Examination of the influence of NAM Expander material on the Performance of Lead Acid Batteries

18th Sep,2024

Amlan Kanti Das,
Senior Vice President, Luminous

Gordon C. Beckley
COO, Hammond Group Inc.

ELBC
16-19 September
Milan, Italy 2024

Most Preferred
Brand of India
Strong brand recognition across India

32%
Highest Brand Preference

95%
Brand Awareness

BRAND INVERTER & BATTERY

6th Edition ICONIC BRANDS OF INDIA 2023 — Made In India

Recognised
Iconic Brand
2023

SELECTED Superbrand INDIA — Consumer & Industry Validated 2019-20

Selected
Superbrand
3 times in a row

Consumer Survey of Product Innovation **2022**

Icon Inverter
voted
Product of the Year
2023

LUMINOUS

Strategic Growth Lever

International Business

Schneider Electric

In alignment with Global Business Strategy

Enhanced Product Range

+

New Geographies

*All data is YTD 2022

Luminous –India Footprint

LUMINOUS

100 Mn+

Happy Consumers

Employee strength

5645 + People

Industrial footprint

8 Factories Inverters & Battery product line

Cities Covered

28 + Cities

Channel strength

1,00,000 + channel partners (Direct + Indirect Distribution)

S/w and R&D focus

275 + Service Centre

Innovation & Technology

18 + Intellectual Property applied and 20+ design registered in Energy storage R&D

90% approx.. District coverage (Direct+ Indirect)

5308 Tehsil and Taluka coverage (Direct+ Indirect)

Presence in 36+ Countries across the globe!

LUMINOUS

5 Mn+

Happy Consumers Worldwide

Brighter WITH LUMINOUS

AMAZE

Most preferred brand by the Retail in India

Two Brands Strategy to win in market

Large, fragmented, and heterogeneous market.

Segment, Target & Position Approach to Consumer Business in India

LUMINOUS

Most loved and preferred brand by the Consumers, A Super Brand of India year on year

Luminous Domestic Product Portfolio

2 Brands

11 Sub Brands

70+ Products

LUMINOUS

INVERLAST | ULTRA CHARGE | SHAKTI CHARGE | POWER CHARGE | NEO CHARGE

RED CHARGE | BOOST CHARGE | LIFE MAX | ECO CHARGE | EXTRA CHARGE

Product Range:
12V 80Ah – 250Ah

Warranty Range:
24m – 60m

AMAZE

TURBO CHARGE

Product Range:
12V 135Ah – 250Ah

Warranty Range:
18m – 36m

Major Competitions

EXIDE

Product Range:
12V 100Ah – 260Ah

Warranty Range:
18m – 48m

AMARON
LASTS LONG, REALLY LONG.

Product Range:
12V 150Ah – 230Ah

Warranty Range:
30m – 42m

Livguard
energy unlimited

Product Range:
12V 90Ah – 260Ah

Warranty Range:
24m – 60m

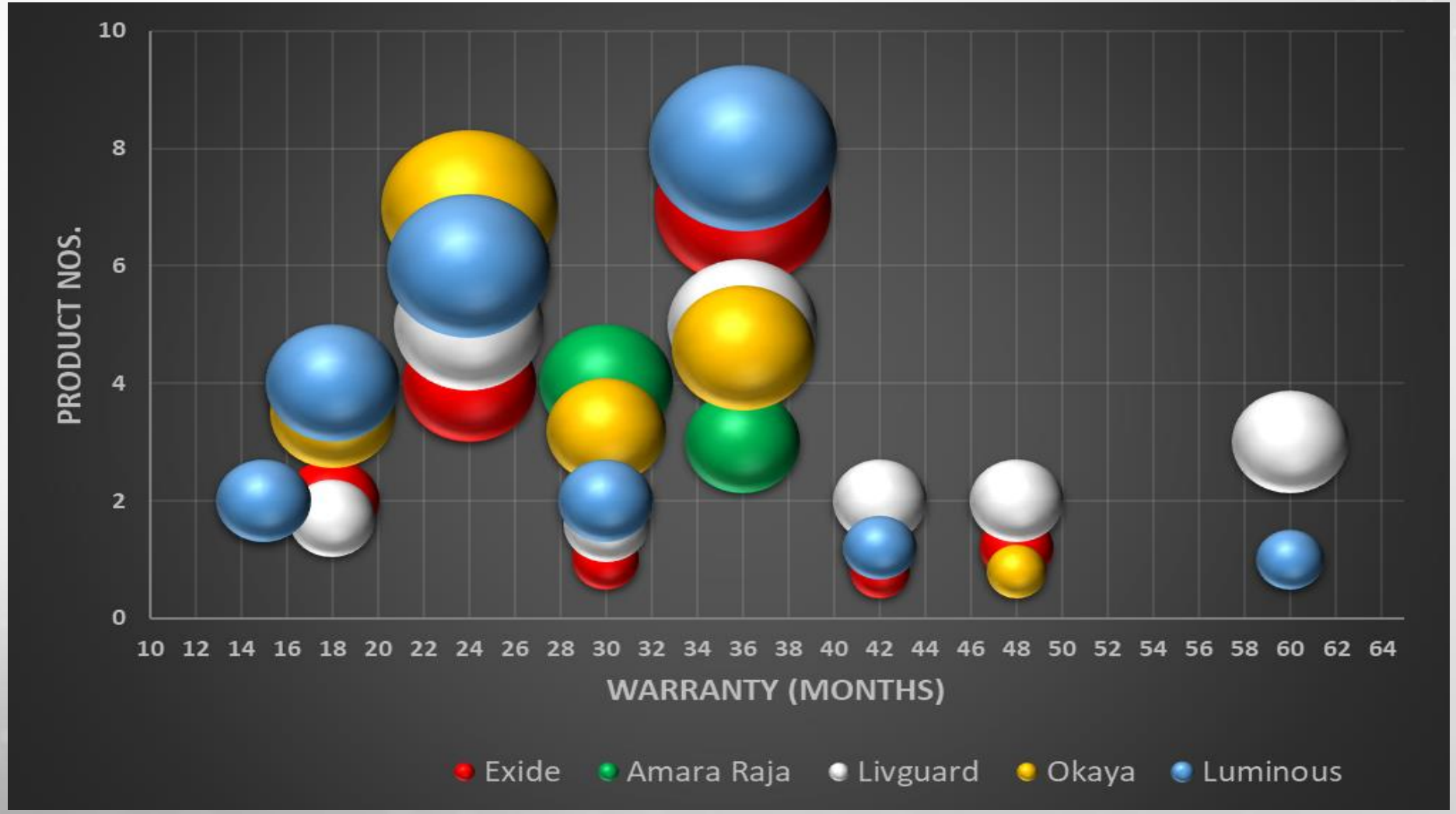
OKAYA

Product Range:
12V 80Ah – 260Ah

Warranty Range:
24m – 48m

Product Mapping of Indian Market

12V 150Ah



- Highly competitive market in all categories.
- High warranty (> 24 Months) expected by customer.
- Considering diverse geological conditions in India, usage pattern varies dramatically.

Major Challenges in Home-UPS Application

Unpredictable Long Duration Power Outage

Poor Charge Acceptance at Low SoC

Prolonged PSoC Operation

Wide Variation in Operating Temperature

NAM Failure

Technical Programme on NAM improvement

HAMMOND
THE CHANGE CATALYST®

LUMINOUS

Technical Program By: HAMMOND THE CHANGE CATALYST®

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HAMMOND: 90+ YEARS SERVING THE BATTERY INDUSTRY

THE CHANGE CATALYST®

R&D Leadership


Global Supply Partner

Manufacturing:
The Americas,
Europe & Asia

State-of-the-Art Lab & Production Facilities


Innovative Performance Additives

TREATED SureCure®

HAMMOND ADVANCED EXPANDERS

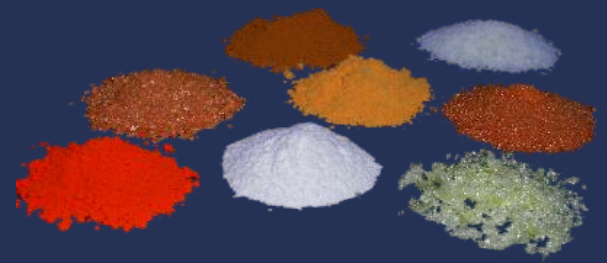
GRAVITY® GUARD

Customer & Quality Focused

CERTIFIED QUALITY ISO 9001 MANAGEMENT SYSTEM

CERTIFIED IATF 16949:2016 COMPANY

Producer of High-Grade Oxides



HAMMOND'S APPROACH TO LUMINOUS EXPANDER DEVELOPMENT

The Challenge

PbA in their present state, suffer from low cycle life and low charge efficiency, leading to high cost for a specific use cases

The Goal

Determine the influence of Expander component (carbon, organic & barium sulfate) combinations to optimize Luminous solar battery design

The Method

L4 Taguchi Design of Experiments were employed to determine the best material and loading levels for antimonial PSOC cycling applications

SPECIFIC PERFORMANCE TARGETS

- **Improve the Charge efficiency.**
- **Improve PSoC (20-80% DoD) cycle-life.**
- **Reduce water loss.**

$L_4 (2^3)$

Trial # \ Factor	A	B	C
1	1	1	1
2	1	2	2
3	2	1	2
4	2	2	1

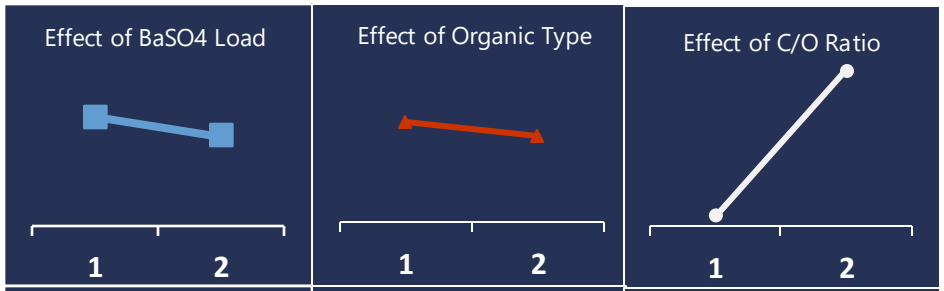
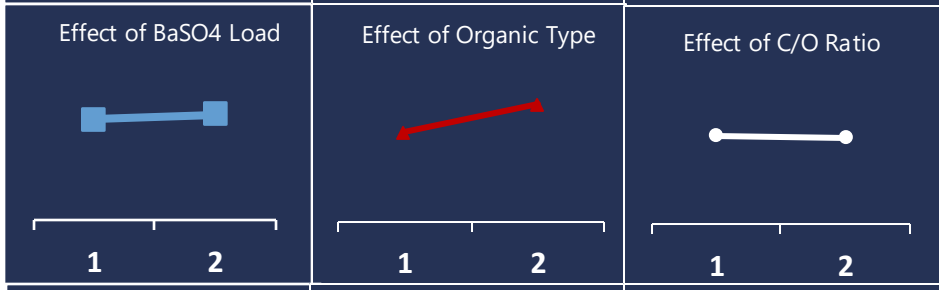
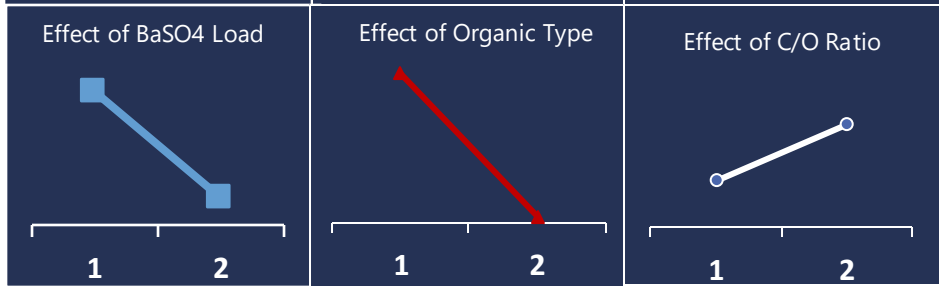
An L_4 requires four separate trial conditions and can be used to study up to three factors at two levels each

FACTOR	RESPONSES
$BaSO_4$ Loading	Charge Acceptance
Organic Type	Water Consumption
Carbon: Organic Ratio	Cycling Performance

HAMMOND: CELL DoE RESULTS

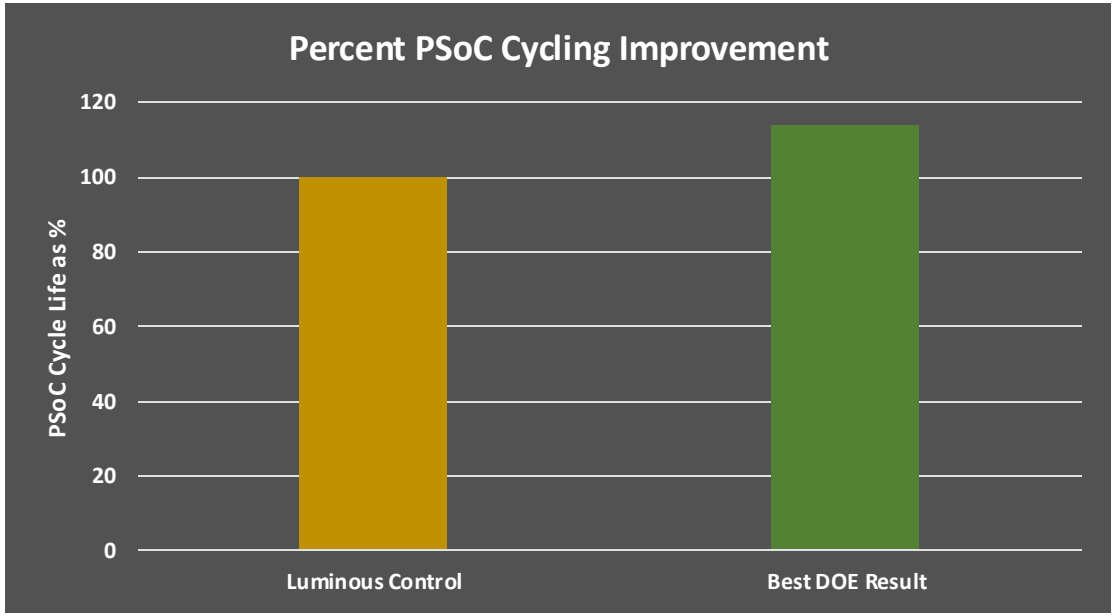
FACTORS

Main Effect Responses

	$BaSO_4$ Loading	Organic Type	C:O Ratio
Charge Acceptance			
Water Loss			
PSoC Cycle Life			

TEST PLAN

- Peukert Discharges (1C, 0.5C, 0.25C, 0.1C) / Charge Acceptance
- Hot Float (60°C, 2.4 VPC for 1 hour)
- PSoC Cycling



RESULTS

- Best Factor A: Low Barium Sulfate Loading
- Best Factor B: Type One Organic
- Best Factor C: High Carbon/Organic Ratio

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Inverters & Batteries | Solar

LUMINOUS

TEAM

LUMINOUS

LUMINOUS

Amlan Kanti Das
Senior Vice President, R&D & Manufacturing

Project Sponsor & Lead

Vidyapati Dey
General Manager, R&D & QA

Technical Lead

Ranjan Sen
Deputy Manager, R&D

Lead Researcher

HAMMOND
THE CHANGE CATALYST®

Project Technical Team

Gordon Beckley
Vice President & Chief Technical Officer

Enqin Gao
Director R&D

Tom Wojcinski
Senior Chemist

Technical Advisory Council

Dr. Francisco Trinidad - John Miller - B.S. CPhD Electrochemistry, University of Madrid, 43 Years PbA Battery Industry

John Miller - B.S. Chemical Engineering, University of Wisconsin, 39 Years PbA Battery Industry

Rosalind Batson - Wright State University, Material Science Expert

Dr. Lash Mapa - PhD Chemical Engineering, Professor at Purdue University Northwest

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HAMMOND ADDITIVE VALIDATION REPORT

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Life Cycle Test-EOD Voltage During PSoC Cycling

Battery Design Version:

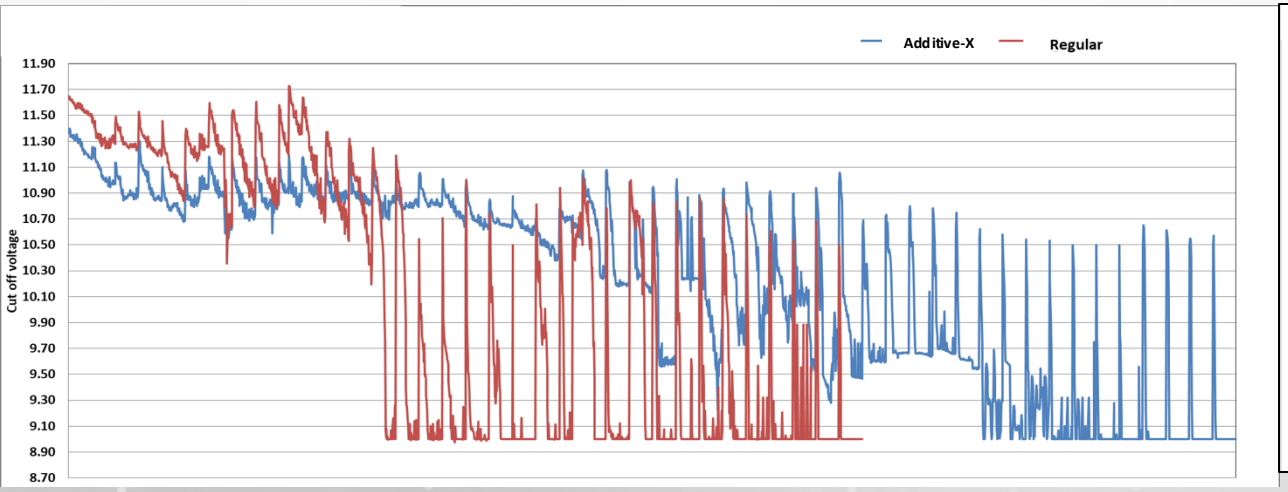
12V 150A, Tubular Flooded

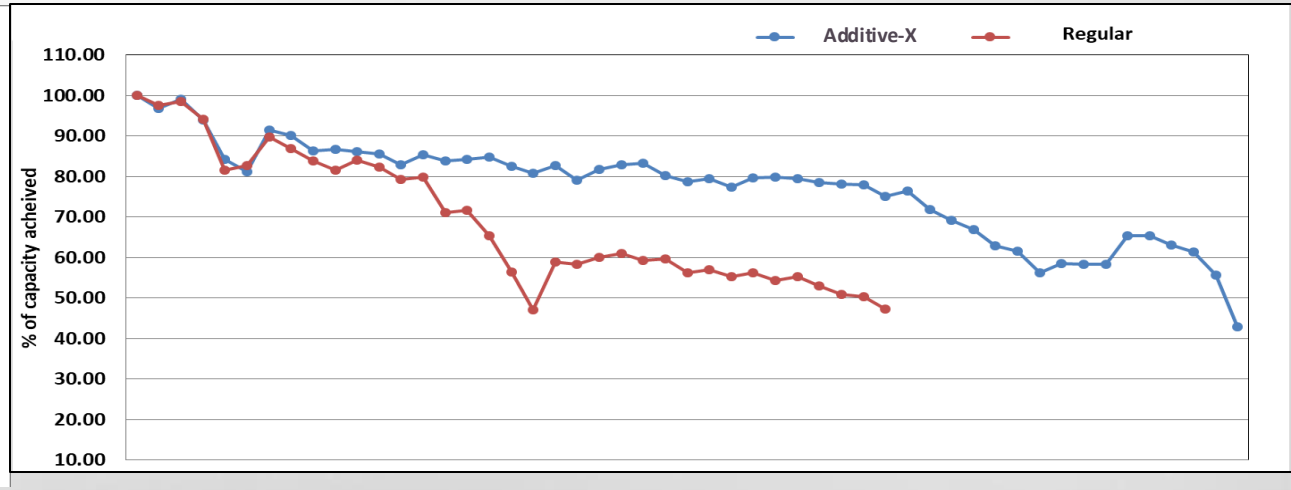
Electrode:

- New negative paste recipe with Hammond additive (**Additive-X**)
- Controlled standard negative paste recipe (**Regular**)

Test Protocol*:

- Discharge @ C3 up to 60% DoD with PSOC cycle (20 ~ 80% SOC). – steps as per standard
- Temperature @ 40°C





Additive-X has helped to achieve around 20-30% more cycles. Repeat experiments also show the same trend.

*** Derived from IEC-61427 / endurance test**

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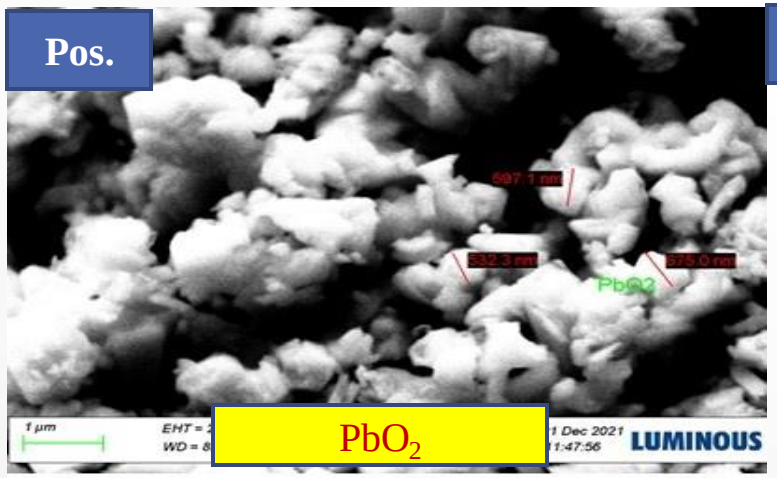
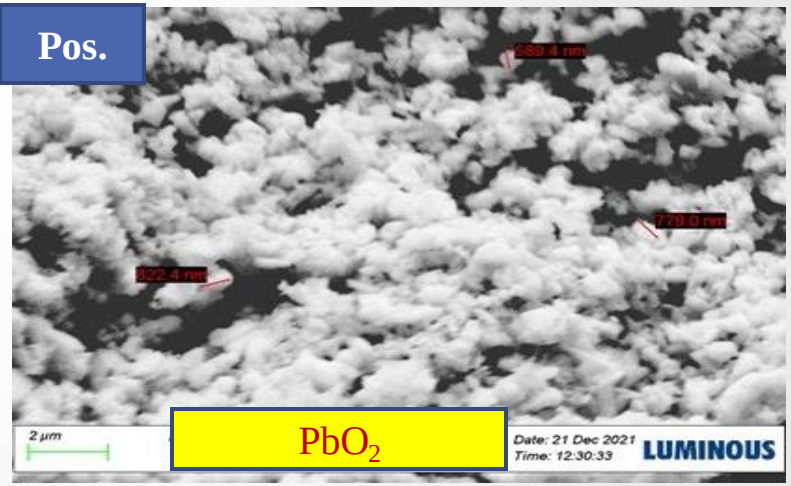
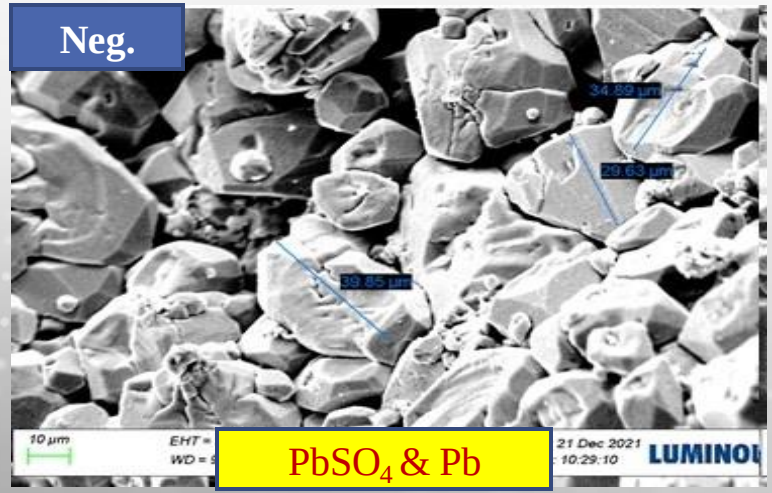
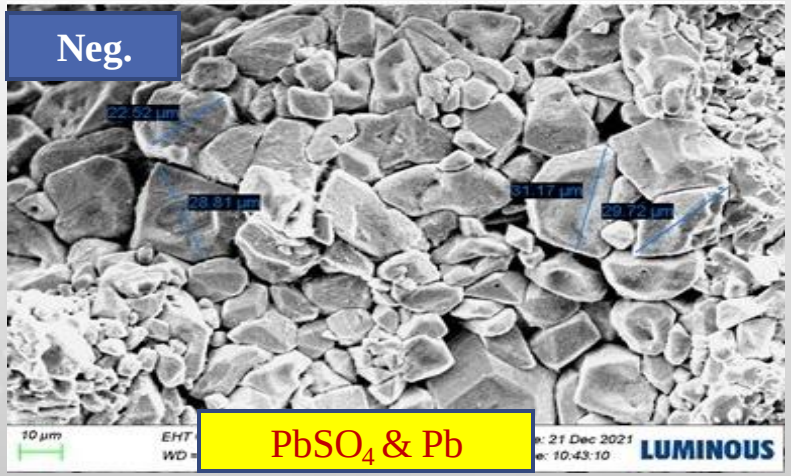
SEM Analysis of End-of-life Battery Plates

Regular	With Additive-X
Pos. 	Pos. 
Neg. 	Neg. 

 # Figure shows Bigger PbSO4 crystals in regular battery negative plate. So, NAM found dislodged from Grid.

In negative plates with Additive-X, PbSO4 crystals were smaller in size. NAM found well connected with grid.

Road to Success

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Any Questions ?

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