

# AN OVERVIEW OF EXPANDERS A PRACTICAL GUIDE

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BCI 113TH CONVENTION, MAY  
6-9, LAS VEGAS, NEVADA

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# INTRODUCTION

- ❑ **WE WILL COVER:**
- ❑ **What Expanders Do**
- ❑ **Expander Materials**
- ❑ **How They Are Made**
- ❑ **How They are Used in Paste Mixing**
- ❑ **Expander Formulations**
- ❑ **Expander Selection Guide**

# WHAT EXPANDERS DO

- ❑ Increase Capacity
- ❑ Improve Cold Cranking Performance
- ❑ Increase Life

## HOW?

- Increasing surface area
- Increasing porosity
- Preventing passivation
- Stabilizing crystal structure

# WHAT ARE THE MAJOR COMPONENTS?

- ❑ Organic Material
  - ❑ Lignosulfonates
  - ❑ Synthetics
- ❑ Barium Sulfate
  - ❑ Blanc fixe
  - ❑ Barytes
- ❑ Carbon
  - ❑ Carbon black
  - ❑ Graphite

# ORGANICS

- ❑ Popular Lignosulfonates
  - ❑ Vanisperse A
  - ❑ Kraftplex
  - ❑ Indulin AT
  - ❑ Vanillex
- ❑ The Only Synthetic
  - ❑ Lomar B

# LIGNOSULFONATES

- ❑ **Extracted from softwoods**
- ❑ **Large, complex polyethers with different functional groups**
  - ❑ **Sulfonate**
  - ❑ **Carboxyl**
  - ❑ **Methoxy**
- ❑ **High molecular weights**

# SYNTHETICS

- **Naphthalene Sulfonates**

- **Lomar B**

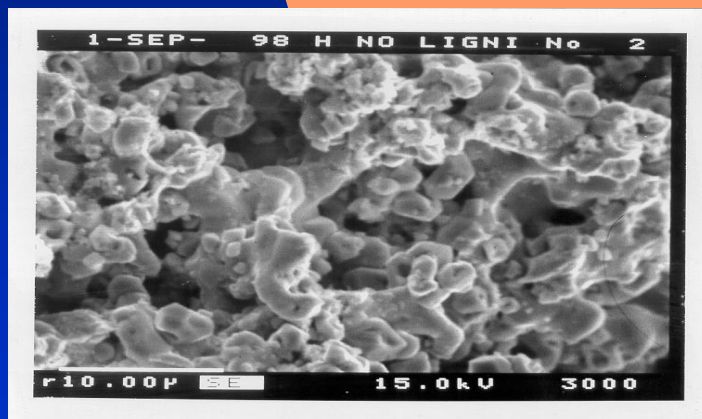
- Molecular weight    12,000-13,000**

- Good High Temperature Stability**

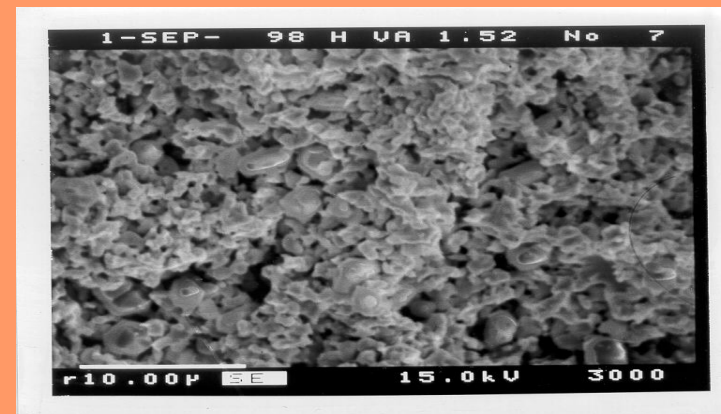
- High Purity**

# ORGANICS

- Adsorb on the surface of the lead crystals
- Increase the surface area of active material
  - ◆ From 0.2 sq. m./g to 0.8 sq. m./g
- Produce fine, porous crystal structure
- Improve low temperature capacity

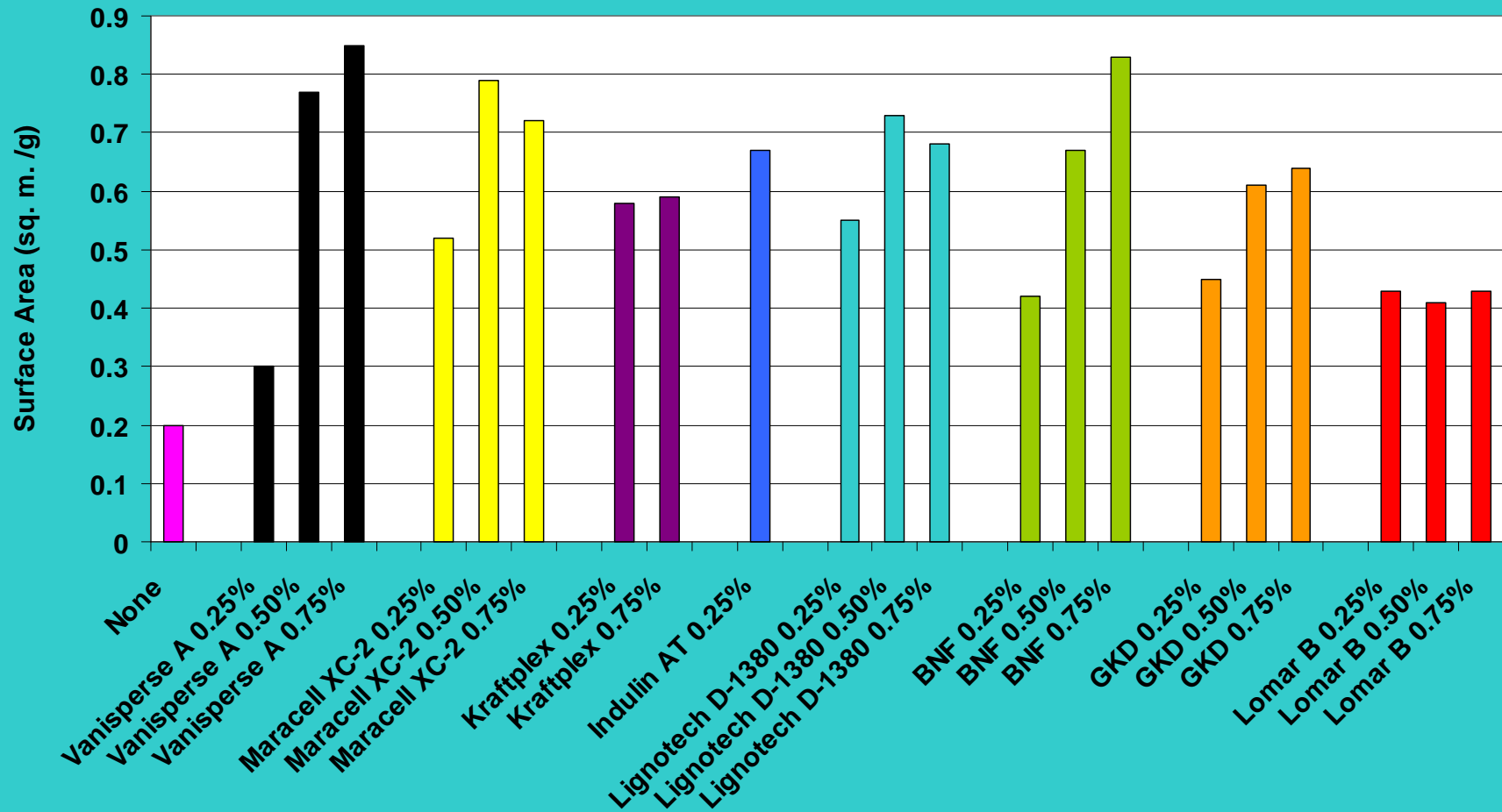


No Organic

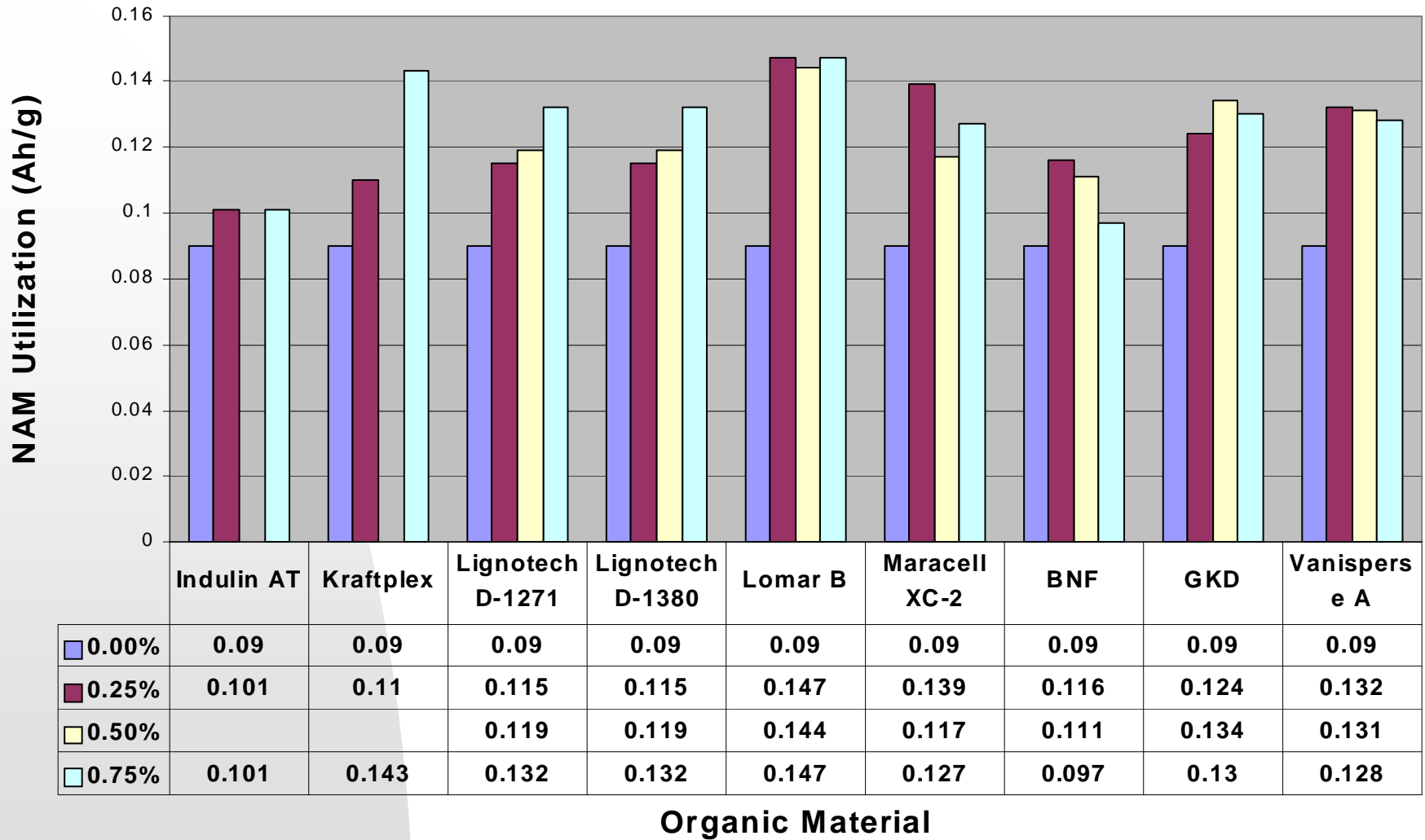


0.5% Vanisperse A

## BET Surface Area of Formed Negative Active Material With Various Organic Additives



## Negative Active Material Utilization (Ah/g) at 5-Hr Rate



# Barium Sulfate

- Two types are used

- **Blanc Fixe**

- Precipitated from solution

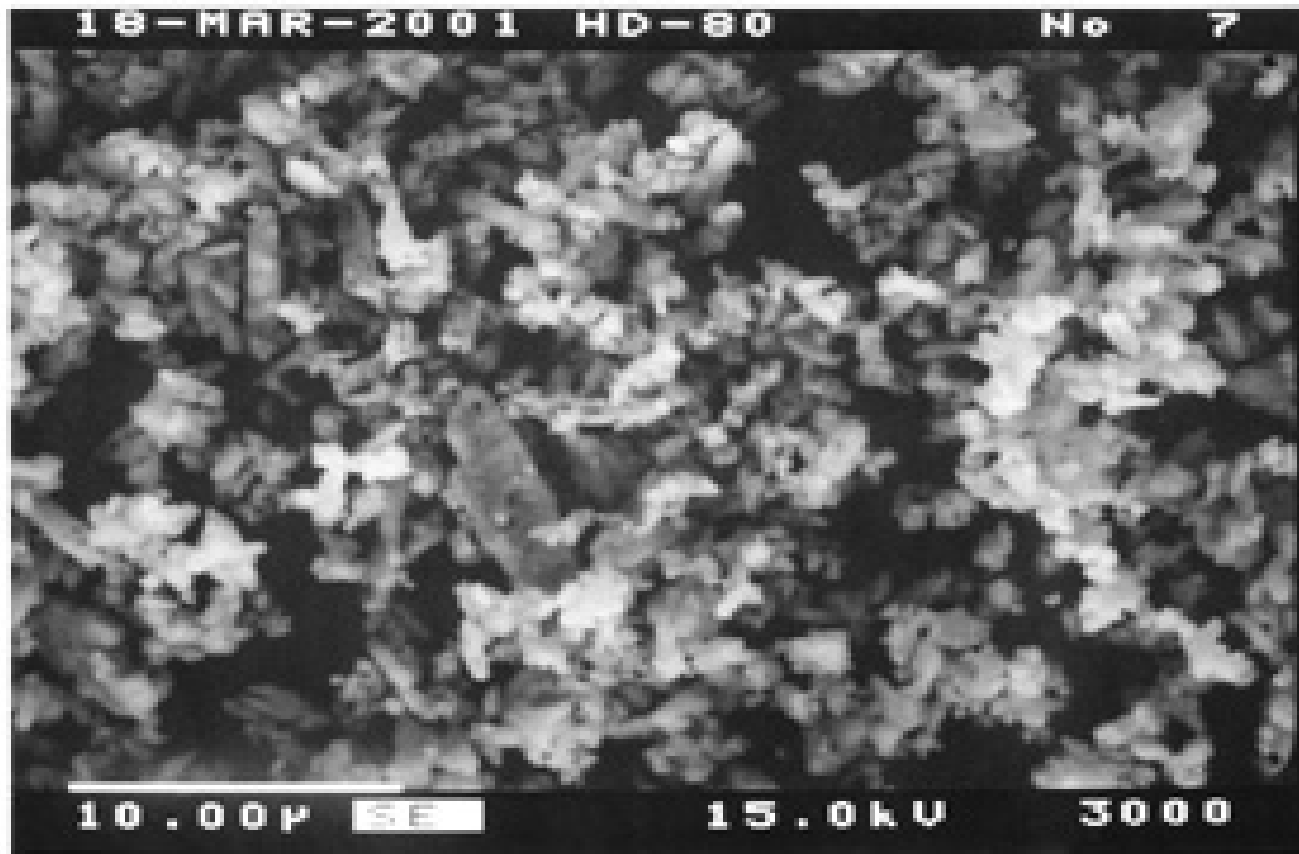
- Median particle size =  $1.0 \pm 0.25$  micron

- **Barytes**

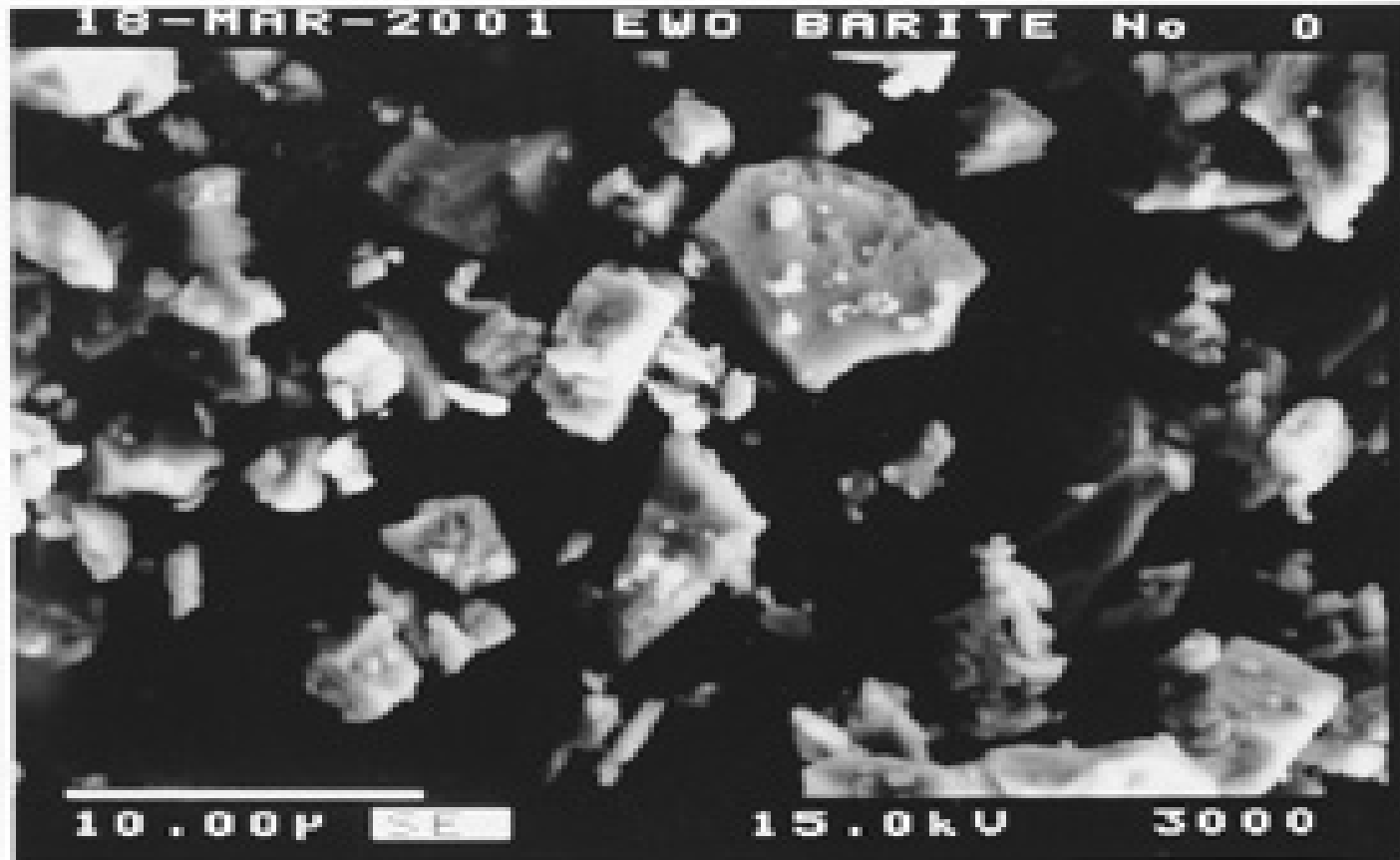
- Milled mineral

- Median particle size =  $3.5 \pm 0.5$  micron

# SEM IMAGE OF BLANC FIXE



# SEM IMAGE OF BARYTES



# FUNCTION OF BARIUM SULFATE

- ❑ Prevents passivation of the active material by lead sulfate
  - ❑ Barium sulfate and lead sulfate have almost identical crystal structures
  - ❑ Lead sulfate precipitates on the barium sulfate crystallites – this eliminates “coating” of the lead sponge
  - ❑ (*Energy of crystallization is eliminated, making it easier for the lead sulfate to grow on the barium sulfate crystals than on the lead*)

# STRUCTURAL CHARACTERISTICS OF BARIUM AND LEAD SULFATES

	BaSO <sub>4</sub>	PbSO <sub>4</sub>
<b>Cation-O bond length (Å)</b>	<b>2.952</b>	<b>2.87</b>
<b>S-O bond length (Å)</b>	<b>1.478</b>	<b>1.490</b>

# LEAD SULFATE NUCLEATING ON BARIUM SULFATE PARTICLES



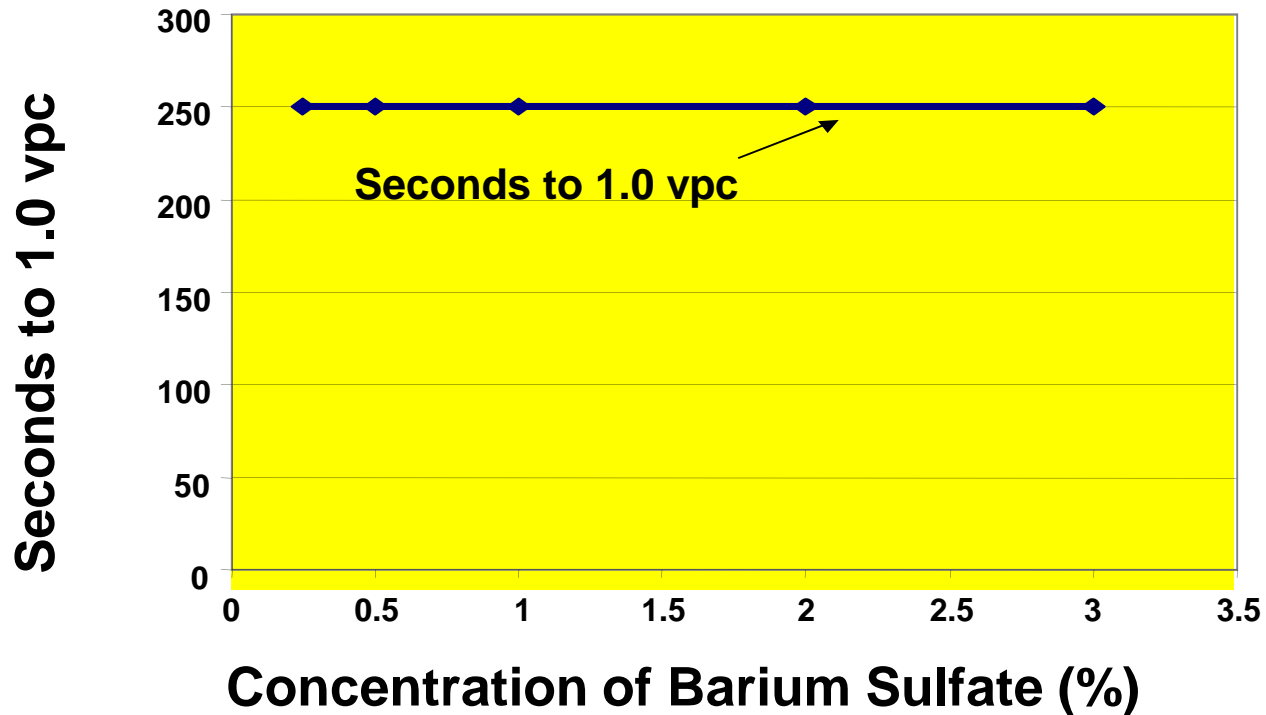
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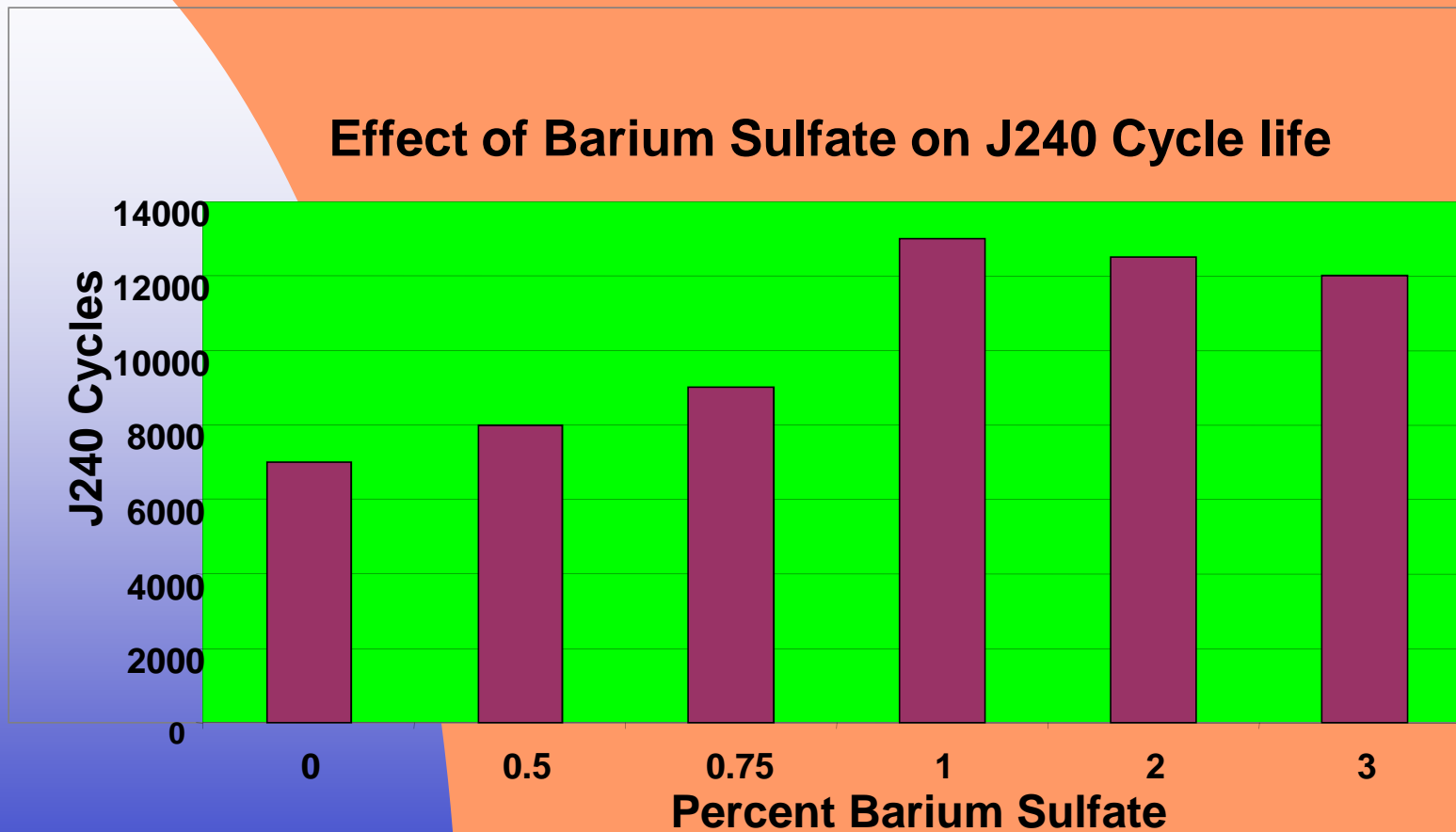
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# BARIUM SULFATE DOES NOT IMPROVE COLD CRANKING PERFORMANCE

Effect of Barium Sulfate on Cold Cranking Performance



# BARIUM SULFATE DOES IMPROVE CYCLE LIFE



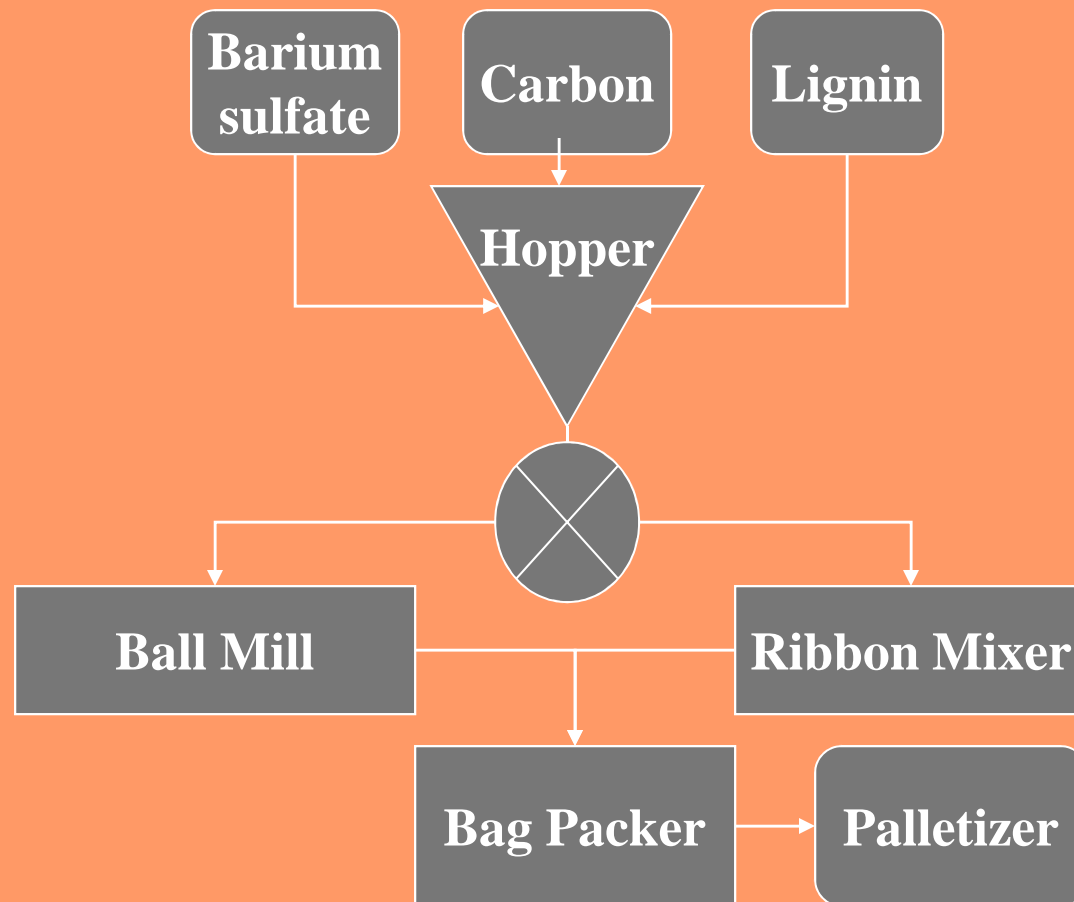
# FUNCTION OF BARIUM SULFATE

- ❑ Barytes is only used in industrial battery expanders
  - ❑ Originally added to improve flow and dispersion
  - ❑ But!
    - ❑ May act as slow release agent

# **FUNCTION OF CARBON BLACK**

- ❑ **Improves conductivity and aids formation**
- ❑ **Colors the plate so that negative plates are easy to distinguish**

# MANUFACTURING PROCESS



# BALL MILL



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# RIBBON MIXER



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# BAG PACKING



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# ADDING EXPANDER TO THE PASTE

## □ IT'S EASY

- Expander is supplied ready mixed in the weight required for your paste mix

- Add to the mixer with the oxide and flock before water addition

# BENEFITS OF PRE-BLENDED EXPANDER

## ■ Lower cost

- ★ Eliminates labor
- ★ Eliminates equipment
- ★ Reduces material cost
- ★ Reduces inventory cost and storage space
- ★ Reduces paperwork

- Expander is tested before it goes into the battery
- Bag weights exactly match your paste batch
- Elimination of paste mixing errors

# TYPICAL EXPANDER FORMULATIONS

## □ Automotive Batteries

□ Barium Sulfate	40%-60%
□ Organic	25%-40%
□ Carbon	10%-20%

**Addition Rate = 0.5%-1.0%**

# TYPICAL EXPANDER FORMULATIONS

## □ Motive Power Batteries

□ Barium Sulfate	70%-90%
□ Organic	3%-10%
□ Carbon	5%-15%

**Addition Rate = 2.0%-2.5%**

# TYPICAL EXPANDER FORMULATIONS

## ☐ Telecommunications

- ☐ Barium sulfate 80%-95%
- ☐ Organic 0%-10%
- ☐ Carbon 3%-8%

**Addition Rate = 2.0%-2.5%**

# TYPICAL EXPANDER FORMULATIONS

## ☐ UPS & Other

- ☐ Barium Sulfate 70%-80%
- ☐ Organic 10%-20%
- ☐ Carbon 5%-15%

**Addition Rate = 2.0%-2.5%**

# TYPICAL EXPANDER FORMULATIONS

## Valve Regulated

<input type="checkbox"/> Barium Sulfate	22%-85%
<input type="checkbox"/> Organic	10%-55%
<input type="checkbox"/> Carbon	0%-22%

**Addition Rate = 2.0%-2.5%**

# APPLICATIONS GUIDE

Application	Recommended Types			
Automotive	HE-4640	HE-631		
Motive Power	HE-115	HE-120	HE-1511	
Telecommunications	HE-750	HE-KXLF		
UPS	HE-1160			
Valve Regulated	HE-120	HE-150	HE-1160	HE-KXLF

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