WHY CAB-O-SPERSE® DISPERSIONS IN METAL PRETREATMENT?

1. Metal pretreatment performance enhancement
   - Greater micro-roughness to promote adhesion
   - Increased hardness and greater scratch resistance
   - Corrosion resistance from stronger barrier properties
   - Formulation stability relative to dry powder addition
   - Ease of handling/incorporation relative to dry powder

2. Ease of processing

3. Ultra-high purity

How do CAB-O-SPERSE® dispersions work?

CAB-O-SPERSE® dispersions provide a superior state of dispersion that yields stability in formulation and improved distribution of the additive particles throughout the coated pretreatment layer. Their high surface area helps induce uniform nucleation of the coating species.

Dispersed particles deposit at the same time as the coating species react with the metal substrate and precipitate on the surface.

Primer or coating

Pretreatment layer micro-roughness promotes adhesion to subsequent coatings.

ENHANCED DURABILITY

Up to 30% higher hardness

- Dispersions improve coating barrier properties by increasing hardness
- In an alkylsilane immersion coating, addition of 1.5% wt. silica increased the hardness >30%
- High hardness is a key factor in enabling scratch resistance

Improved corrosion resistance

CAB-O-SPERSE® dispersions deliver superior corrosion resistance properties in a model formulation when compared to comparable colloidal silica dispersions.

<table>
<thead>
<tr>
<th>% wt. silica</th>
<th>Type of silica in coating</th>
<th>Salt spray corrosion resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>CAB-O-SPERSE dispersion</td>
<td>★★★★★</td>
</tr>
<tr>
<td>52</td>
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<td>★★★★★</td>
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<tr>
<td>71</td>
<td>CAB-O-SPERSE dispersion</td>
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<tr>
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<td>Colloidal dispersion</td>
<td>★★★★</td>
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<tr>
<td>59</td>
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<td>★★★★</td>
</tr>
<tr>
<td>86</td>
<td>Colloidal dispersion</td>
<td>★★★</td>
</tr>
</tbody>
</table>

Performance ranking:
- ★★★★★ Excellent
- ★★★★ Fair
- ★★ Poor

This table was adapted from US Pat. 5,805,015. Ammonium zirconium carbonate solutions were used to form amorphous coatings containing predispersed silica particles. % weights are for dry coatings.

Roughness increased 6x with dispersed silica in an alkylsilane immersion coating measured via AFM*

Improving adhesion with micro-roughness

Adhesion between the coating and the metal pretreatment layer is improved when the pretreatment delivers surface roughness.

The condensing species forming the pretreatment layer exhibit greater micro-roughness from the presence of uniformly distributed fumed metal oxide particles delivered by CAB-O-SPERSE® dispersions.

Strong adhesion promotion helps yield consistent performance throughout the coating.

SEM* image of a rough surface layer formed by a polymer coating enhanced with CAB-O-SPERSE® dispersion

*Scanning Electric Microscopy

*Atomic Force Microscopy
CABOT-SPERSE® DISPERSIONS FOR METAL PRETREATMENT

**RELATIVE PERFORMANCE IN METAL PRETREATMENT**

**Cabot products:**

**General guidelines:**
- Large particles facilitate stable formulations
- Alumina provides increased hardness and abrasion resistance vs silica
- Cationic additives promote adhesion

**Legend:**
- Material: Silica, Alumina
- Stabilizer chemistry: NH₃, KOH, Proprietary
- Particle charge: Anionic, Cationic

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**FORMULATION INFORMATION**

CABOT-SPERSE dispersions are suitable for immersion coatings and coil coatings (including dry-in-place, or DIP, coatings).

The list below provides component ranges to consider in several types of pretreatment formulations.

**Coil coatings**
- Chromate systems:
  - Chrome (III) chromate: 1-10% wt.
  - Silica: 1-10% wt.
  - Water (balance)
- Titania systems:
  - Fluotitanic acid solution: 1-5% wt.
  - Silica: 1-5% wt.
  - Water soluble polymer: 0.2-0.75% wt.
  - Water (balance)
- Zirconia systems:
  - Ammonium zirconium carbonate: 1-5% wt.
  - Silica: 1-5% wt.
  - Water soluble polymer: 0.5-1% wt.
  - Water (balance)

**Immersion systems (dipped 0.5 – 10 min before removal)**
- Silane systems:
  - Alkylsilane: 1-3% wt. in water or water/alcohol
  - Silica: 0.01-1% wt.
  - Water (balance)

**Additional formulation guidance:**
- Water soluble polymer binders promote adhesion, flexibility, and forming
- CABOT-SPERSE dispersions facilitate addition of fumed metal oxide particles to pretreatment formulations — the superior state of dispersion improves formulation stability
- It is recommended to match the pH of the CABOT-SPERSE product to that of the formulation for maximum stability

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