

BLACK DIAMOND
STRUCTURES™ *

Resilience Through Innovation

How MOLECULAR REBAR® Strengthens Battery Manufacturing in Unstable Markets

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Global Challenges and Our Vision of a Solution



Since the ABC20 (2023), the Pb-Acid battery market was forced to endure multiple crises

- Continued International conflicts
- Logistical nightmares
- Inflation
- Growing pressure from Li-Ion
- Antimony prices
- Erratic energy costs

We believe these challenges can be met; but only with the right products and the right partners

- New product innovation: PbAC, PbLite®, etc.
- Our Alliance: Atomized Products Group, Addenda

Strong Partnerships Help Businesses Prosper

We are proud to support our partners as they grow their business and are grateful for the reciprocity


- BDS supports battery manufacturers across 6 continents and over 20 countries



eRickshaw

- Thousands of eRickshaw drivers use MOLECULAR REBAR® batteries daily
- Enabled >15-month warranty
- Resists sulfation, vibration
- Lower maintenance


Eastman
....Let's grow together



Advanced Traction Design

- Batteries containing MOLECULAR REBAR® operate in Heathrow
- Reliable fast charge
- Improved thermal operation
- Reinforced active material

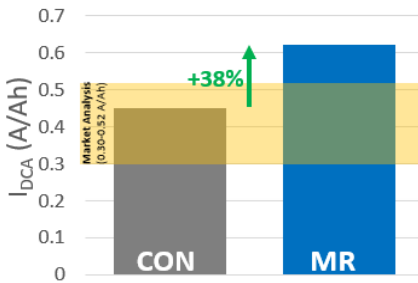
Eternity
TECHNOLOGIES



Deep Cycle + Renewables

- Unparalleled reliability under deep discharge
- Superior operation under renewable workloads
- Optimizable formation efficiency

Rolls
BATTERY ENGINEERING

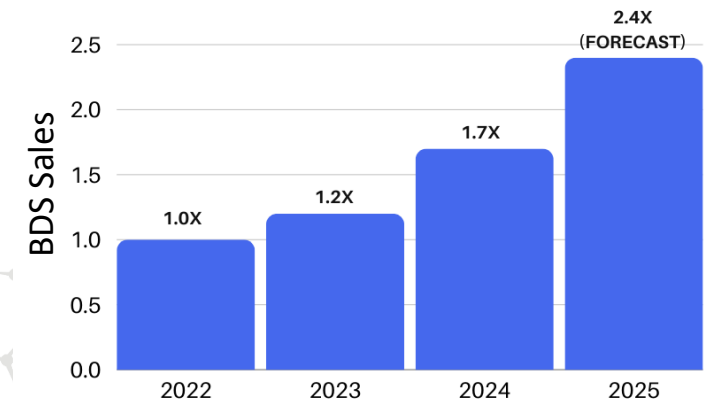


Enhanced Flooded Batteries

- MOLECULAR REBAR® provides market-leading performance to EFB
- 38% increased DCA
- Improved CCA (>10%)
- No water loss issues

AUTOX

2.4X



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Temperatures are Higher, Corrosion is Up; PbAC Helps

Corrosion is the targeted failure mode for Pb-Acid batteries, but it is exacerbated by extreme weather

- For every 10 °C, a lead-acid battery's life is halved

Our PbAC product helps our partners extend their battery life in extreme heats

- Decreases PAM shedding, improves PAM-grid connections, and pairs well with high-powered NAM

Customer Testimonial #1: Improving an Existing Battery

- 50% increase in 100% DoD reliability by complimenting Pb1410N in the NAM (UEV-SC) with PbAC (UEV-SC+)

COMPETITOR

18Ah 30Ah


22Ah 32Ah

LCB BATTERY

STANDARD AGM
UP TO 400 CYCLES

LCB UEV-SC SERIES
UP TO 800 CYCLES

LCB UEV-SC+ SERIES
UP TO 1200 CYCLES



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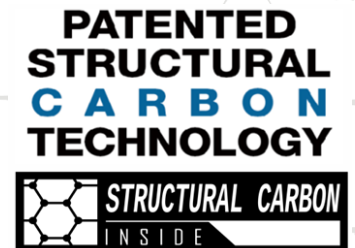
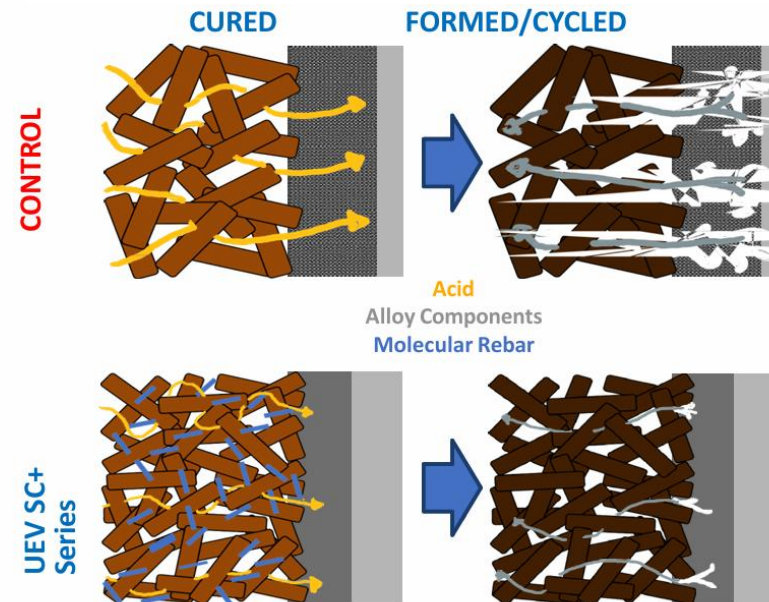
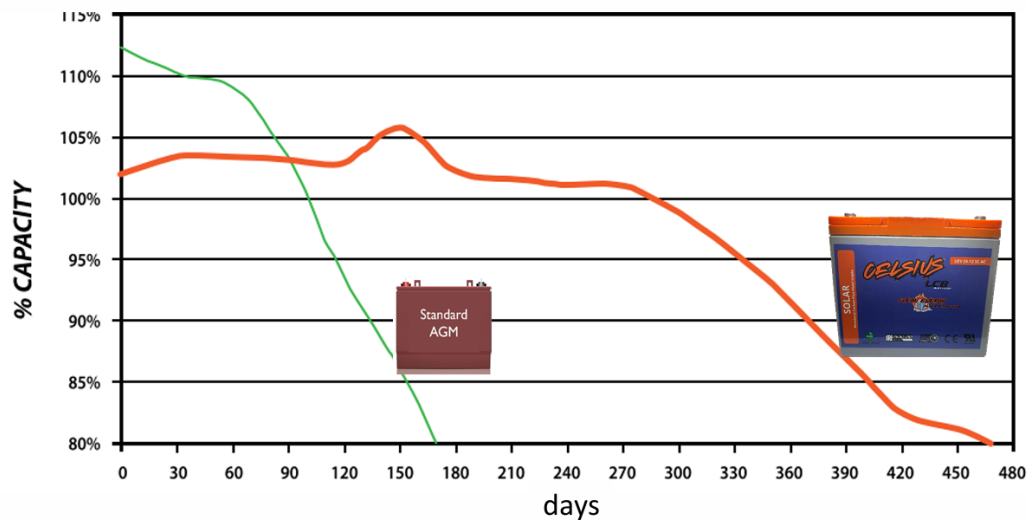
Temperatures are Higher, Corrosion is Up; PbAC Helps



Customer Testimonial #2: Designing a Novel Energy Storage System (ESS) Product

- The Celsius battery is an advanced, heat-tolerant, VRLA monobloc design incorporating many new elements
- PbAC, and other changes, permit up to 3X the life of standard VRLA 100%DoD at 60 °C

LCB **CELSIUS** offers up **3X longer** in temperatures of 60°C



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Reducing Cost at a Critical Moment

EU MFR

Our PbLite process additives reduce costs and increase production capacity

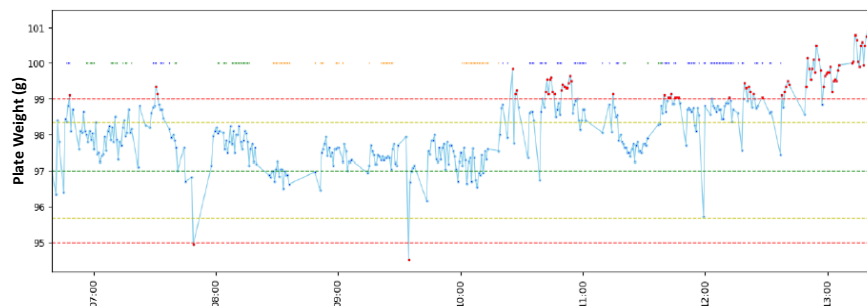
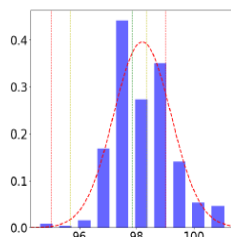
Customer Testimonial #3: Better Process

- **2X Cpk**, more capable process
- **7% faster** plates per minute,
- **Generates \$225/batch** for customer

Formulation	Plate Count	Active Time (min)	Eff. Plate/min	Cpk	Out of Spec (%)
Reference	167,526	358.12	467.8	0.21	24.8
PbLite®	167,921	336.17	499.5	0.44	11.6
Difference	+395 (+0.24%)	-21.95 (-6.13%)	+631.7 (+6.78%)	+0.23 (+109.5%)	-13.14 (-53.0%)

1 shift, 11 batches/shift

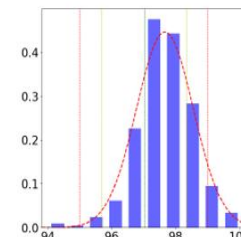
Reference



Mean	Deviation from Mean	CP	CPK	Std. Deviation	Out of Spec, Above %	Out of Spec, Below %
98.2	1.2	0.66	0.26	1.01	20.46	0.51

↓ 95 97 99 ↑

PbLite®



Mean	Deviation from Mean	CP	CPK	Std. Deviation	Out of Spec, Above %	Out of Spec, Below %
97.9	0.9	0.7	0.38	0.95	16.43	0.0

↓ 95 97 99 ↑

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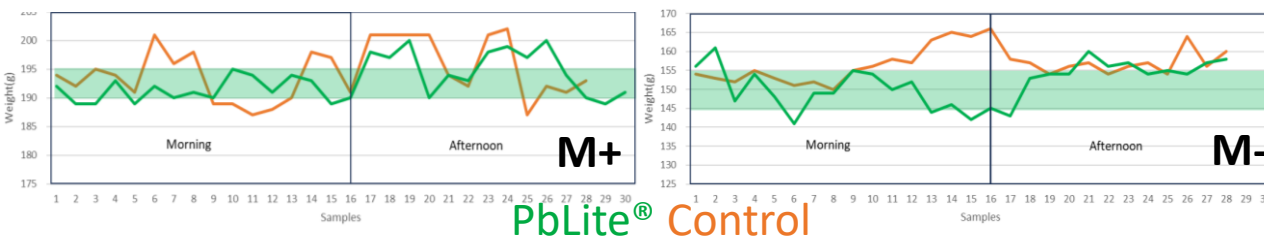
Reducing Cost at a Critical Moment

ASIAN MFR

PbLite® is rapidly becoming a global success

Customer Testimonial #4: Better, Cleaner Process

- Increase in plate production **5-8%**
- Improvement in Cpk values **2-5X**
- Reduce the reject/rework plate **36-44%**
- Cleaner panels, decreasing need for lug brushing
- **Saving cost \$78k per year**



	Increase in Cpk (Weight)	Reduction in Panel Reworks*	Panel Production Increase**
Negative Plates (M-)	2.5X	44%	5%
Positive Plates (M+)	5.4X	36%	8%

*This customer places incompletely pasted panels back into production **There are two plates per panel



Control NEG



PbLite® NEG



Before Lug brushing



After Lug brushing

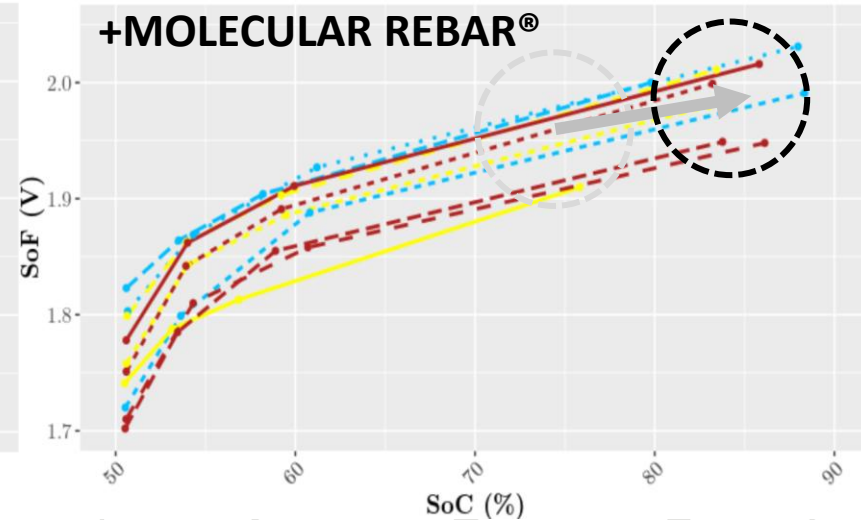
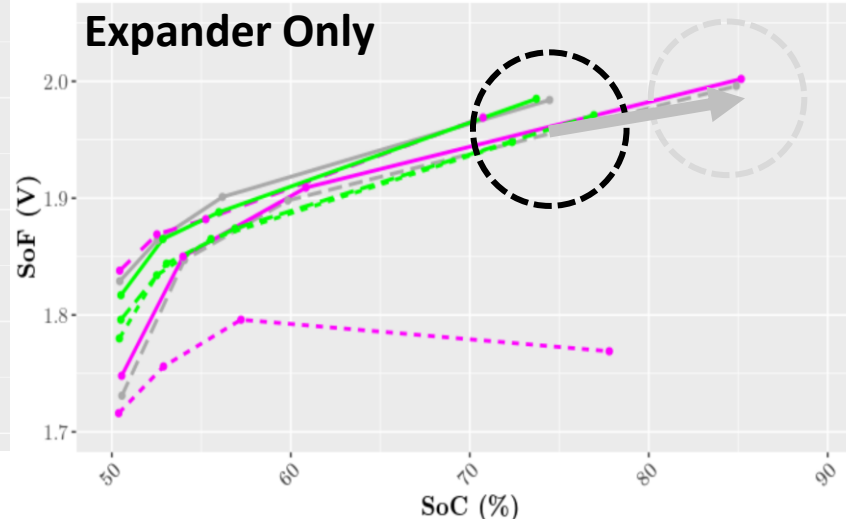
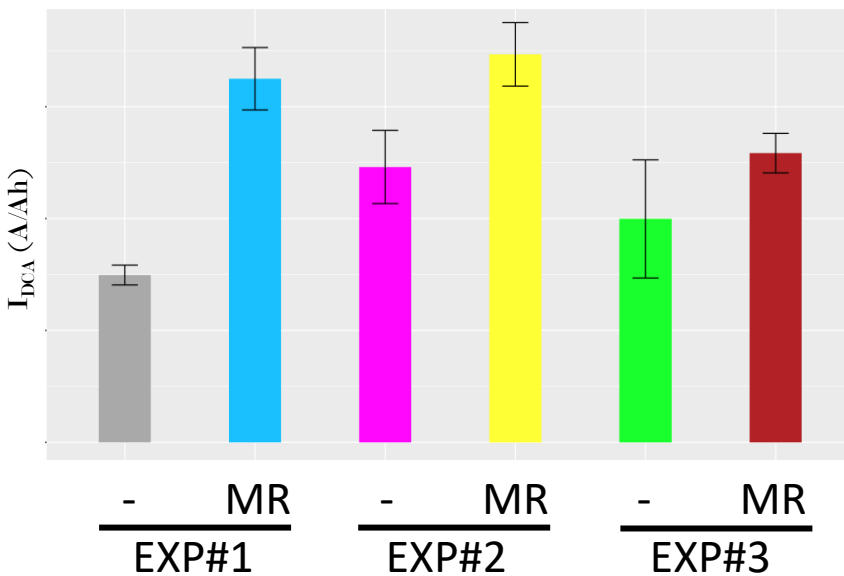
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Redesigning Batteries for New Applications (AUX)

eVehicles demand small, powerful, reliable batteries to safeguard passengers, we can help

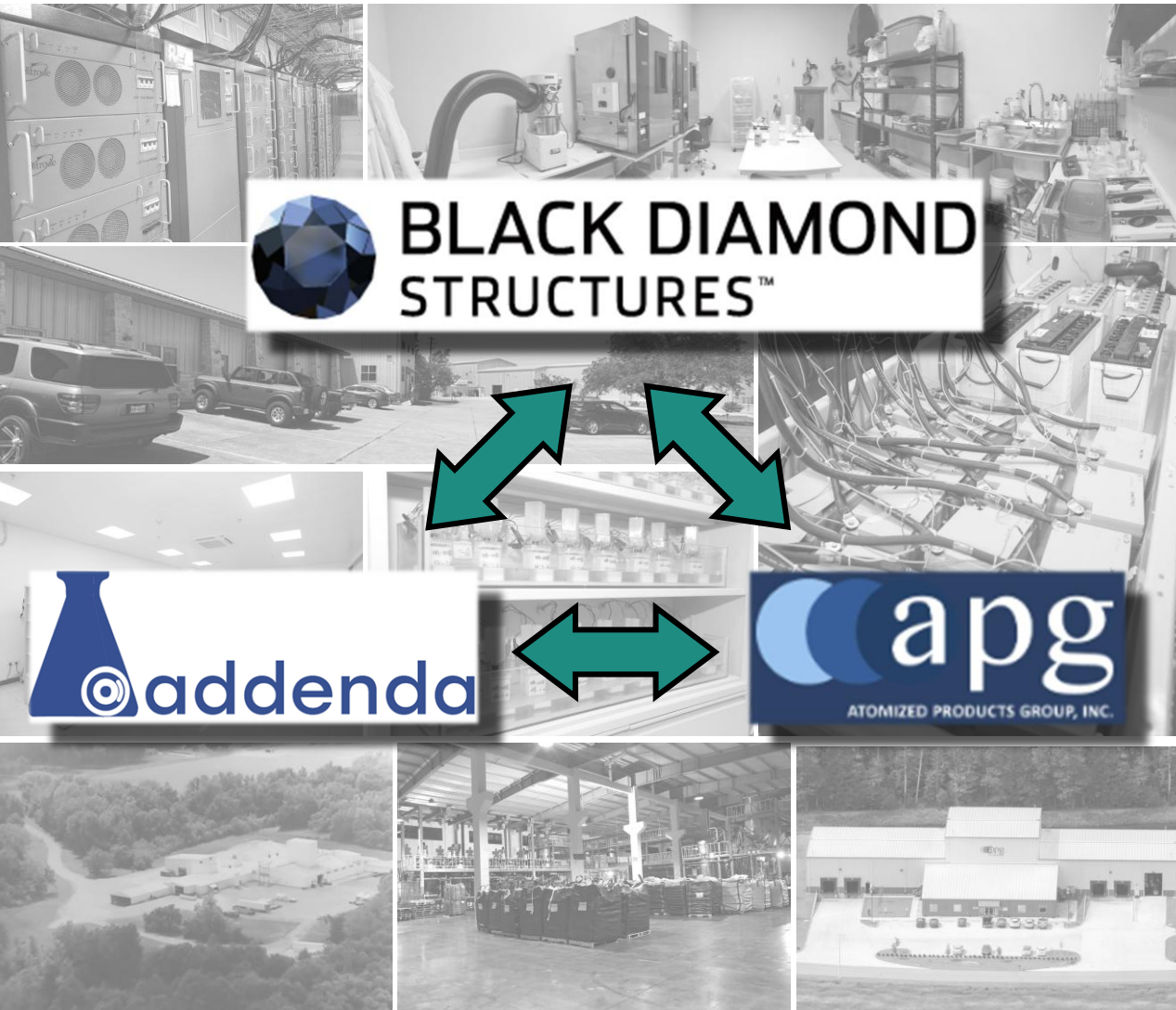
BDS helps you understand new AUX specs, thanks to our engagement w/ IEC discussion groups, ALBA

- Internally, we are currently focused on providing excellent charge recovery, without any detriments
- This 2 V work combines MOLECULAR REBAR® with new expander components from our partners
- Targeting higher DCA and improved SoF recovery per unit SoC (further up, right, charts below)



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Our Advanced Additive Alliance



Black Diamond Structures, Atomized Products Group (APG), and Addenda announce an Alliance

- Formed to better serve our customers
 - Improves customer access to bespoke products
 - Bolsters customer technical support network
 - Aims to decrease customer development time
- Integrates
 - Product portfolios
 - Commercial teams
 - Research facilities (2 V, 12 V, Materials Testing)
 - Global manufacturing capability
 - Decades of application knowledge

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Products:

- Consistent high-quality supply of expander for any application from two USA-based manufacturing locations
- CX® line of advanced graphite-based expanders seeing worldwide commercial adoption for EFB and AGM
- Long term supply agreements with all approved expander raw material suppliers
- High quality alternative product suppliers for risk mitigation and cost benefits

Capabilities / Scale / Certifications:

- IATF 16949:2016 certified at Chesapeake facility
- ISO 9001:2015 certified at Garland facility
- Certified Woman-Owned Business by the WBENC
- Capacity for significantly higher volumes



One of APG's Facility in Virginia, USA, manufacturing Expander

Positive Additives:

- Micronized Tetrabasic Lead Sulfate (4BS) seed
- Nanoscale α/β -seed on various lead sulfate phases
- Various grades of doped, mixed-metal oxide for use in PAM
- Red Lead
- Lead Oxides
- All products extensively tested and approved

Negative Additives:

- Produces negative expander strictly for the Chinese market at the Addenda China facility
- Organic crystal modification agents incorporating US-sourced kraft lignin and synthetic compounds
- Advanced nanoscale barium sulfate

No Tetra L2



1% Tetra L2



Critical material distributor servicing Korea, East Asia, and Beyond:

- Established in 1987
- Specialize in battery components, materials, manufacturing machine, consultancy and spare parts
- Adhere to a policy of providing “Best Service, Lower Prices, and Full Knowledge” to their customers

37 years of deep, global, battery and application knowledge

- Honored to serve ‘Know-How’, ‘Know-Who’, and ‘Know-Where’
- Offer quality components, materials, and equipment at competitive price and short delivery time
- Services SLI flooded, AGM ISG, industrial, traction cell, and AGM VRLA applications, from oxide to finishing

Ready to serve

- Your inquiries are always welcome
- www.ebckorea.com



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*Thank You For
Your
Attention!*

➡ **Booth 118**

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