

Development of new additive for positive active material and application to enhanced flooded batteries for micro-HEVs

2022 European Lead Battery Conference
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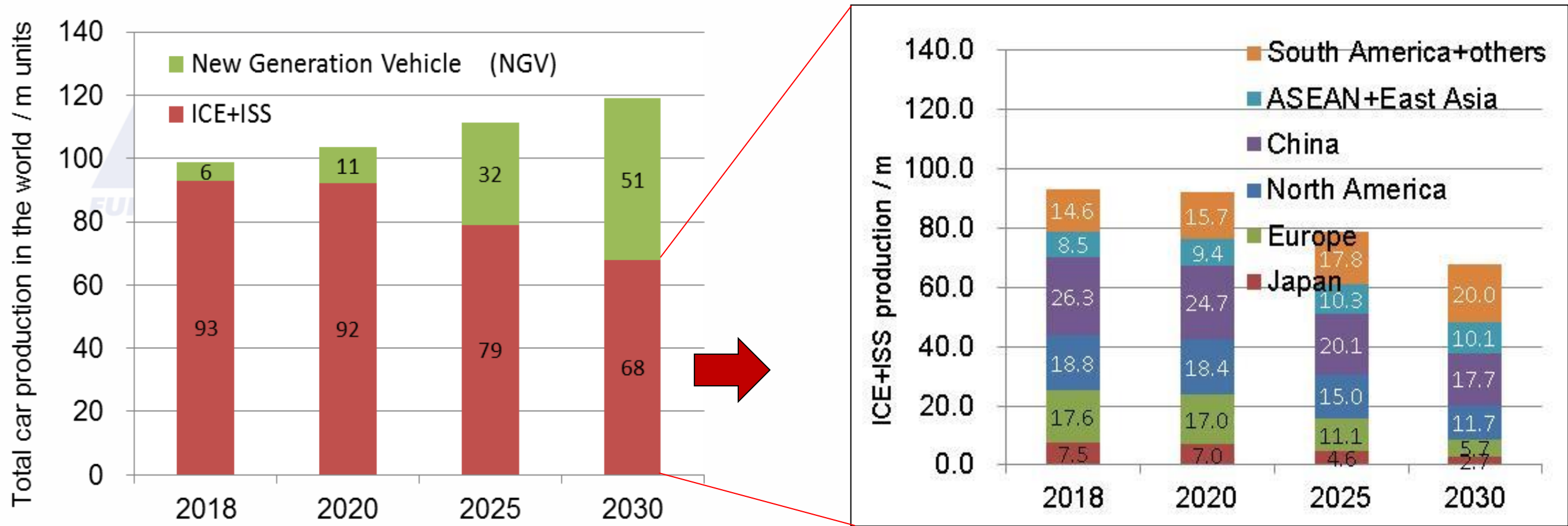
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The Furukawa Battery Co., Ltd. Japan



Presentation Outline

1. Introduction
2. Progress of the Enhanced flooded battery for ISS & Micro-HEV Applications
3. Optimized PAM density and new additive in PAM
4. Cycle life test and PSOC test results of Improved EFB
5. Conclusions

Prospects for vehicle electrification by region



New Generation Vehicle (NGV) : Includes brake regeneration micro-HEV(12V/48V), HEV (mild, strong), HEV(Trucks, Buses), PHEV, EV, EV(trucks and Buses), FCV

※ Fuji Keizai Co., Ltd., *Future prospects for energy and large rechargeable batteries and materials*, (Japan 2019)

China, North America, Europe, Japan will shift to NGV.
 In contrast, demand for ISS is expected to grow in South America and ASEAN countries.

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Progress of The Furukawa Battery Enhanced flooded battery for ISS & Micro-HEV Applications



★ April 2015
Honda STEP WGN



N-55 UltraBattery (45Ah)

★ May 2022
Honda STEP WGN



N-65 EFB (50Ah)

★ 2011
Honda Jazz(Fit)



N-55 EFB (45Ah)

★ April 2015
Honda S-660



M-42 EFB (40Ah)

★ February 2020
Honda Fit



N-65 EFB (50Ah)

2010

2015

2020

2022

Improvement points for ISS & Micro-HEV Applications

Negative Electrode

- ✓ Optimized Carbon additives in NAM
 - ⇒ Increase of charge acceptability
 - ⇒ Improvement of PSOC durability

Electrolyte

- ✓ Specific gravity PbSO₄ modifying additive
 - ⇒ Increase of charge acceptability

UltraBattery

- ✓ Capacitor technology
 - ⇒ High charge acceptability
 - ⇒ Long cycle life

Positive Electrode

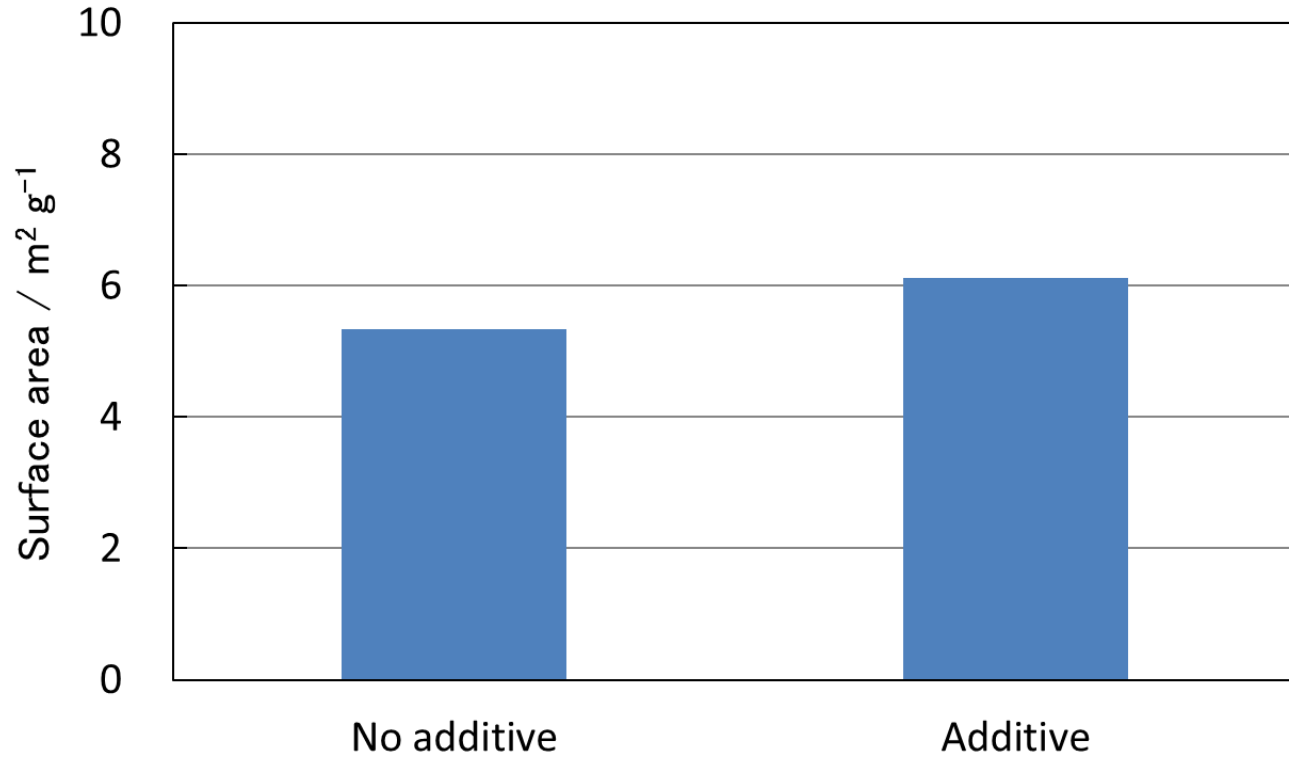
- ✓ Optimized PAM density and additive in PAM
 - ⇒ Increase of Battery Capacity
 - ⇒ Improvement of PSOC durability

Improved Positive Electrode to increase both battery capacity and durability

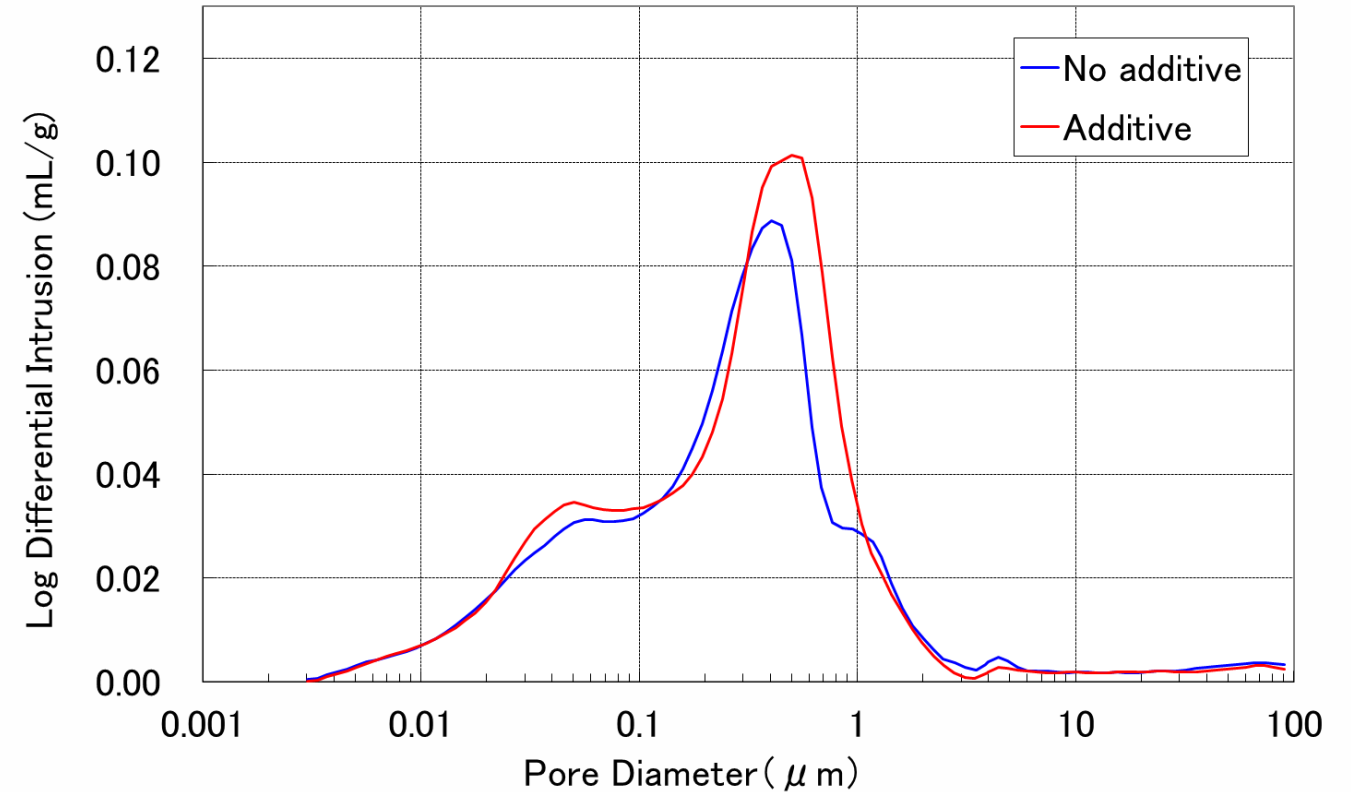
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Effect of Optimized new additive in PAM



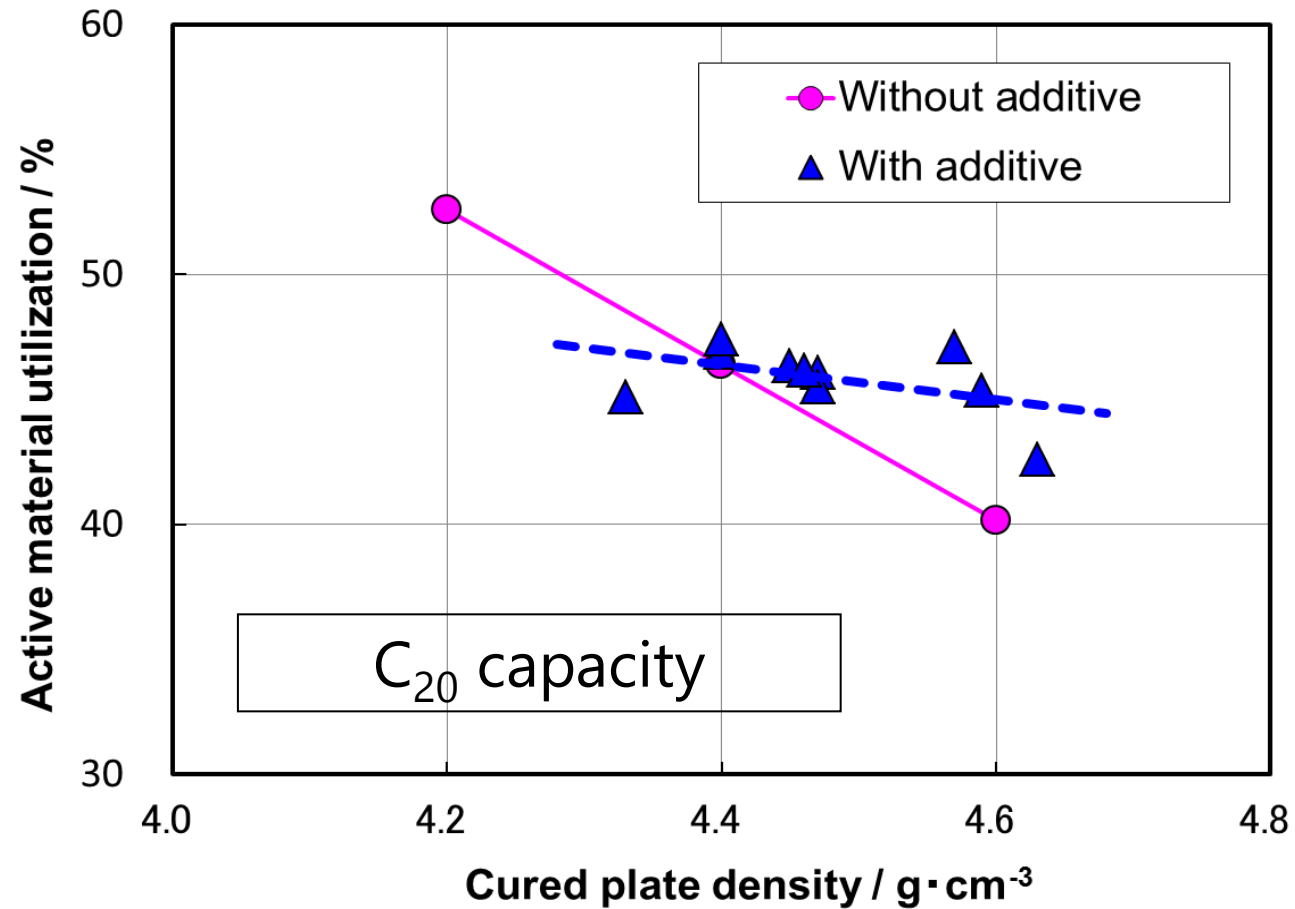
Relationship between the SSA of No additive PAM and additive PAM



Pore diameter distribution of No additive PAM and additive PAM

- Improvement of specific surface area was confirmed by adding additives
- The measurement results showed that the pore distribution did not change significantly with or without the additive, but the pore volume increased.

Effect of Optimized PAM density



- ✓ New additive in PAM
⇒ Effective in improving PAM utilization and effective in increasing battery capacity.
- ✓ PAM density
⇒ Durability improved by increasing PAM density compared to conventional

Relationship between the utilization of the formed PAM and the cured PAM density

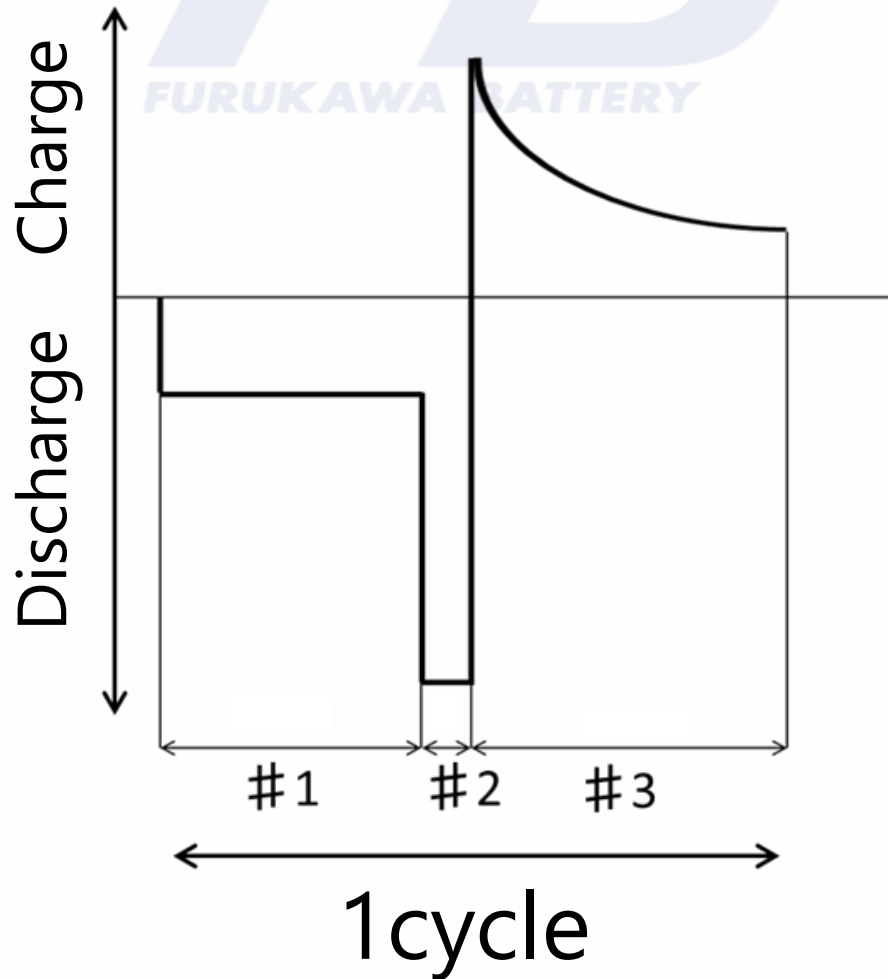
⇒ Based on the results obtained from the PAM study, JIS N-size(N-65) batteries were produced and life tests were evaluated.

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Result of SBA(S 0101:2014) Idling stop start cycle life test

Battery Association of Japan standard SBA S0101:2014

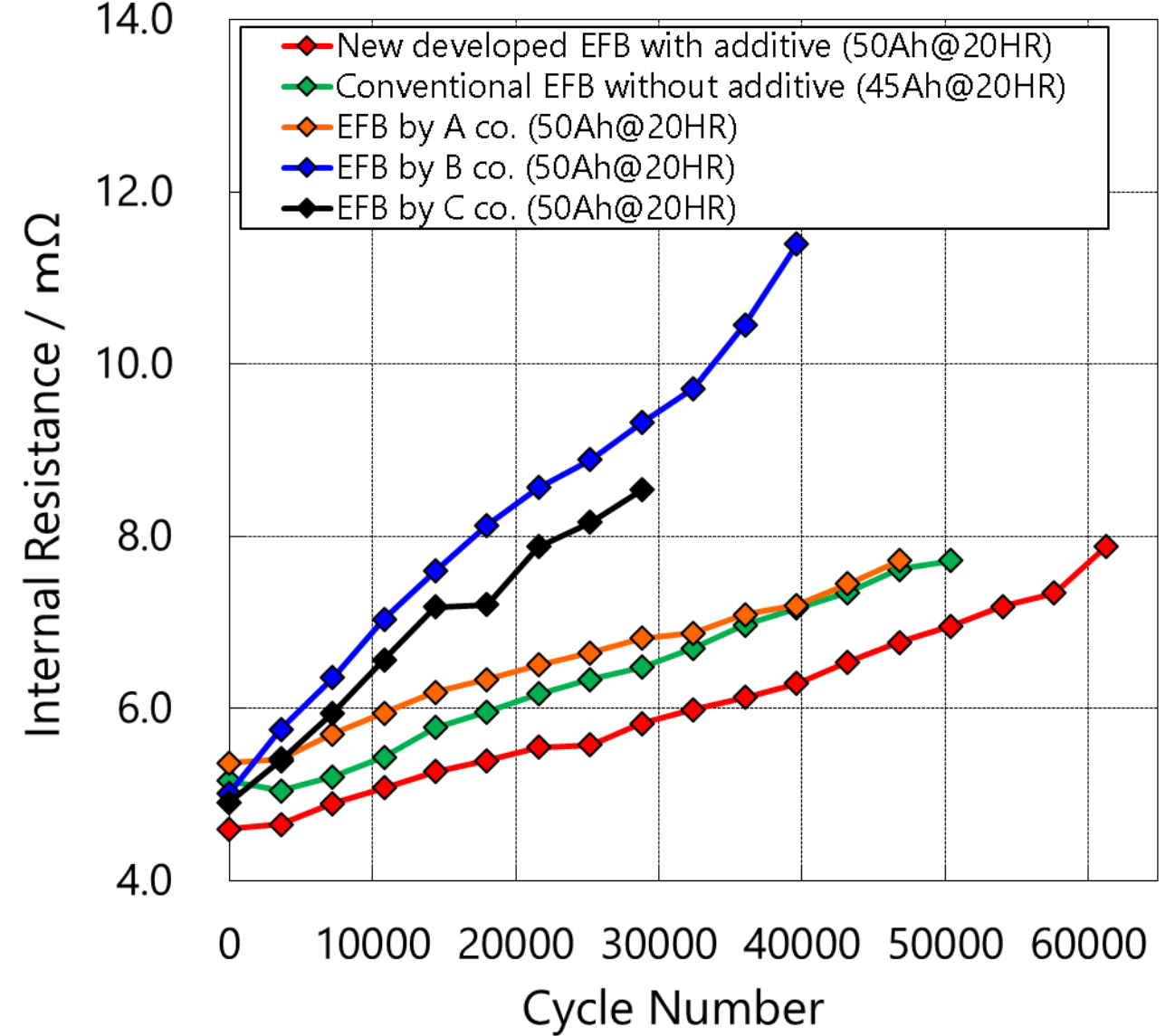
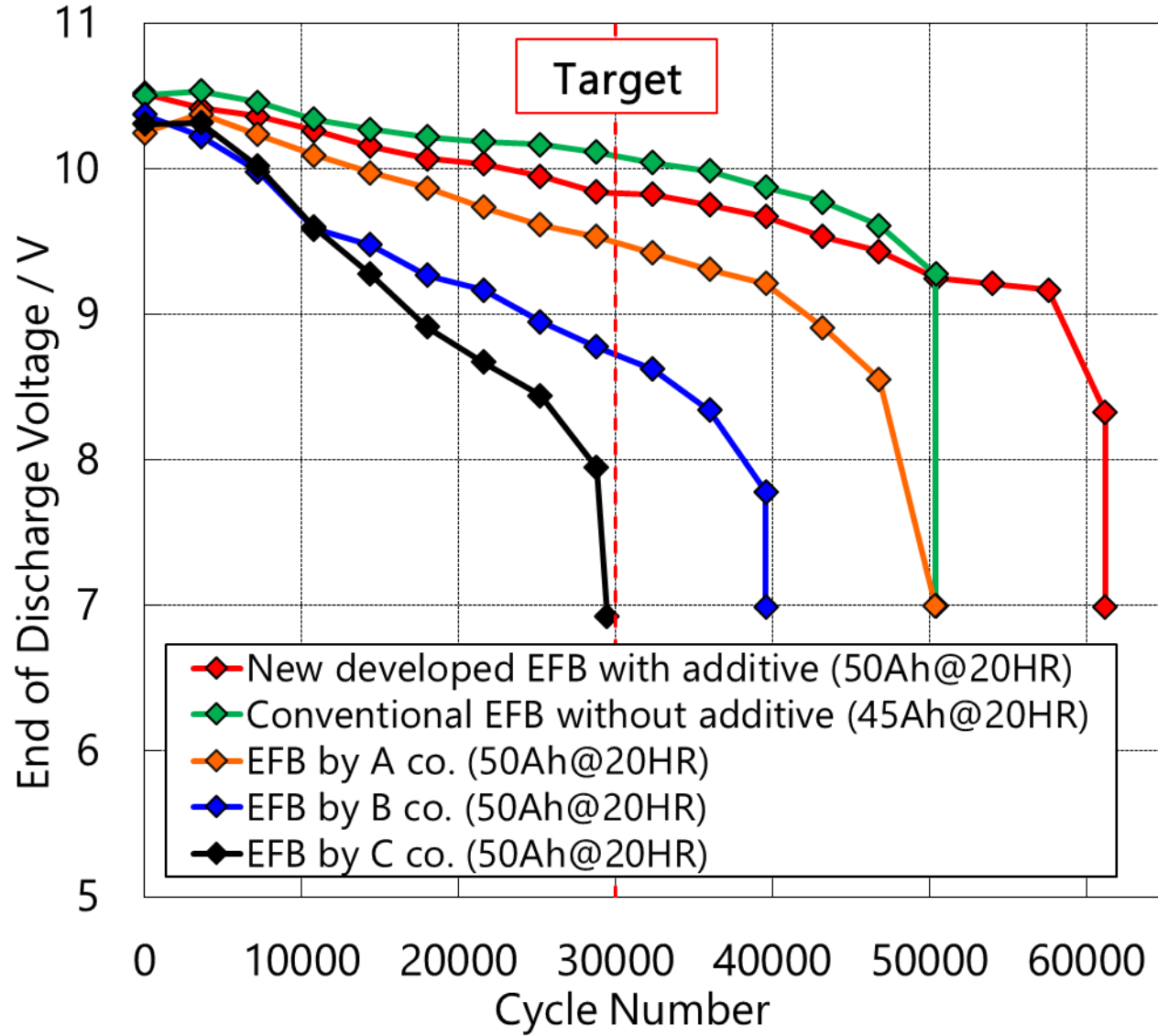


Mode	Time (sec)	Current(A)	Voltage(V)
#1 Discharge	59	$18.3 \times I_{20}$	-
#2 Discharge	1	300	-
#3 Charge	60	100	14.0

Temperature : 25°C


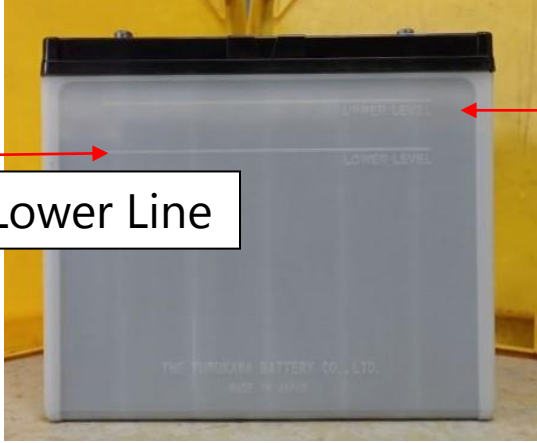
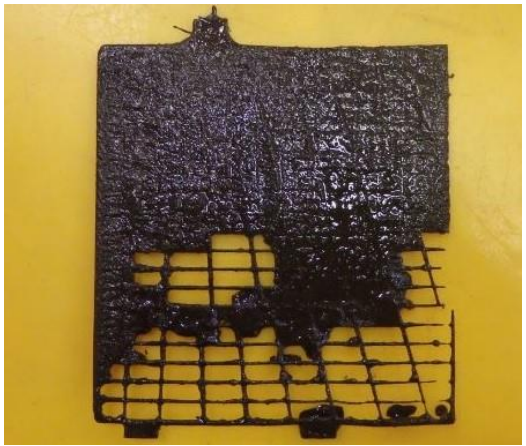

Test batteries : JIS N size

Result of SBA(S 0101:2014) Idling stop start cycle life test



Durability of new developed EFB has excellent performance

Teardown result of SBA(S 0101:2014) Idling stop start cycle life test

	Conventional EFB N-55 (45Ah)	New developed EFB N-65 (50Ah)
SOH after test (%)	15	21
Battery Appearance		
Positive electrode		

Electrolyte level

Lower Line

○Water consumption

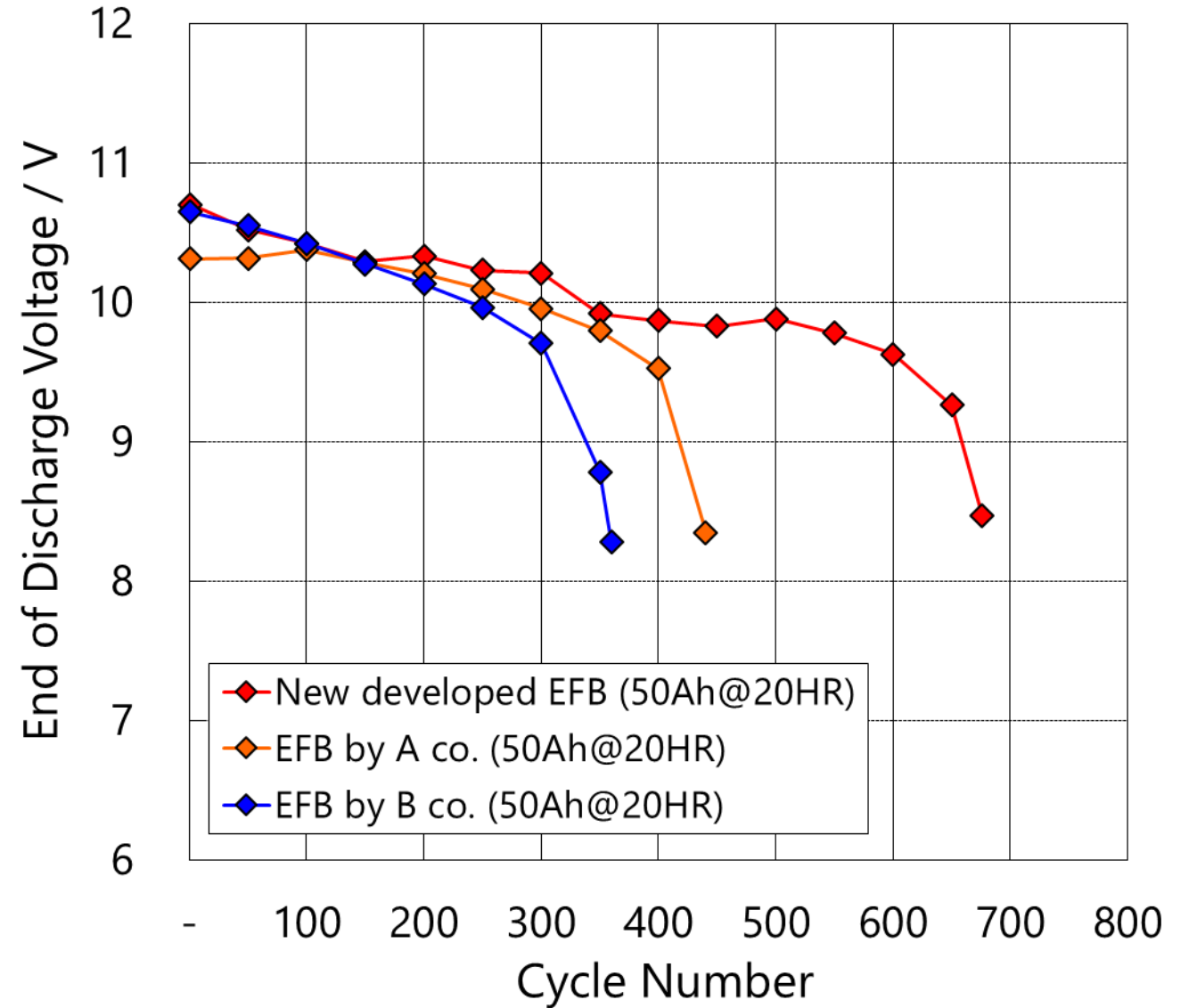
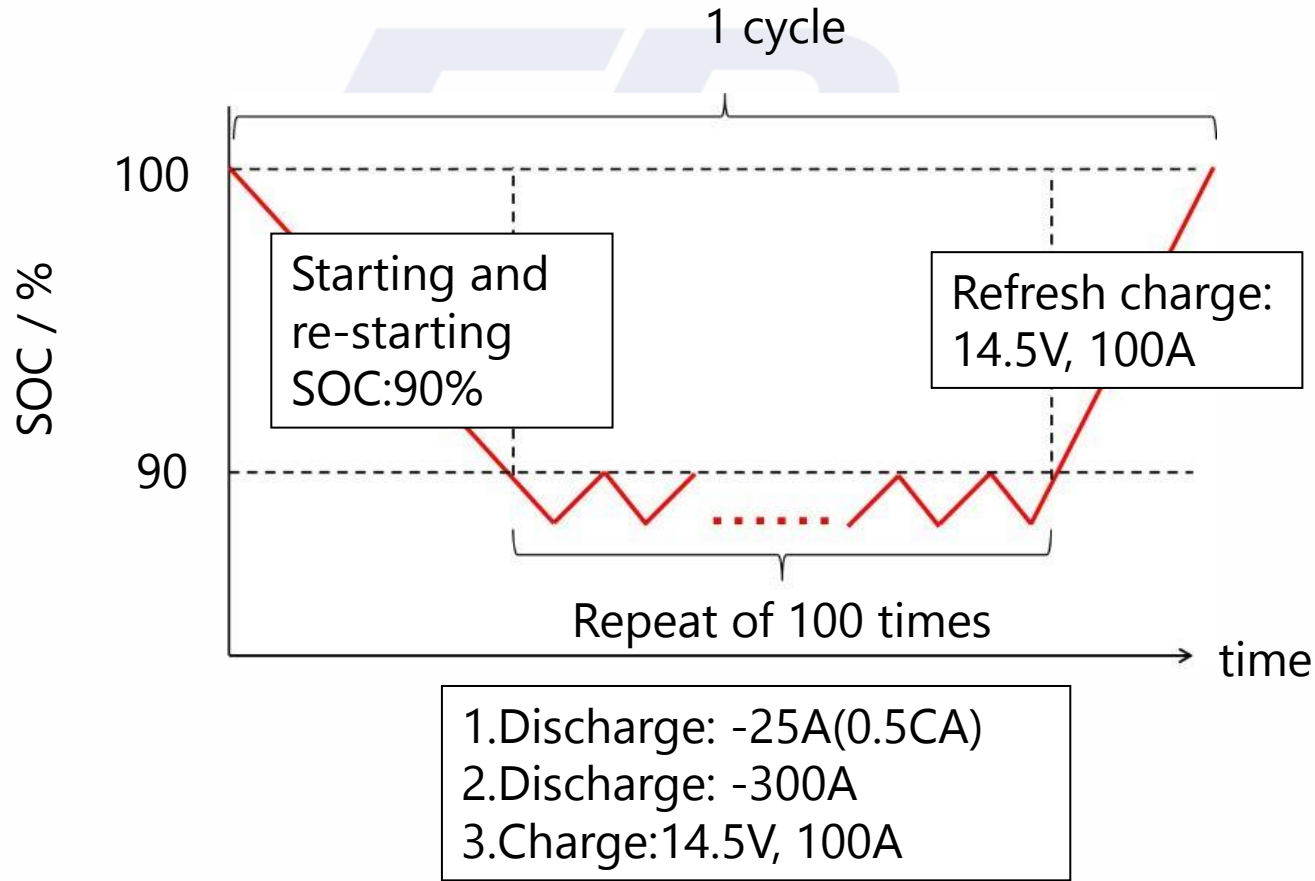
Conventional EFB ≒ New developed EFB

○Progress of PAM Softening

Conventional EFB > New developed EFB
(Bad) (Good)

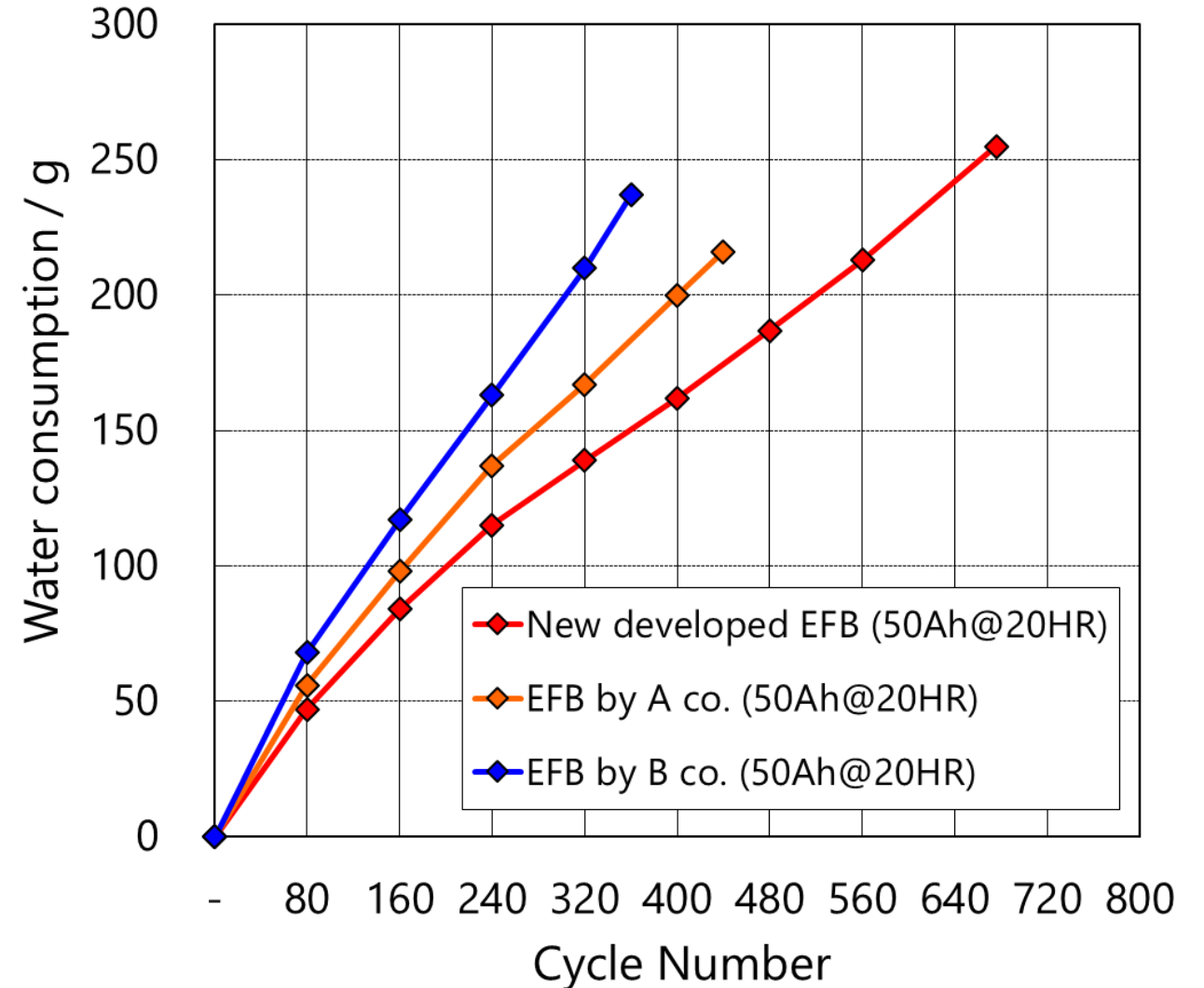
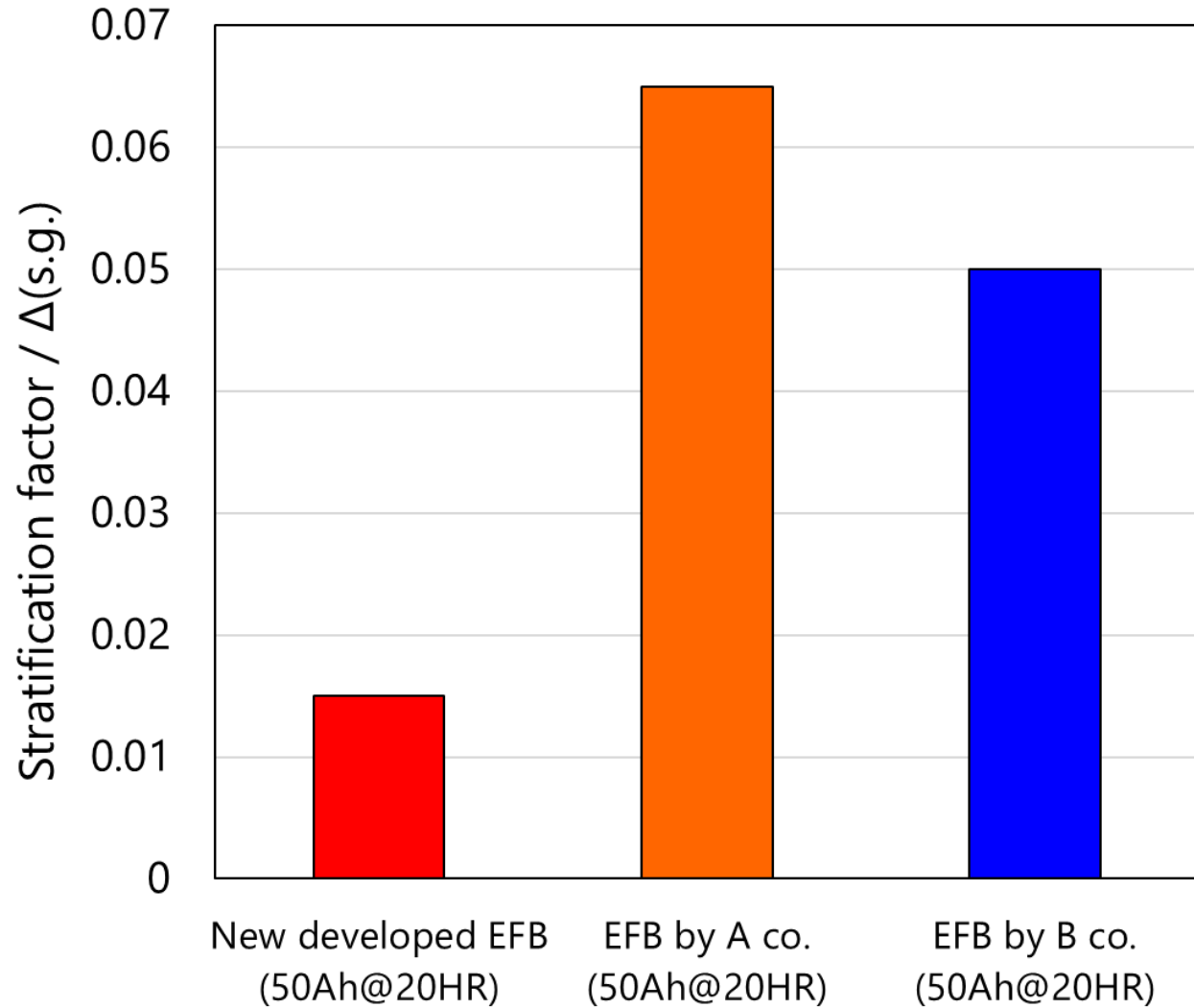
Improved PAM improves cycle life

Result of PSOC cycle life test



Durability of new developed EFB has excellent performance

Result of PSOC cycle life test



Stratification suppression is suggested to be due to softening suppression rather than stir electrolyte with gas generation.

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Conclusions

- The properties of PAM were studied and controlled to increase the specific surface area and pore volume by adding new additives.
- Battery capacity and charge-discharge durability were improved by optimizing the amount of PAM new added and the density of the PAM.
- When evaluated by the SBA life cycle test, it was confirmed that the cycle was more than twice the target cycle, and the life was approximately 1.2 times longer than other batteries. In addition, when evaluating the more severe PSOC test, it was confirmed that the battery life is about 1.5 times longer than other batteries.
- Newly developed batteries are used by car manufacturer.

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Thank you for your kind attention