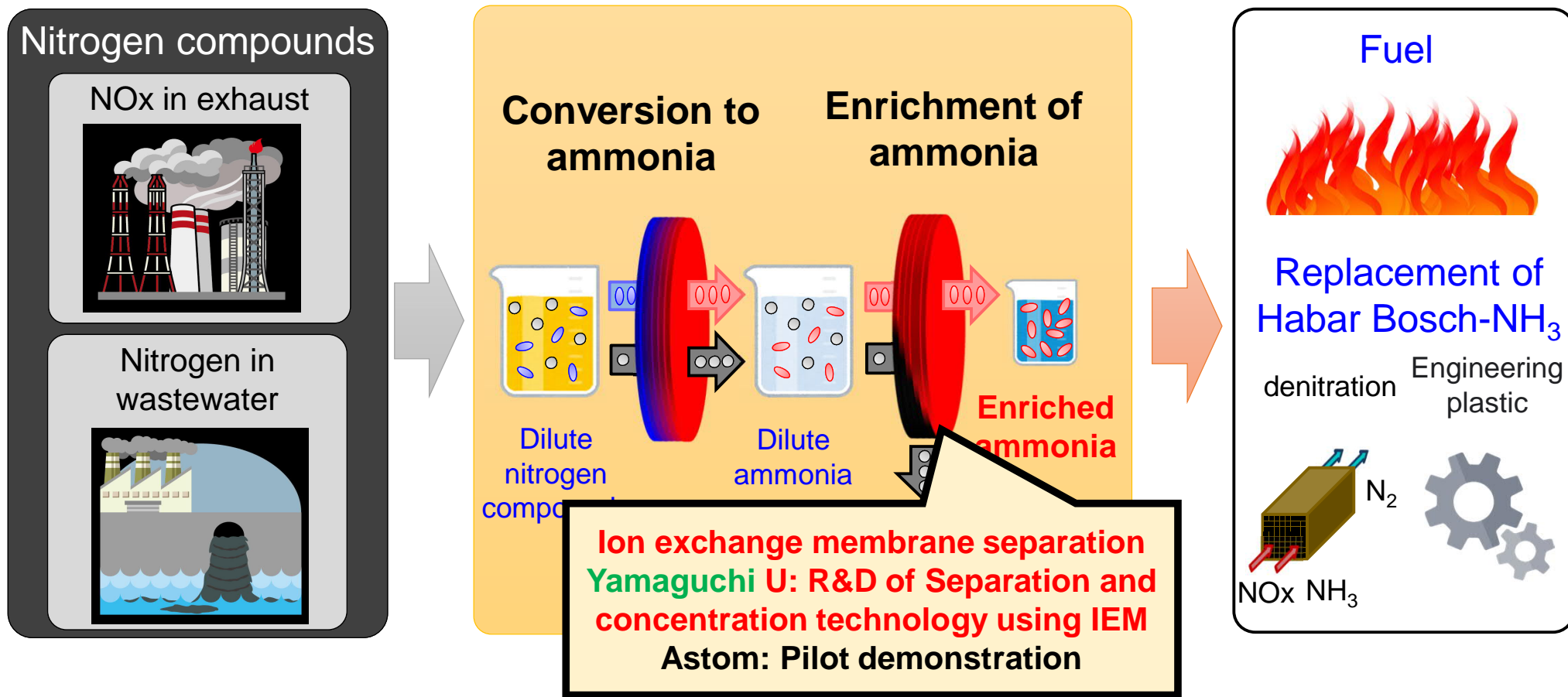
# Innovative Circular Technologies for Harmful Nitrogen Compounds/ To Solve Planetary Boundary Issues

Theme 2. Recycling nitrogen compounds in wastewater to ammonia resource  
Theme 2-2. R&D on ammonia recycling by separation and concentration  
R&D of  $\text{NH}_4^+$  concentration processes by ion exchange membrane method

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Implementing organizations : National Institute of Advanced Industrial Science and Technology (AIST),  
The University of Tokyo, Waseda University,  
Tokyo University of Agriculture and Technology, Kobe University,  
Osaka University, Yamaguchi University, Kyowa, Hakko Bio Co., Ltd.,  
ASTOM Corporation, Toyobo Co., Ltd., FUSO Corporation, Ube Industries, Ltd,



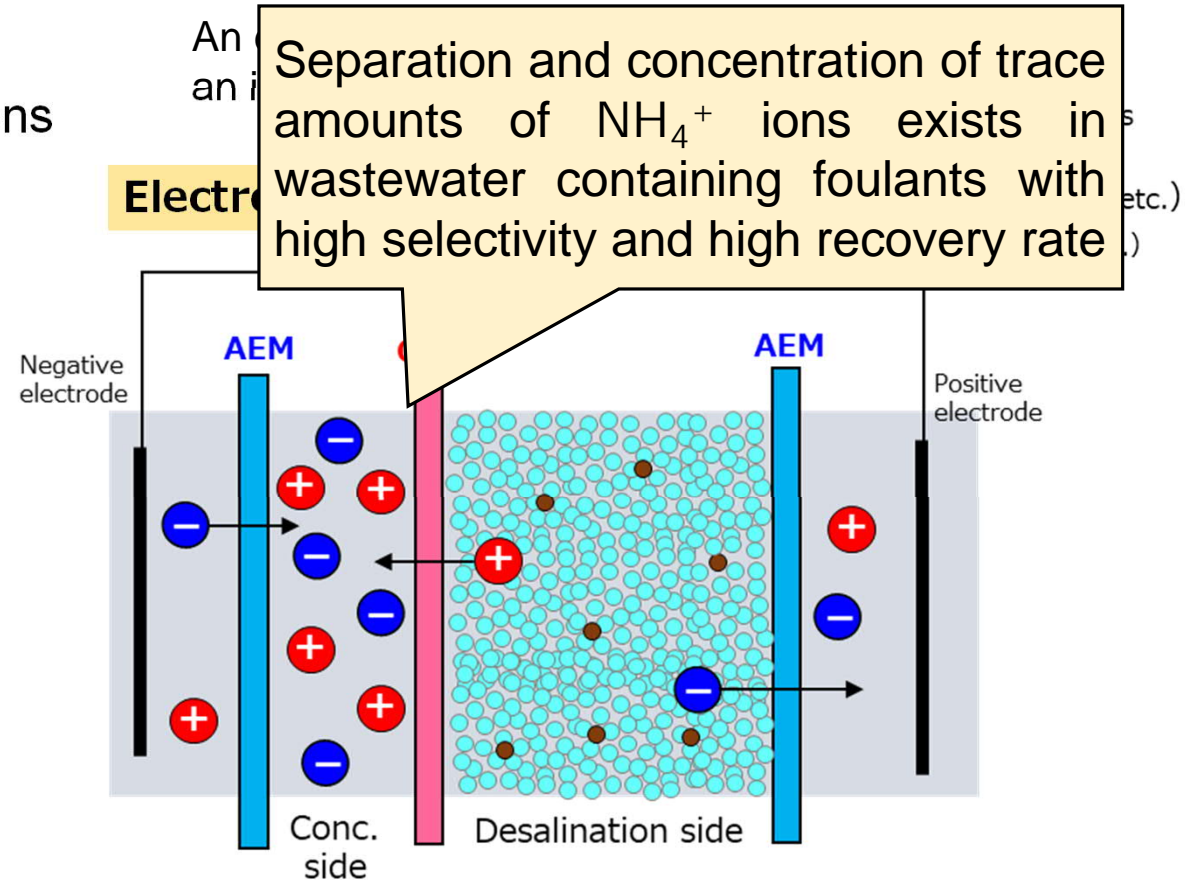
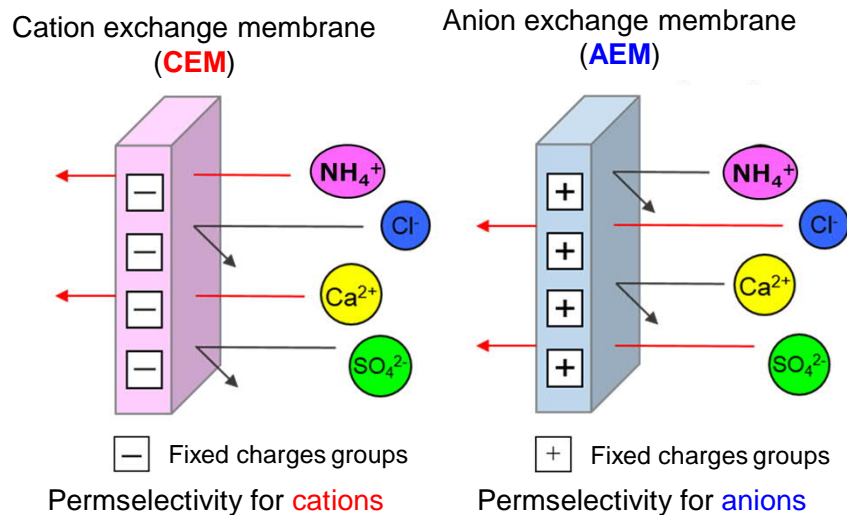
Target of Theme 2 for FY2029 : demonstration with a pilot plant with and enrichment on a scale of 5~15 m<sup>3</sup>/d.

Position of YU:R&D of NH<sub>4</sub><sup>+</sup> concentration processes by ion exchange membrane (IEM) method

Target of YU for FY2029: :R&D of membrane material, module design and system optimization program for NH<sub>4</sub><sup>+</sup> concentration process by IEM method

R&D of separation processes using ion exchange membranes for the enrichment of the ammonium for the recovery as a resource

**Ion exchange membrane:**  
Selectively permeates only specific ions



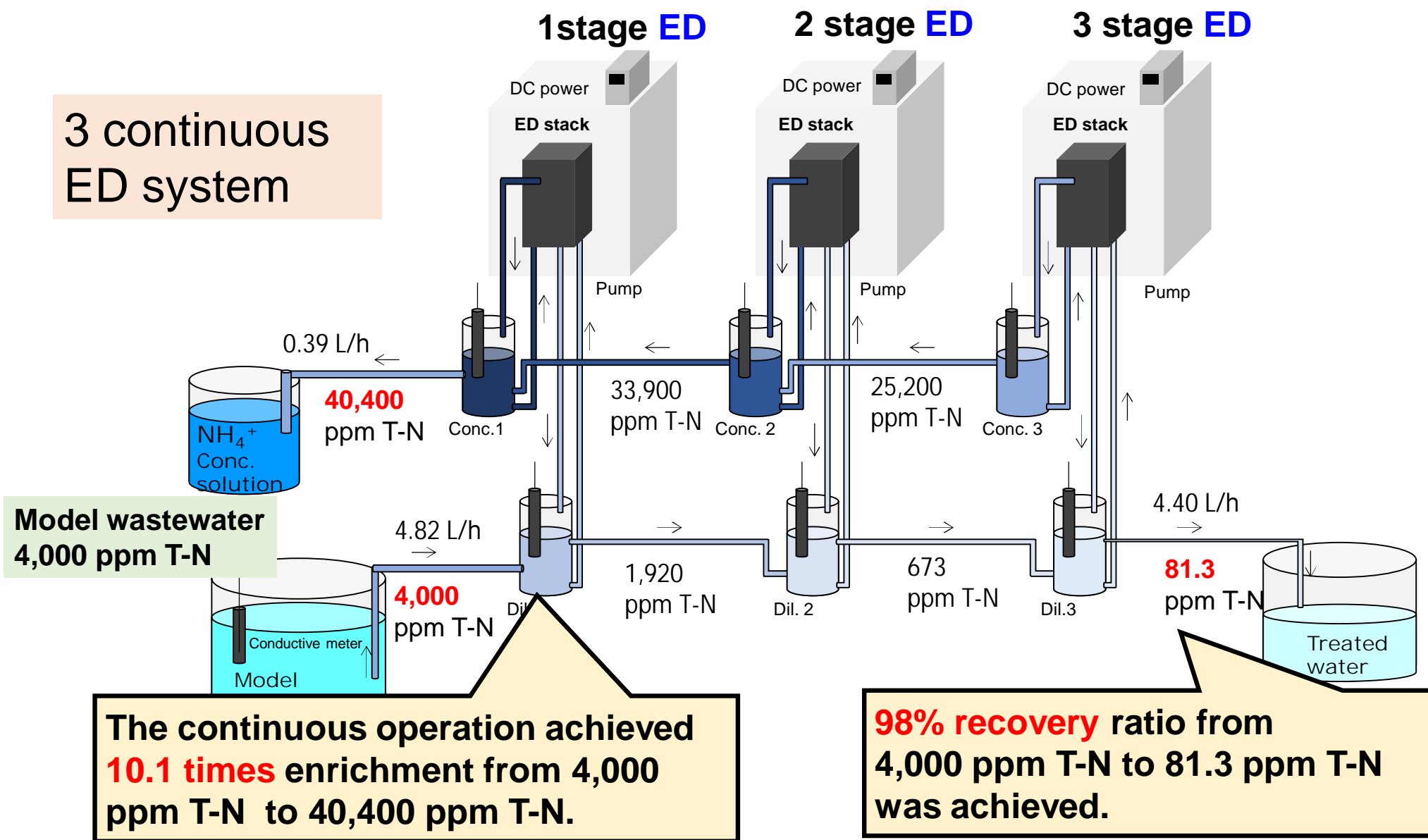
Selective separation of ions by electric force

## R&D Items

- R&D of a system that can continuously recover and concentrate  $\text{NH}_4^+$  ions in water using an ion exchange membrane
- Selective concentration of monovalent ions from a mixture of monovalent and divalent ions

- A continuously selective concentration system of  $\text{NH}_4^+$  from model wastewater was developed.
- Achieved 10.1 times concentration ratio and 98% of recovery ratio.

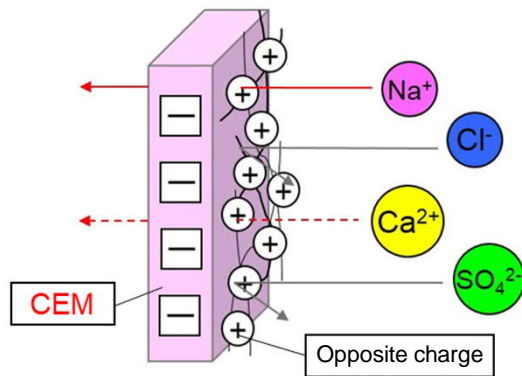
## 3 continuous ED system



- Monovalent ion selective membrane achieved 1/10 of Ca ion permeability.

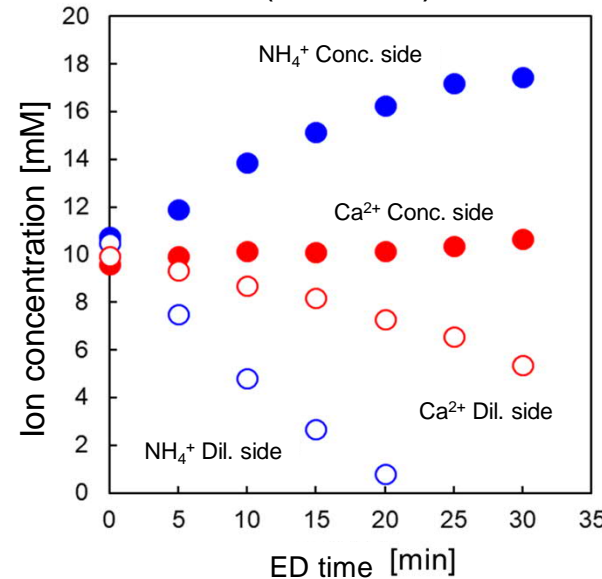
Not only monovalent ions but also divalent ions such as  $\text{Ca}^{2+}$  are exist in wastewater  
 → The divalent ions must be removed for stable operation because of formation of scale.

Monovalent ion selective IEM (MS-IEM)

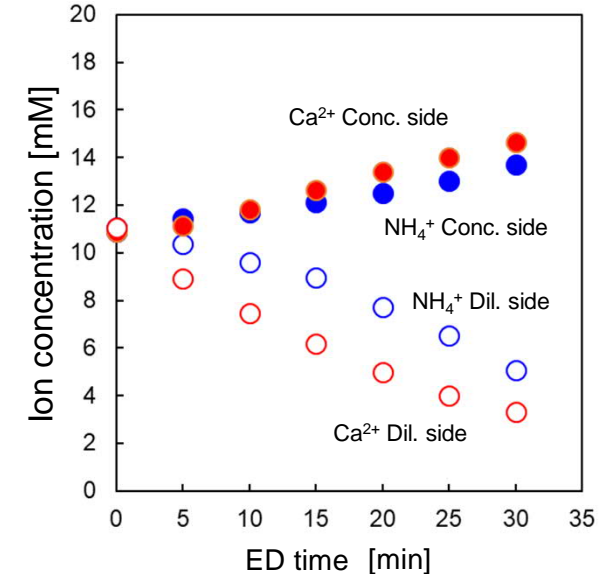


Exp. condition		
	Conc. side	Dil. side
Initial solution	0.01 M $\text{NH}_4\text{Cl}$ 0.01M $\text{CaCl}_2$	0.01 M $\text{NH}_4\text{Cl}$ 0.01M $\text{CaCl}_2$
Volume	500 ml l	500 [mL]
Current	止電流: 0.05 A	
Std-IEM	CSE/ASE	Astom Corp.
MS-IEM	CIMS/ACS8T	Astom Corp.

Monovalent ion selective IEM (MS-IEM)



Standard IEM (Std-IEM)



Exp. data

IEM	Flux ratio	Reduction rate (%)
MS-IEM ( $J_{\text{Ca}}/J_{\text{NH}_4}$ )	0.18	90
Std-IEM ( $J_{\text{Ca}}/J_{\text{NH}_4}$ )	1.83	

The reduction rate in flux of MS-CEM and Std-CEM was 1/10

## Position in the project

R&D of  $\text{NH}_4^+$  concentration processes by ion exchange membrane (IEM) method.

## Target for FY2029

R&D of membrane material, module design and system optimization program for  $\text{NH}_4^+$  concentration process by IEM method.

## R&D items

- R&D of a system that can continuously recover and concentrate  $\text{NH}_4^+$  ions in water using an ion exchange membrane.
- Selective concentration of monovalent ions from a mixture of monovalent and divalent ions.

## Achievement

- A continuously selective concentration system of  $\text{NH}_4^+$  from model wastewater was developed.
- Achieved 10.1 times concentration ratio and 98% of recovery ratio.
- Monovalent ion selective membrane achieved 1/10 of  $\text{Ca}^{2+}$  ion permeability.

