CABOT

FUMED METAL OXIDES

APPLICATION GUIDE

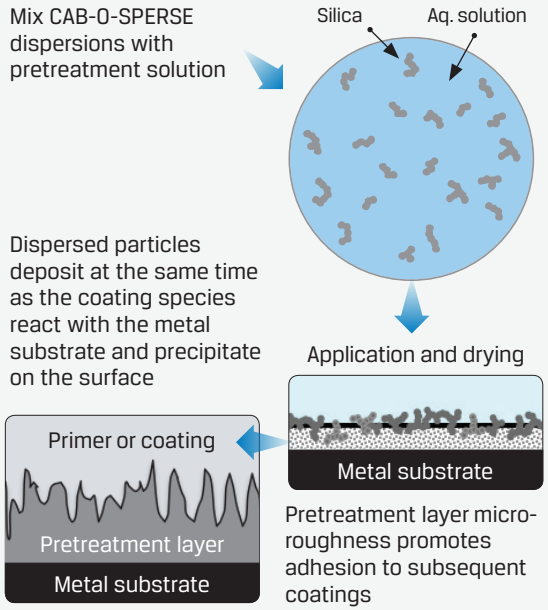
CAB-O-SPERSE® DISPERSIONS FOR METAL PRETREATMENT

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?

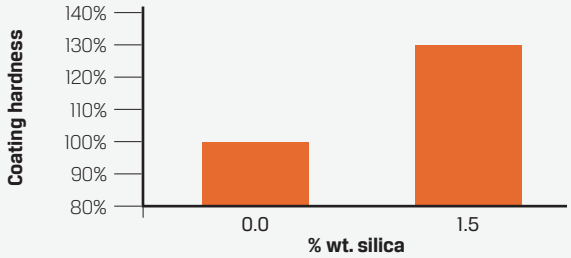
CAB-O-SPERSE dispersions provide a superior state of dispersion that yields stability in formulation and improved distribution of the additive particles throughout the coated pretreatment layer. Their high surface area helps induce uniform nucleation of the coating species.



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.

% wt. silica	Type of silica in coating	Salt spray corrosion resistance
35	**CAB-O-SPERSE dispersion**	◑
52	**CAB-O-SPERSE dispersion**	●
71	**CAB-O-SPERSE dispersion**	●
37	Colloidal dispersion	◑
59	Colloidal dispersion	○
86	Colloidal dispersion	○

Performance ranking: ● Excellent ◑ Fair ○ Poor

This table was adapted from US Pat. 5905105. Ammonium zirconium carbonate solutions were used to form amorphous coatings containing predispersed silica particles. % weights are for dry coatings.

IMPROVED ADHESION

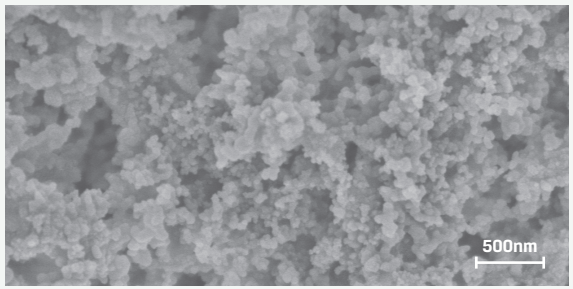
Driving adhesion with micro-roughness

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.

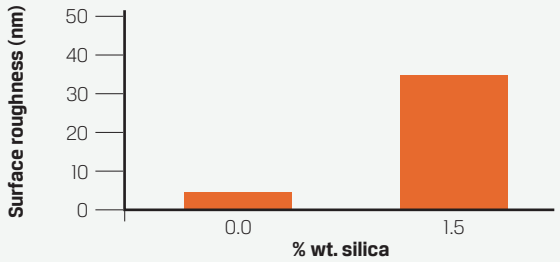
Strong adhesion promotion helps yield consistent performance throughout the coating.

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



*Scanning Electric Microscopy

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



*Atomic Force Microscopy

RELATIVE PERFORMANCE IN METAL PRETREATMENT

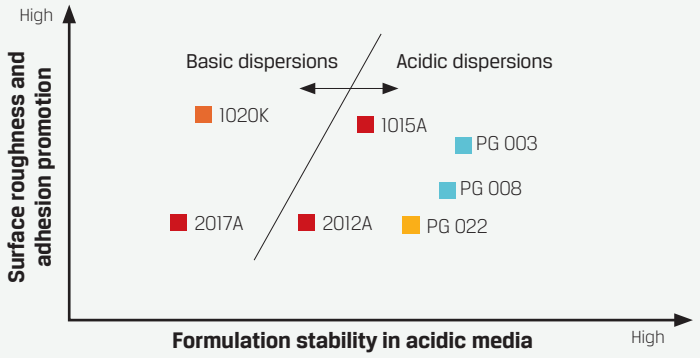
Cabot products:
CAB-O-SPERSE dispersions: 2012A, 1015A, 2017A, 1020K, PG 022, PG 003, PG 008

General guidelines:

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

Legend:

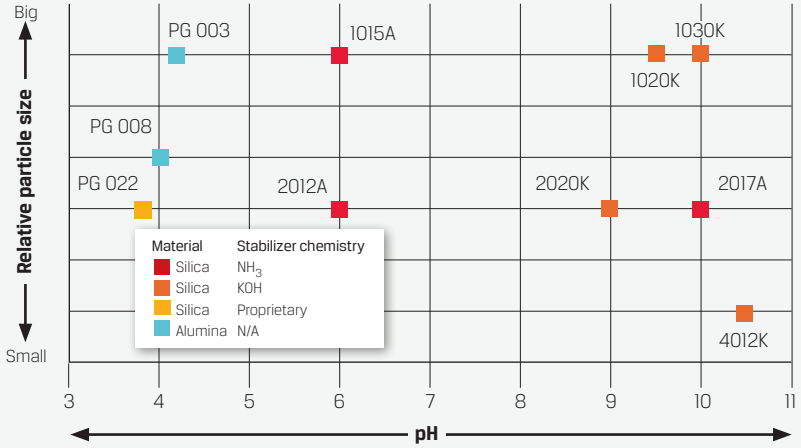
Material	Stabilizer chemistry	Particle charge
Silica	NH_3	Anionic
Silica	KOH	Anionic
Silica	Proprietary	Cationic
Alumina	N/A	Cationic



Note: Data are for fixed solids loading

CAB-O-SPERSE PRODUCTS AND PROPERTIES

CAB-O-SPERSE product	Loading	Charge
1015A	15%	Anionic
1020K	20%	Anionic
1030K	30%	Anionic
2012A	12%	Anionic
2017A	17%	Anionic
2020K	20%	Anionic
4012K	12%	Anionic
PG 003	40%	Cationic
PG 008	40%	Cationic
PG 022	20%	Cationic



FORMULATION INFORMATION

CAB-O-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
- CAB-O-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 CAB-O-SPERSE product to that of the formulation for maximum stability

CABOT

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