



GS BATTERY (U.S.A.) INC.

a subsidiary of

GS Yuasa Corp.

GS Yuasa Heat Tolerant Design Characteristics

Typical Failure Modes of VRLA Batteries

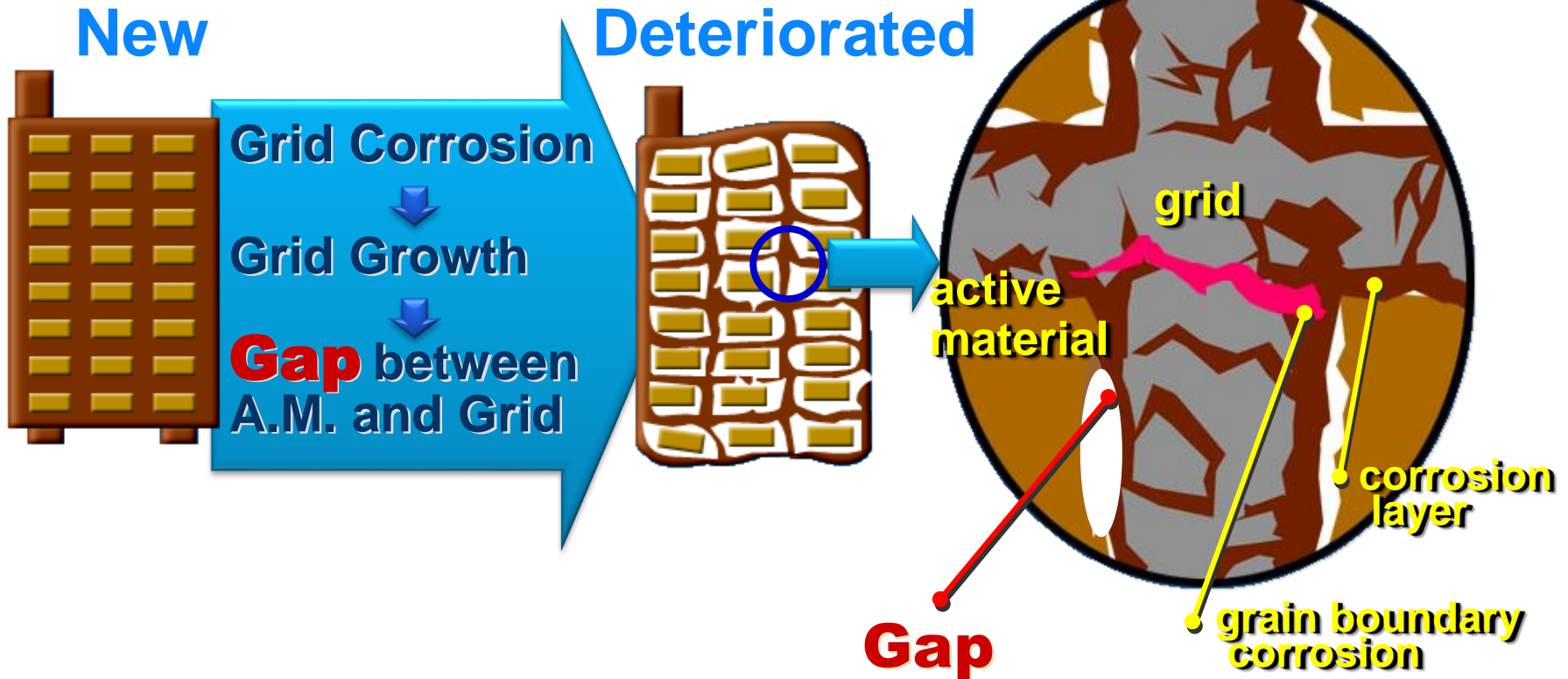
FAILURE MODE
Positive Grid Corrosion
Dryout
Thermal Runaway
Post Leak



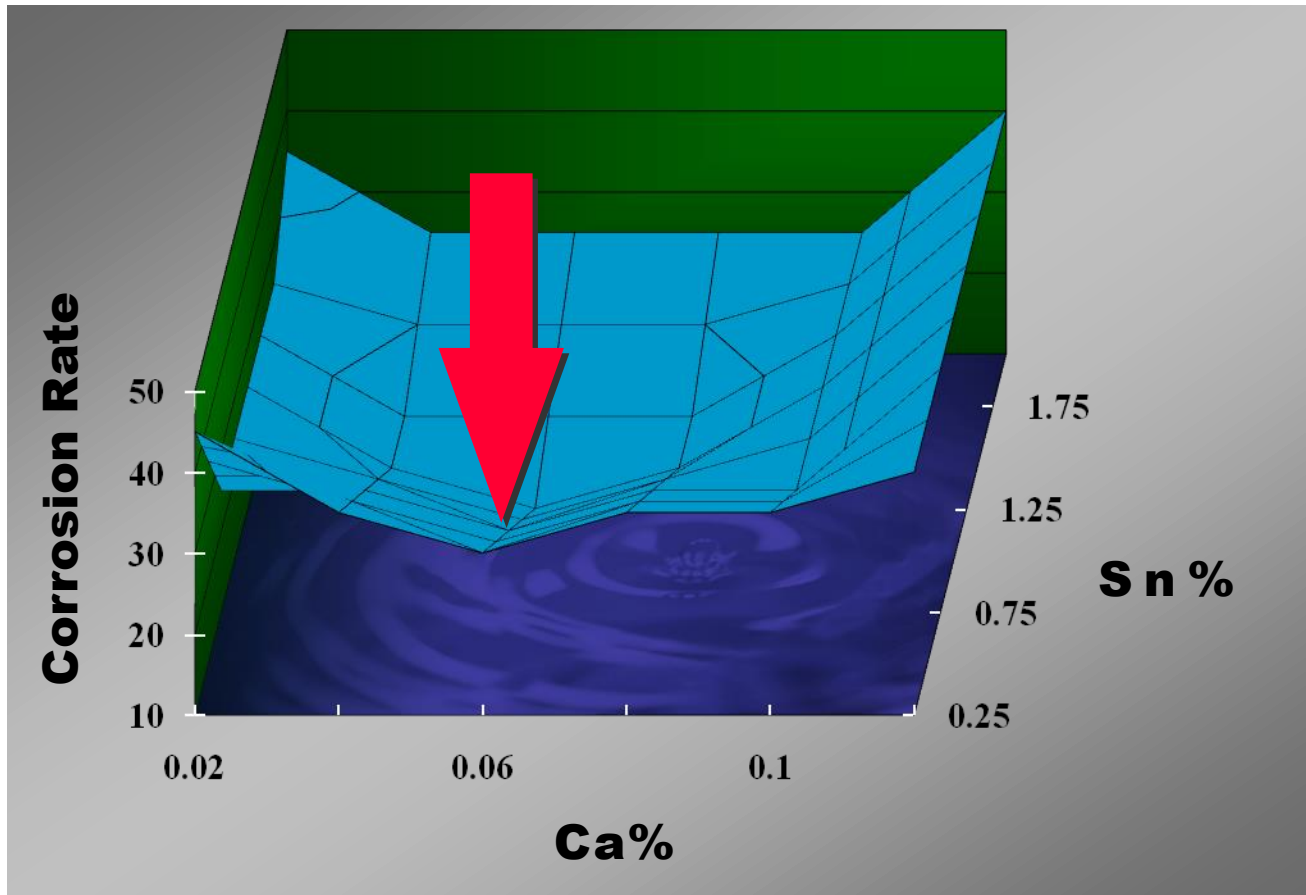
Positive
Grid
Growth

Mechanism of Plate Deterioration

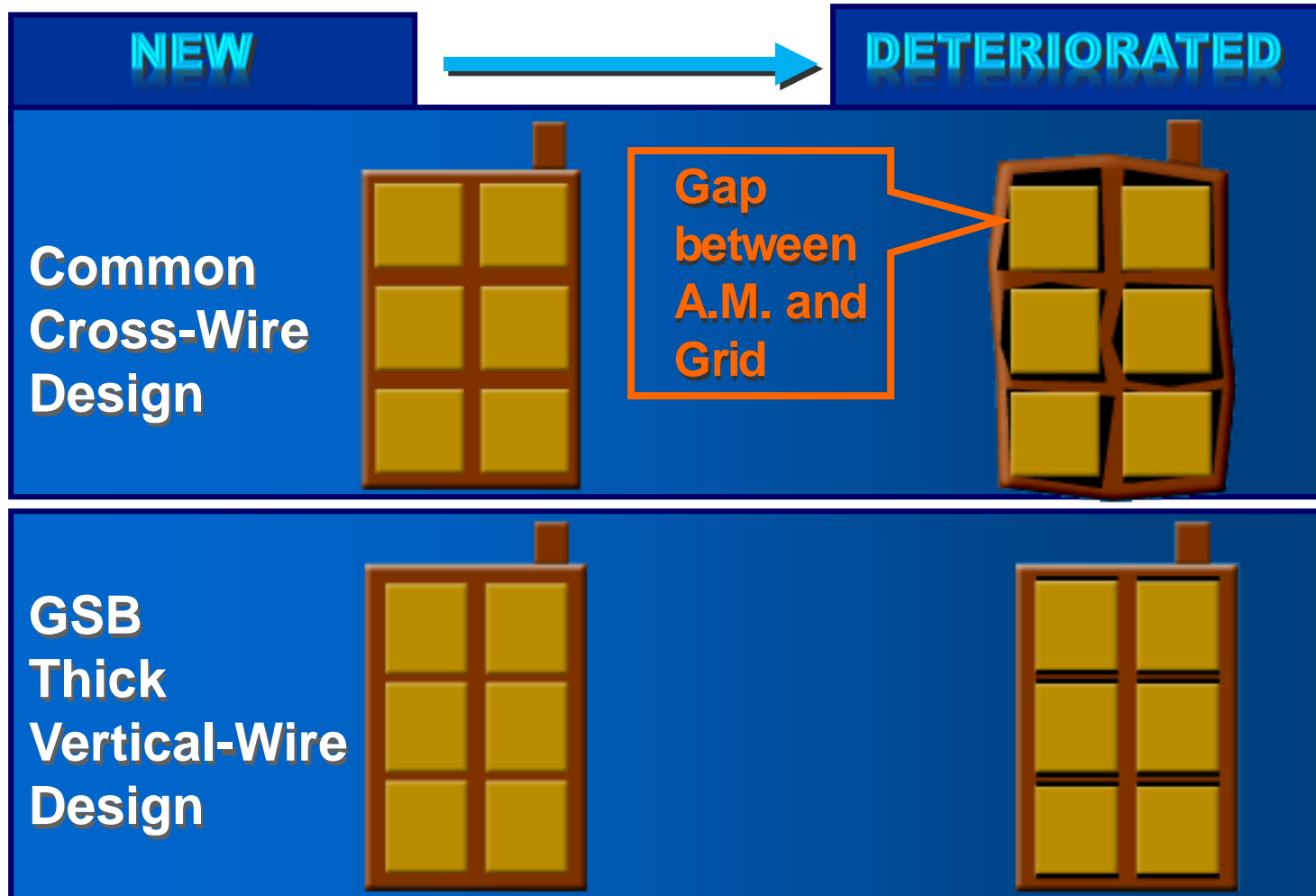
Grid Deterioration



Low Corrosion Rate Positive Grid Alloy

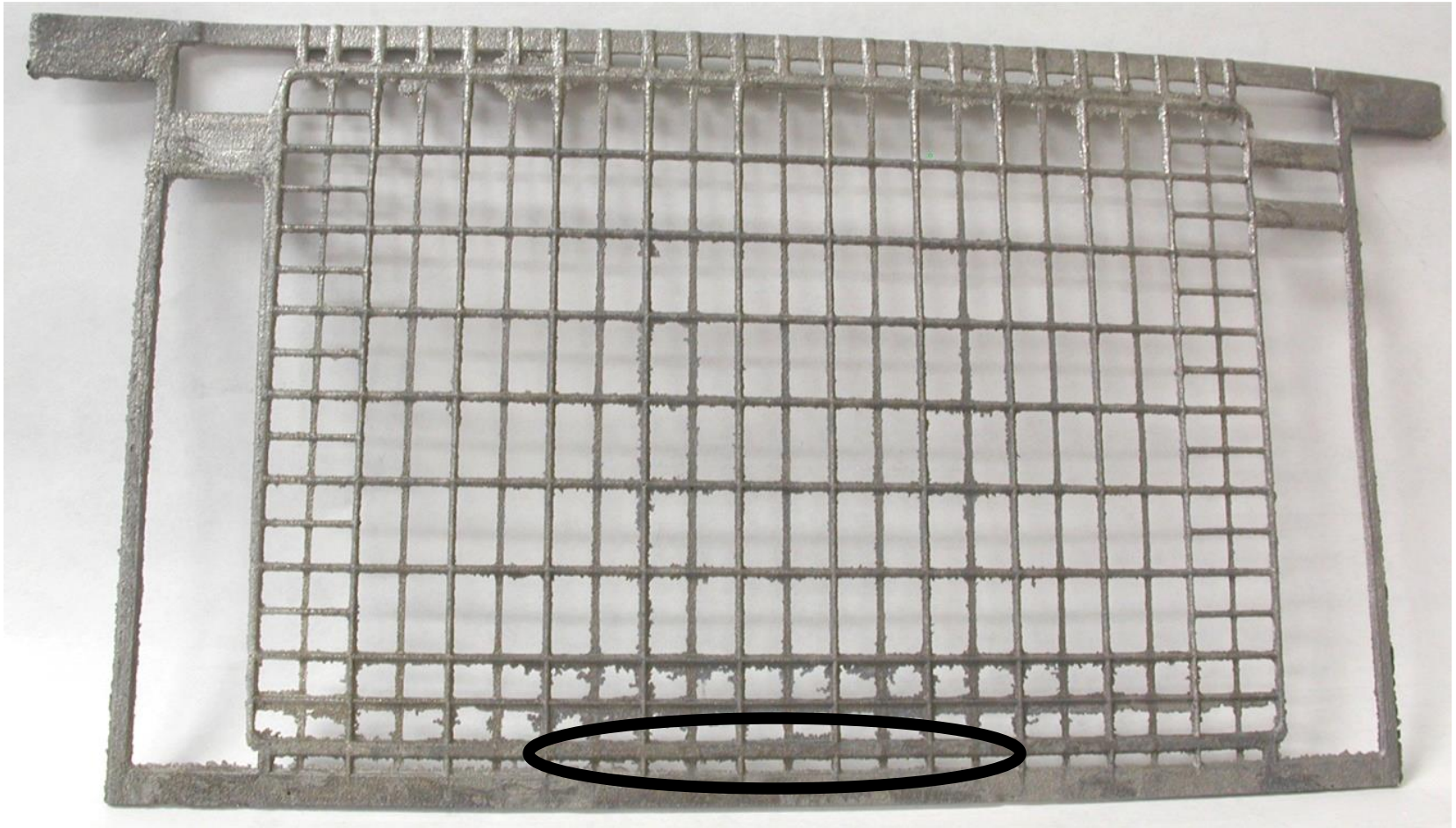


Reinforced Grid Design

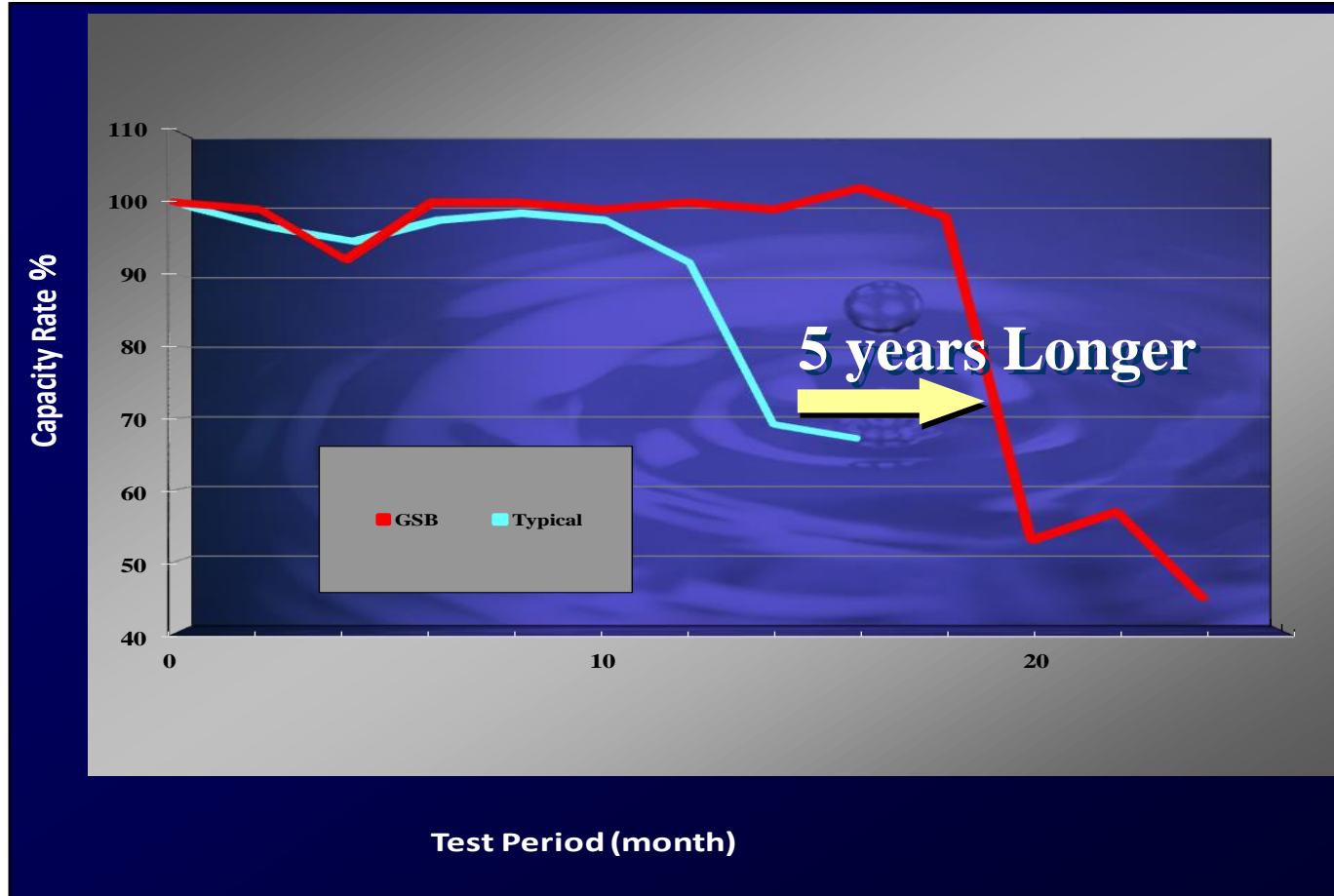




Grid Outer Perimeter



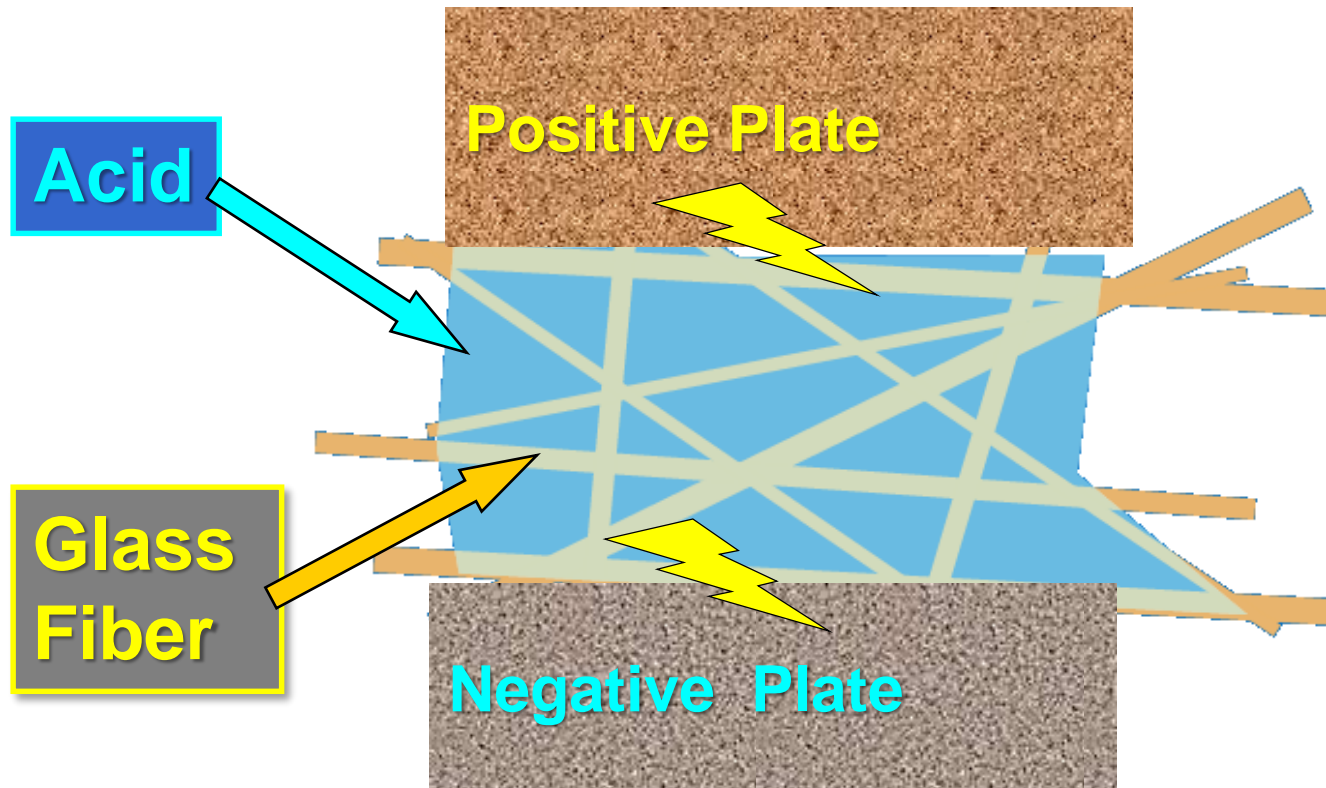
Float Life Improvement



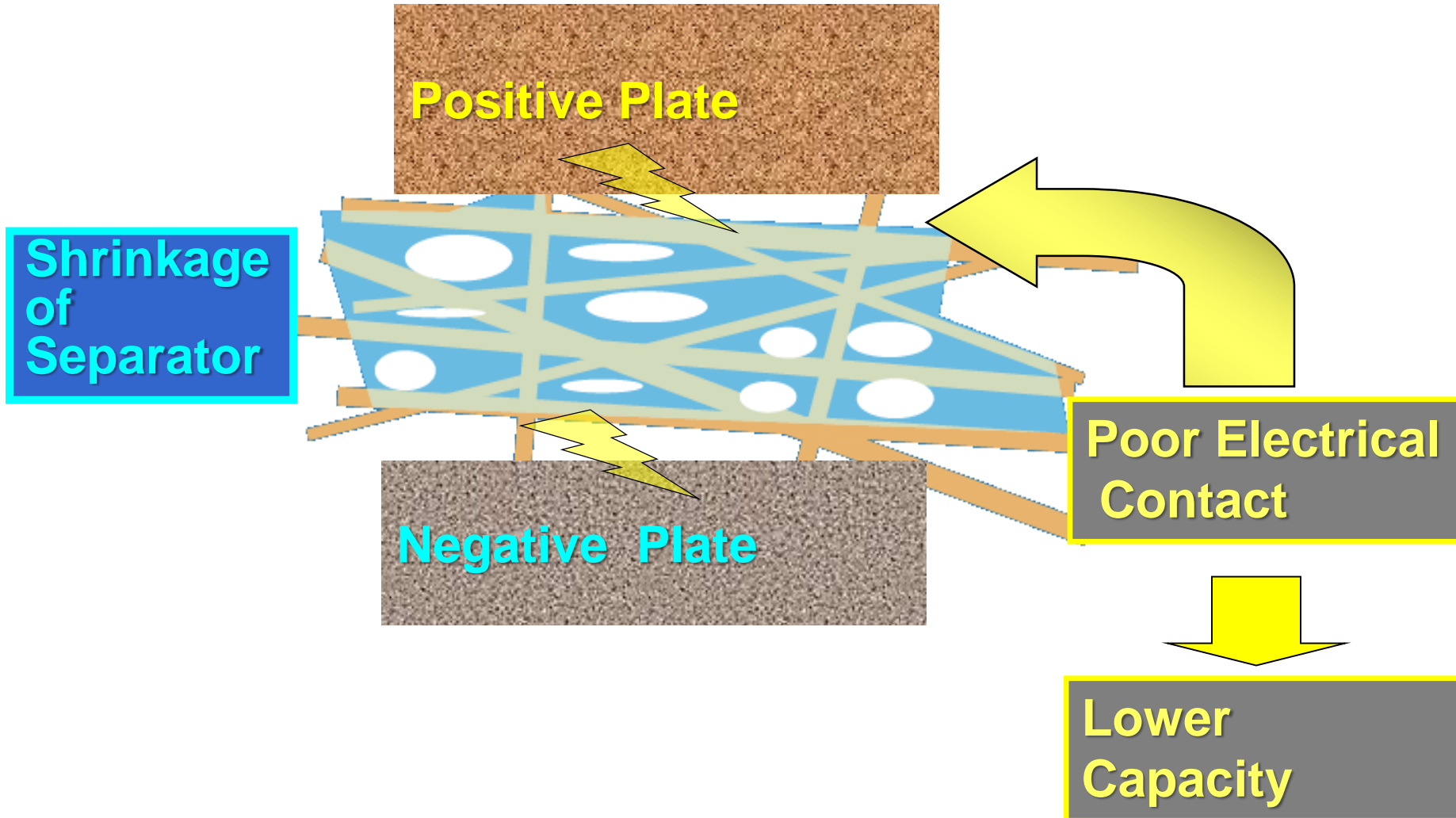


DRYOUT

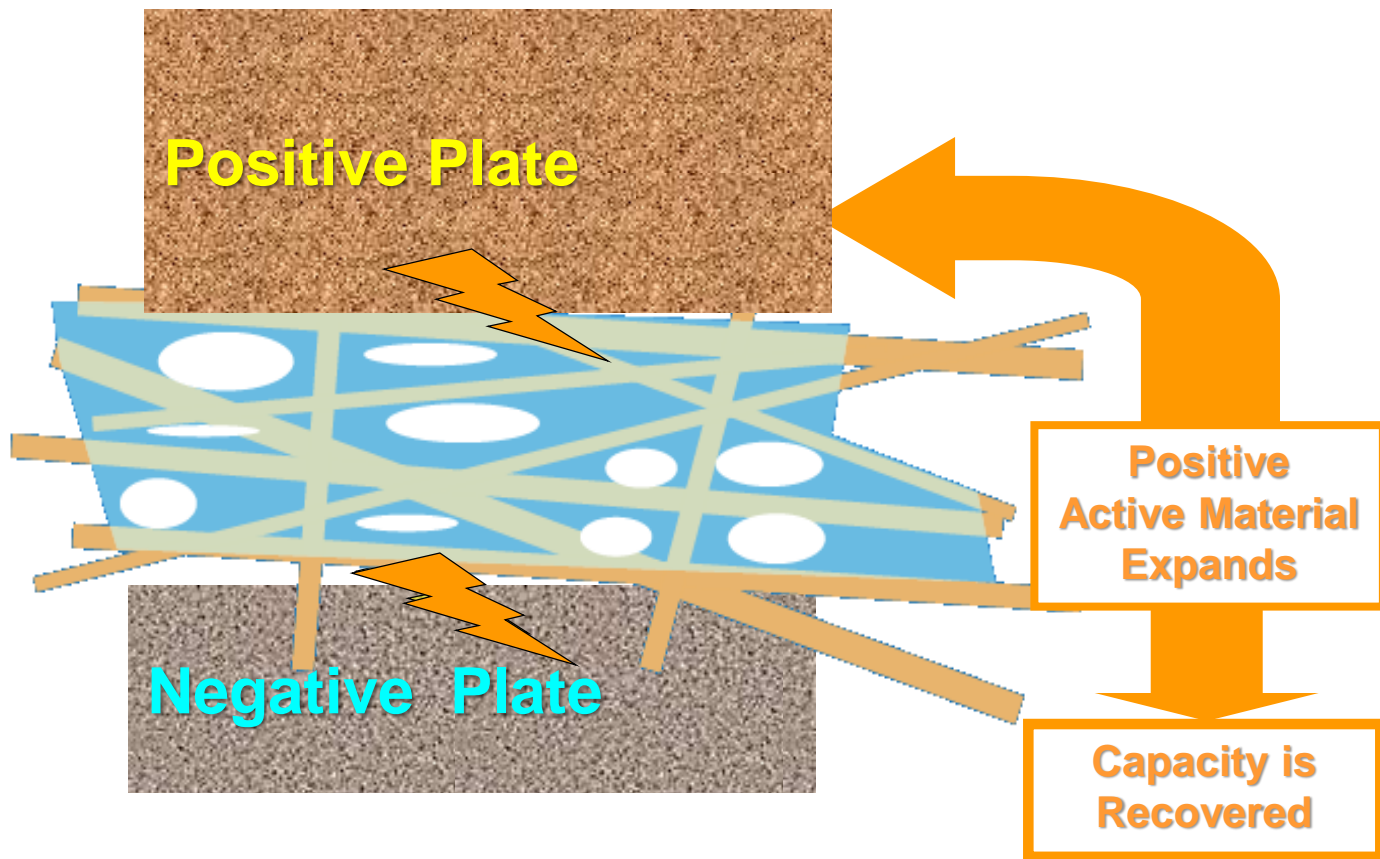
AGM Separator in Contact with Plates



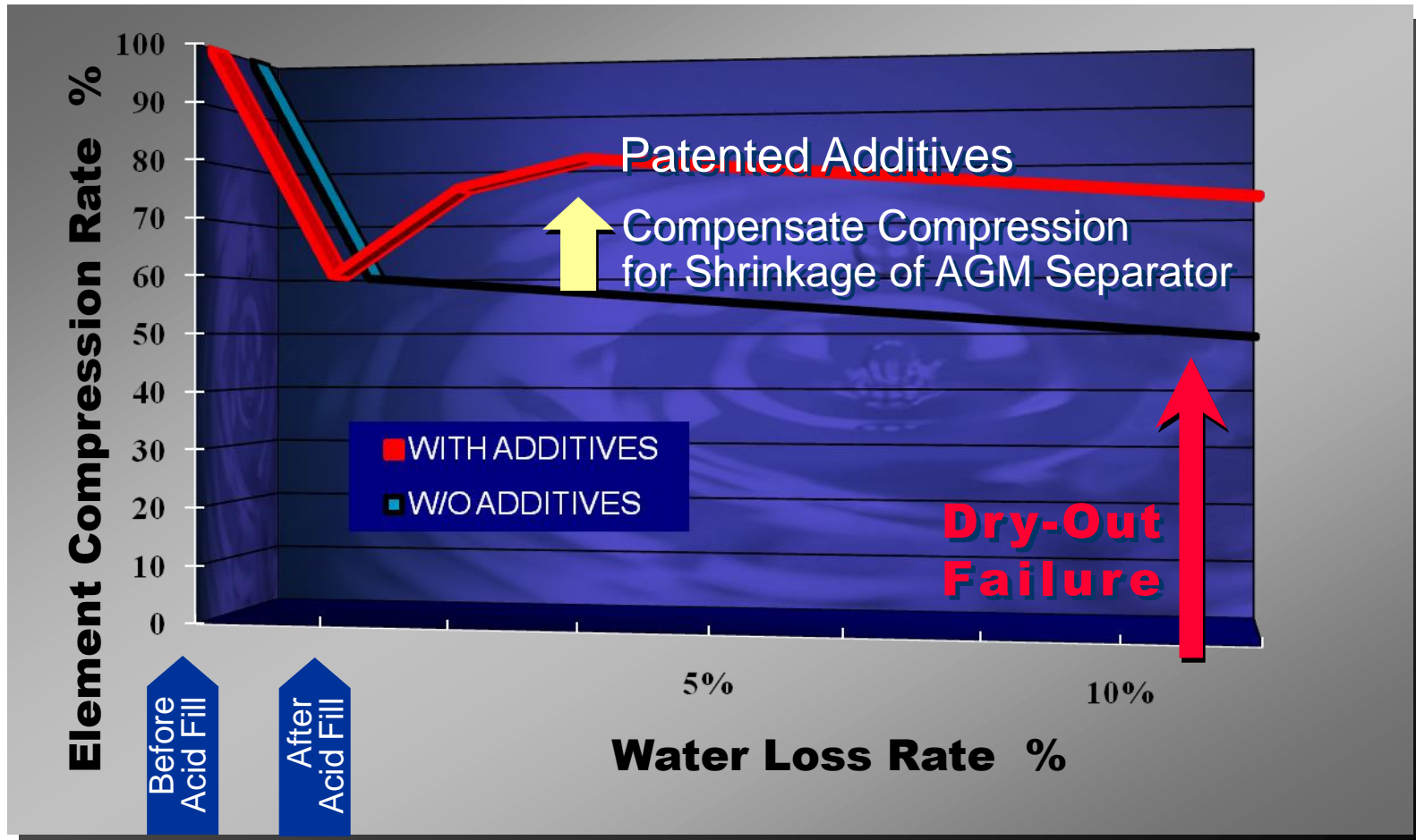
Shrinkage of the Separator (caused by water loss)



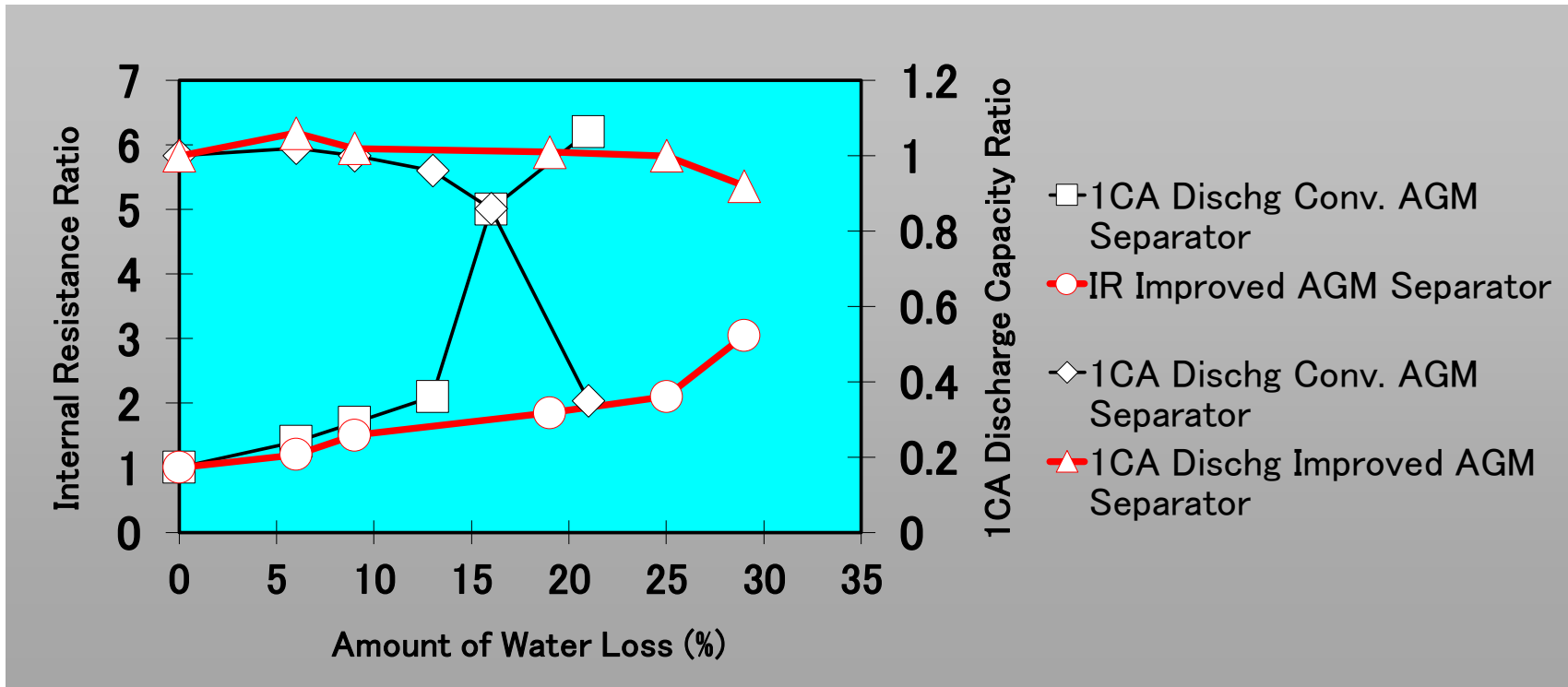
Additives to Positive Active Material



Patented Additives to Positive Active Material



Improved AGM Separator





Rigid Container Material

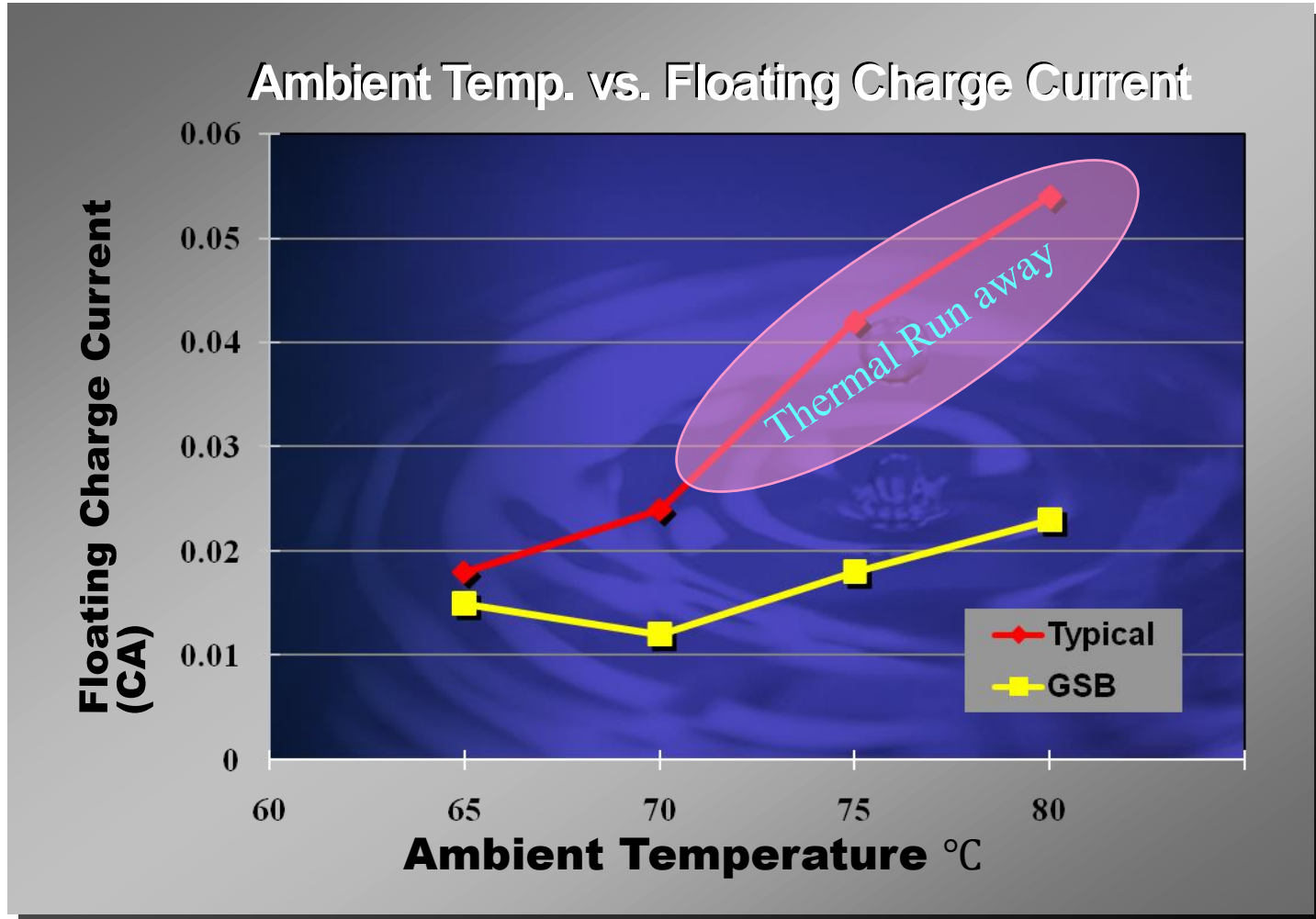
Countermeasures for Dry Out and Compression Loss Summary

Technologies for Improvement	GSY PWL/PYL
Patented Additive to Positive Active Material	✓✓
Shrinkage Improved AGM Separator	✓✓
Rigid Case Material	✓✓



Thermal Runaway

Countermeasure For Thermal Runaway





Thermal Runaway Proof Points

Case 1

- Aug 2001-80C Cabinet, Covington, GA
- Float Voltage Forced High (-56.76 to -58.6)
- Internal Cabinet Temp. 37.6C to 50.6C
- Batteries Did Not Thermal Runaway And Continued To Function Properly
- Documented in INTELEC 2002 Paper

• Case 2

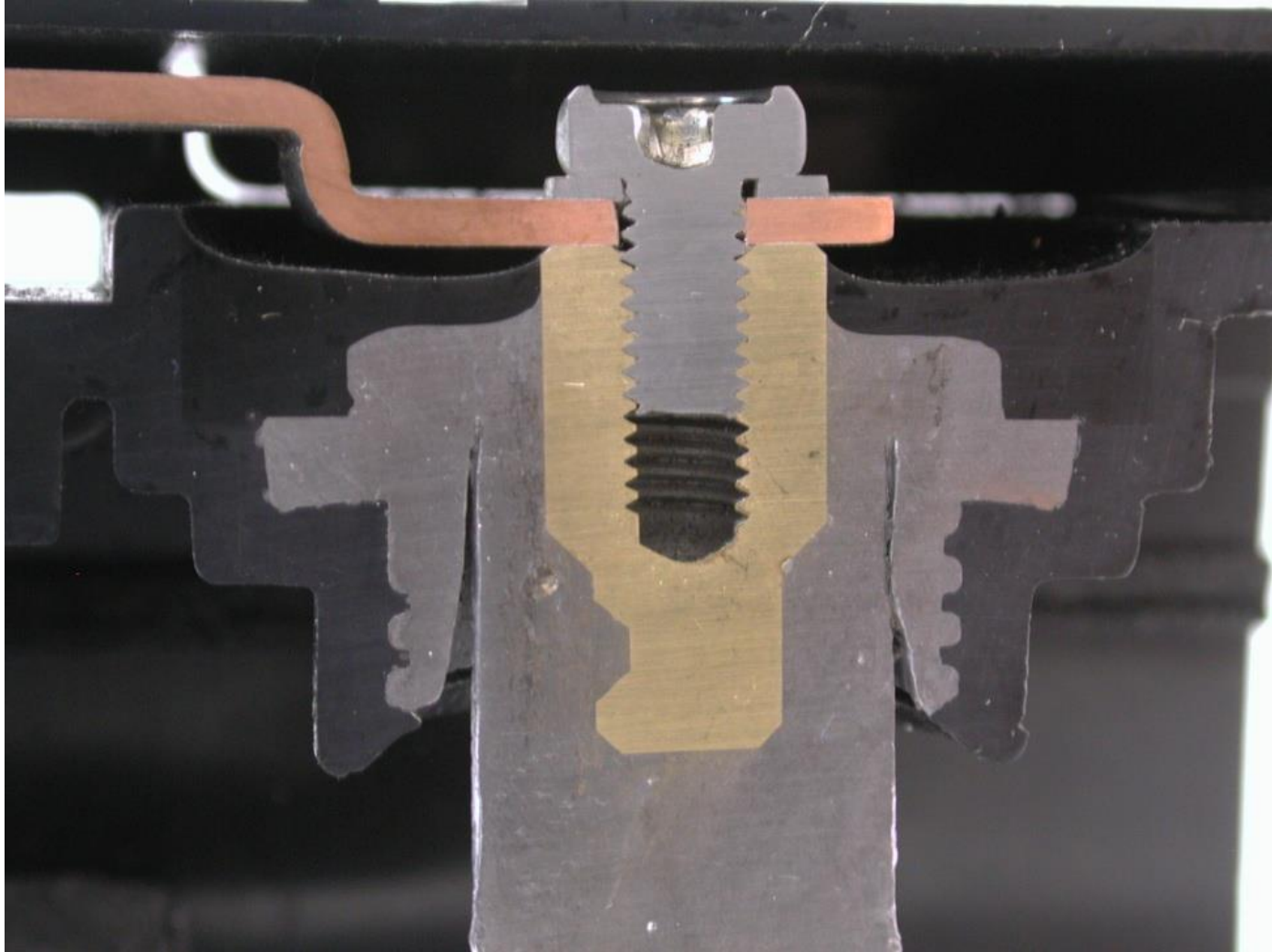
- Identified October 2005, MESA 4 98 Series, Lorain A150CAB Power System, Gainesville, FL
- Rectifier was incorrectly adjusted to float at 61V for a period of 18 months
- Batteries Dried Out But Did Not Thermal Runaway



Post Seal Failure



Epoxy Post Seal Design



FAILURE MODE	GSB COUNTERMEASURES
Positive Grid Corrosion	<ul style="list-style-type: none">•Low Corrosion Rate Grid Alloy<ul style="list-style-type: none">•Low Calcium (>99% Lead)•Reinforced Outer Perimeter of Grid
Dryout	<ul style="list-style-type: none">•High Compression Design<ul style="list-style-type: none">•Rigid ABS Container Material•Additives to Positive Active Material•Improved AGM Separator•Smooth Plate Surface
Thermal Runaway	<ul style="list-style-type: none">•Patented Additives to Negative Active Material
Post Seal Failure	<ul style="list-style-type: none">•Epoxy Post Seal•No Mechanical “O” Ring Seal