

Alternative Power Safety for Mobile Equipment

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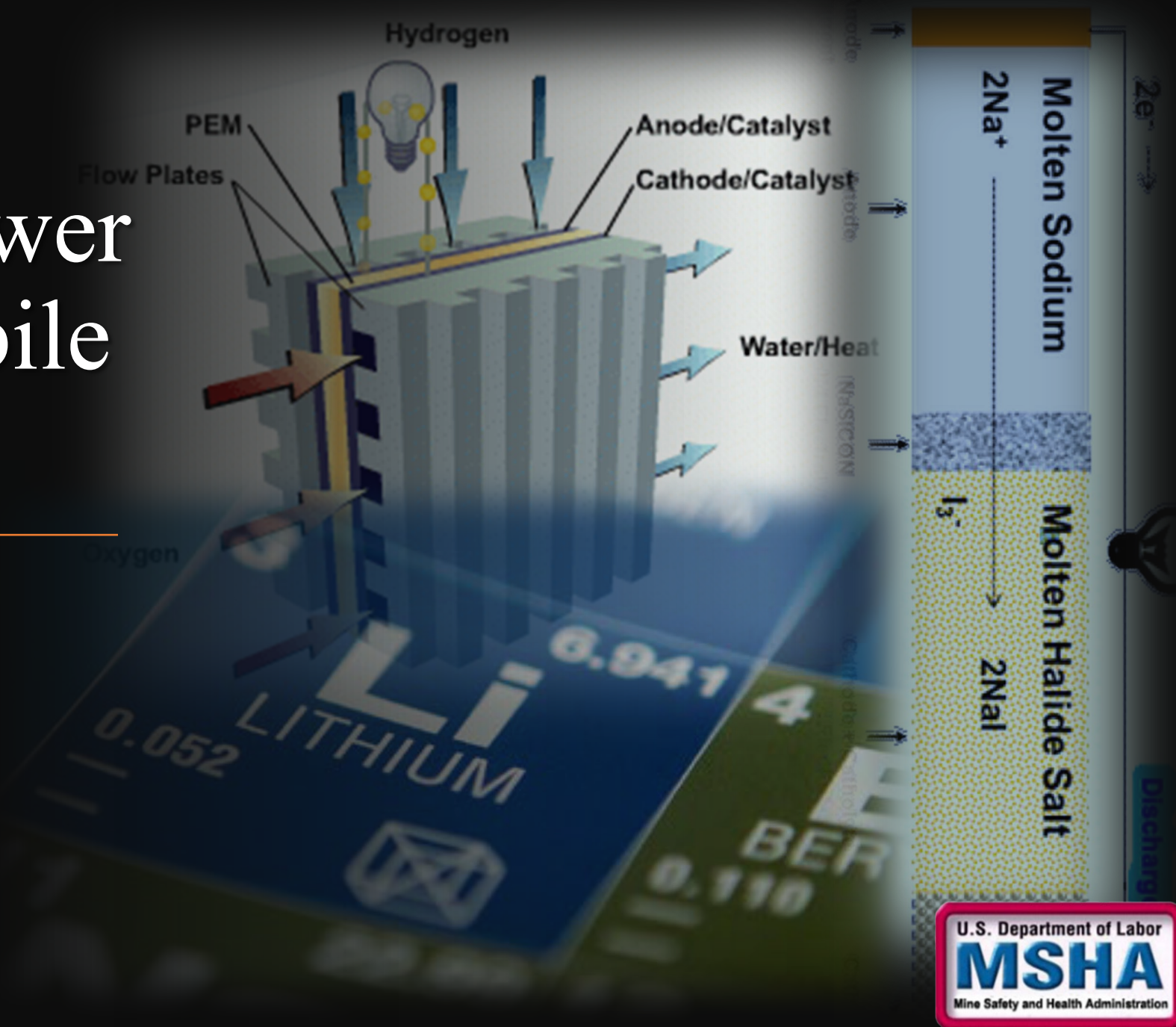
New Technology Program Manager

MSHA Technical Support

NIOSH Automation & Emerging

Technologies Partnership

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Historical Activity

Electrifying traditionally ICE* powered equipment

- Retrofit
- Purpose built

*Internal Combustion Engine

Re-powering traditionally lead acid battery powered equipment

Typically:

- Lithium (e.g., LFP, LTO)
- Molten salt
- Fuel Cells

Large Equipment  Large Batteries



Proposed
Uses

Surface



Underground



Underground Coal / Gassy Mines



Underground Permissible
Equipment Required



Benefits

Reduce/Eliminate Emissions (DPM)

Less Noise (Be Careful of Unintended Consequences)

Less Maintenance

Increased Efficiency

Weight Savings
Greater Energy Density

Enabling for Automation



Considerations

Training

Maintenance

Examinations

Charging / Re-fueling

Battery Management System and Monitoring

Transportation and Storage

Fire Protection

Egress / Warning / Escape

Collisions



Training

- Controls
- Acceleration
- Braking
- Maneuverability (weight distribution)
- Pre-shift / Pre-Operational Checks
- Routine Maintenance
- Other Unique Hazards



Maintenance & Examinations

- Qualifications
- Who Performs What?
 - Mine Personnel
 - Manufacturer
- Damage – What are you looking for?
 - FMEA can be helpful
 - Job Hazard Analysis
- Out of Service Criteria



Charging
Re-Fueling
Transportation
Storage

- Location
- Training/Procedures
- Equipment Needed
- Guarding
- Access Control
- Environmental Control
- Firefighting
- Monitoring
- Examinations



Battery Management System & Monitoring

- Consensus Standards Testing
- Detecting Hazards:
 - Temperature
 - Gases
 - Reduced Capacity
 - Isolation
- Fault / Out of Tolerance Definition
- Fault Actions
- Automatic / Manual Response



Fire Protection

- Component / Full Scale Burn Testing
- Early Detection
- Appropriate Suppression Agent
- Delivery – At the Source
- Automatic / Manual Activation
- Define Fire Gases / Acid Gases
 - Chemistry
 - Volumes
- Firefighting Plan



Egress
Warning
Escape

- Respirator / SCSR /PPE Required
- Operator Route
- Notification / Communication
- Inby Miner Escapeway / Refuge
- Mine Rescue / Evacuation



Collisions Structural Integrity

- Consider Reduced Machine Noise
- Impact Testing
- Guarding
- Traffic Control
- Collision Warning / Avoidance



Parting Thoughts

- Plan
- Train
- Address Known Hazards
- Avoid “That Will Never Happen”
- Utilize Risk Assessments
- Provide Information Necessary for MSHA Inspectors to Inspect

Questions?

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