

FUMED METAL OXIDES



**CABOT**

creating what matters

## **Fumed Silica and Fumed Alumina Selection Guide for Inkjet Media Applications**



# Fumed Silica and Fumed Alumina Selection Guide for Inkjet Media Applications

## Introduction

Digital photo-printing or photo-imaging is a rapidly growing technology replacing traditional analogue print processes in a wide range of applications.

In photography, the revolutionary adoption of digital cameras, enables users to shoot, print and share images through an increasing array of technologies and media.

Traditional film based on silver halide photography is being replaced by digital imaging in applications ranging from consumer photography through professional/portrait photography, retail photo-processing, to the large scale commercial production of photographic quality posters and promotional displays.

Inkjet printing has become the leading print technology for many digital photographic imaging applications and has led to the development of new technologies for producing high quality, fast drying media. In addition to digital photography, the emergence of digital printing is creating a whole new range of exciting inkjet applications including greeting cards, CD labels, transparencies, jigsaws and decals. Each new application brings special demands for media ranging from photobase paper to polyester transparencies and textiles.

Cabot Corporation has combined its expertise in fine particles and surface modification chemistry to create a range of high performance aqueous dispersions for use in the manufacture of digital inkjet printable semi-gloss and glossy media. These products are especially designed to combine a range of premium imaging finishes together with excellent processing characteristics.

This brochure covers Cabot's range of silica and alumina dispersions and powder materials for Inkjet Media applications. The **CAB-O-SPERSE®**, **CAB-O-SIL®** and **SpectrAl™** product ranges are designed to provide:

- **High absorptive capacity**
- **Fast drying characteristics**
- **Good substrate adhesion**
- **Excellent image quality and gloss**

Cabot holds and has filed several patents related to the use of its product ranges in Inkjet Media applications.

## Types of Photographic Media

A wide range of coated and uncoated media can be used for printing on inkjet printers. While general purpose uncoated media are suitable for text, the printing of photographic images is best achieved using a specially designed photographic media.

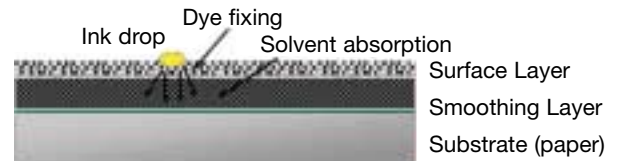
These special purpose products have high performance coatings enabling images to be printed quickly with outstanding picture quality. Two coating technologies are currently used: swellable coatings that are polymeric in nature, and particulate coatings which consist mainly of inorganic porous particles.

The use of particulate or microporous coatings is fast becoming the preferred technology for producing high quality “instant dry” glossy inkjet paper. A typical design for microporous paper would resemble the diagram on the right.

Most of the top layer is composed of particles, along with a small amount of binder such as polyvinyl alcohol. This type of media construction has instant drying properties, because of the porosity of the ink fixing layer and the receiving layer. As ink drops hit the surface, capillary action pulls them quickly into the coating.

Alternative coating technologies such as polymer swellable coatings rely on diffusion of the ink which results in slower dry times and risk of ink transfer, smudging, and ink bleed in high humidity environments.

### Drying on Porous Media



Typical Surface Layer  
 85 % Alumina  
 10 % Polyvinyl Alcohol  
 5 % Additives

## Choice of Particles for Microporous Coatings

The formulation for the top layer needs to provide a number of important properties to the media. Among these are:

- Instant ink absorption
- Gloss
- Color density
- Smoothness
- Color palette or gamut
- Adhesion to the substrate
- Defect free printing

In addition, the paper is often designed to print well on more than one type or brand of inkjet printer. This requirement places an even higher demand on the performance of the particles.

For optimum ink absorption and the highest gloss, a highly structured nano-particle such as a fumed metal oxide is ideally suited and produces unsurpassed performance in this application. Fumed alumina and fumed silica have a number of advantages that enable them to meet the needs of high performance inkjet media.

Product Property	Desired Performance
Small particle size	High gloss
Highly structured particle	High porosity, ink absorption
Strongly hydrophilic	High solids formula
High chemical purity	No effect on color / hue

# Product Selection Guide

## 1. CAB-O-SPERSE dispersions for Inkjet Media:

Manufacturers of ink-receiving coating formulations typically use water-based formulations of 20-40% total solids content to coat the substrates for inkjet applications. Fumed metal oxide particles from Cabot are available as pre-dispersed slurries, which are easy to mix into coatings.

Product	Description
CAB-O-SPERSE PG001	30 % fumed silica aqueous dispersion, pH 10.0
CAB-O-SPERSE PG002	20 % fumed silica aqueous dispersion, pH 9.5
CAB-O-SPERSE PG063	40 % fumed silica aqueous dispersion, pH 10.0
CAB-O-SPERSE PG022	20 % cationic fumed silica aqueous dispersion, pH 4.0
CAB-O-SPERSE PG003	40 % fumed alumina aqueous dispersion, pH 4.0
CAB-O-SPERSE PG042	44 % fumed alumina aqueous dispersion, pH 4.0

## 2. CAB-O-SIL Fumed Silicas and SpectrAl Fumed Alumina for Inkjet Media:

The performance of the dispersion process is a critical step to achieve application performance. Cabot recommends that appropriate care and efforts be applied to producing dispersion when using its **SpectrAl** and **CAB-O-SIL** products.

Product	Description
CAB-O-SIL M-5	200 m <sup>2</sup> /g Fumed Silica, pH 4.0
CAB-O-SIL M-7D	200 m <sup>2</sup> /g Fumed Silica, densed, pH 4.0
CAB-O-SIL EH-5	380 m <sup>2</sup> /g Fumed Silica, pH 4.0
SpectrAl 51	55 m <sup>2</sup> /g Fumed Alumina, pH > 5.0
SpectrAl 81	80 m <sup>2</sup> /g Fumed Alumina, pH > 5.0

Using the table below, formulators can select recommended grades of fumed metal oxide dispersions or dry materials either by application or functionality.

	Application									Functionality						
	Premium glossy photo paper	Glossy picture paper	Wide format glossy paper	Semi gloss (satin) photo paper	Trans- parency	Transparent back-lit film	Security paper	Greeting cards / specialties	On-line paper coating	Instant dry	Water Fastness	Gloss	Trans- parency	Colour Gamut	High Solids	Porosity
PG001				•			••			•••						••
PG002				•	••	••	••			•••			••			•••
PG063				••			••		•••	•••					•••	••
PG022	••	•••	•••	••	•••	•••		•••		•••	••	••	•••	•••		•••
PG003	•••	•••	•••		••	••		•••	••	•••	•••	•••	••	••	•••	••
PG042	•••	•••	•••		••	••		•••	••	•••	•••	•••	••	••	•••	••
COS M-5	••	••	••	••	••	••	••	••		•••		••	•••	•••	•	•••
COS M-7D				••			••			•••		•	•	•••	••	•••
COS EH-5	••	••	••	••	••	••	••			•••		••	•••	•••	•	•••
SpectrAl 51	•••	•••	•••					•••	•••	•••	•••	•••	••	••	•••	••
SpectrAl 81	•••	•••	•••		••	••		•••	•••	•••	•••	•••	••	•••	•••	•••

••• Highly Recommended

•• Recommended

• Limited Suitability

# Product Application Guide

## 1. CABOT Fumed Alumina: Use & Performance

**CAB-O-SPERSE** PG003 and PG042 fumed alumina dispersions exhibit high performance in gloss, ink drying time and image quality in inkjet media.

In addition, they have high solids content which enables them to be formulated into high solids coatings for the best coating efficiency and drying rate. A typical formulation for the fumed alumina dispersions is given in the table below.

The type of substrate, the type of binder, and other factors affect the choice of a surfactant. This formula can produce a coating with a 60° gloss of about 70, good adhesion to the substrate, high image quality and instant ink drying. Variations on this recipe can be used as appropriate.

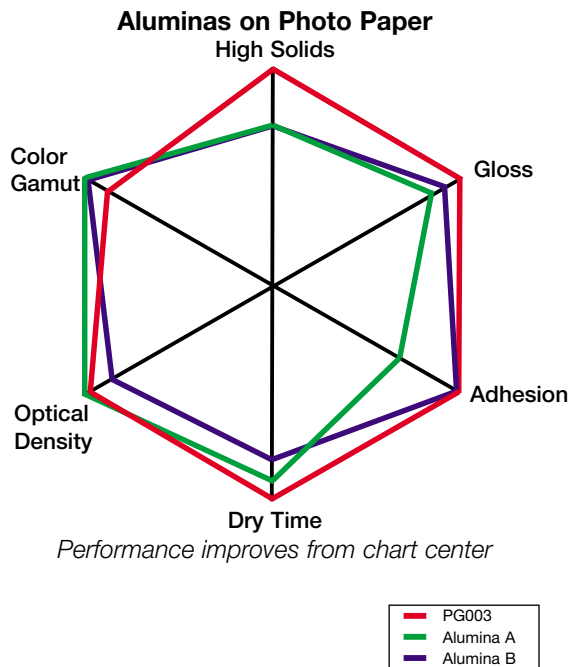
Ingredient	Dry parts	Description
CAB-O-SPERSE PG003	100	Fumed alumina dispersion, 40 % solids
Polyvinyl Alcohol binder	16.7	Low molecular weight
Polyvinyl Pyrrolidone	4	Low molecular weight
Surfactant	0.2–1.0	As appropriate for substrate
Total solids		25 – 35 %

Fumed alumina dispersions, such as PG003 and PG042, have several advantages over competitive particles in glossy inkjet media applications.

Fumed aluminas from Cabot have unique structures which allow very high loadings of up to 44 % solids in the dispersion.

A consequence of this loading is that high solids coatings can be made, which dry faster and require less drying energy than competitive coatings. An additional feature of the alumina dispersions is that they have low and stable viscosities, and coatings produced from them have controllable viscosities.

The diagram on the right indicates comparative performance of the Cabot dispersions against two competitive materials.



Cabot Fumed Aluminas are available in dry form for customers having dispersion capability. Please refer to the Cabot SpectrAl product range.

## 2. CAB-O-SPERSE Cationic Fumed Silica Dispersions in Inkjet Media Coatings

For very high image quality, CAB-O-SPERSE® PG022 cationic fumed silica dispersion exhibits the best performance in inkjet media. This product is a dispersion of cationic fumed silica, which has a proprietary treatment to give the particles a positive charge.

The positive charge improves the dye fixation properties of the silica, which leads to improved color properties and water fastness. A typical formulation for this product is given in the following table.

Ingredient	Dry parts	Description
CAB-O-SPERSE PG022	100	Cationic fumed silica dispersion, 20 % solids
Polyvinyl Alcohol binder	12.5	High molecular weight
Co-solvent	0-3	For wetting
Surfactant	0.2-1.0	As appropriate for substrate
Total solids		15 – 20 %

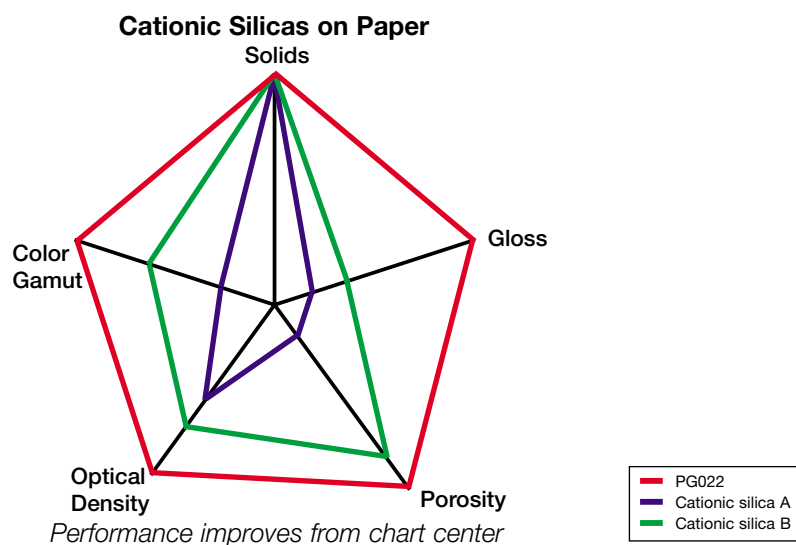
Other raw materials may be added to this basic formulation as needed for substrate adhesion, ink compatibility, or other performance needs. Coatings based on PG022 exhibit a semi-gloss to glossy appearance, instant ink drying, and very high color properties such as color density or gamut.

### Competitive Performance of CAB-O-SPERSE PG022

PG022 has a number of advantages over competitive silicas. Since the particles are cationic, the coating exhibits good dye fixation and water fastness compared to anionic silicas.

Additional advantages are evident compared to other cationic silicas, as shown below. The strengths of PG022 are in better gloss and visual density, as well as higher porosity and improved color gamut.

Coatings made with PG022 also exhibit excellent image quality, making it suitable for the most demanding narrow or wide format applications.

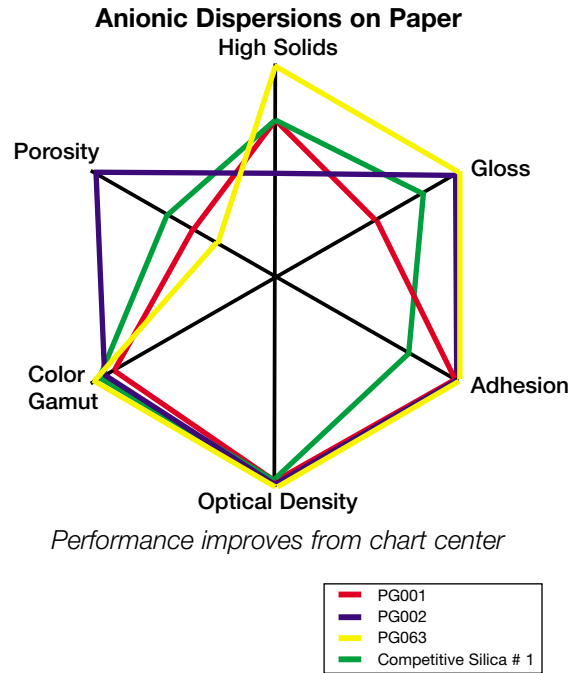


## The Use of CAB-O-SPERSE Anionic Dispersions PG001, PG002 and PG063

The comparison graph (right) shows the relative performance of these three silica dispersions vs. competitive silicas. PG063 and PG001 are clearly useful for applications requiring a glossy, high solids coating, which leads to improved drying and process economics.

PG002, while lower in product solids, has the best optical density values and the highest color gamut of the silicas tested. These properties are due to its very high porosity when it is correctly formulated into an ink-receptive coating.

For customers having dispersion capability, Cabot dry powder CAB-O-SIL fumed silicas are commercially available.



## The Use of CAB-O-SPERSE Dispersions on Polyester Film

CAB-O-SPERSE PG022 and PG002 dispersions for inkjet coatings have the following advantages over competitive porous particles:

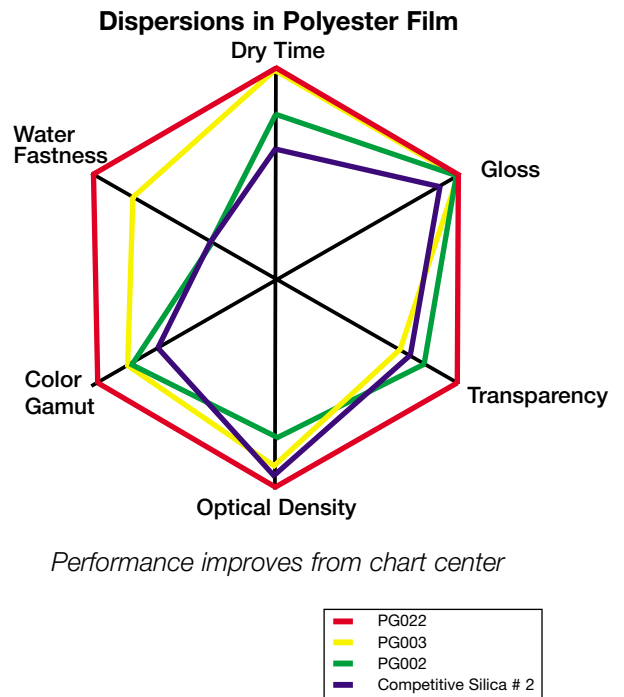
- Higher gloss
- Faster ink drying time
- Improved color gamut
- Higher transparency
- Improved water fastness

CAB-O-SPERSE PG022 & PG002 are recommended for use in the Inkjet receptive coating for premium, high transparency, polyester film applications. Suggested applications include transparencies, labels and back-lit film.

CAB-O-SPERSE PG002 & CAB-O-SPERSE PG022 combine instant dry performance with superb image quality.

As the chart on the right indicates, PG002 and PG022 have distinct advantages over colloidal silica in ink drying time, gloss, optical density and color gamut. When compared to polymeric coatings CAB-O-SPERSE PG022 and PG003 provide improved waterfastness and fast ink dry time.

CAB-O-SPERSE PG003 exhibits superior adhesion to substrate and resistance to cracking.



**North America:**

Cabot Corporation  
 Business and Technical Center  
 157 Concord Road  
 Billerica, MA 01821-7001  
 USA  
 Tel.: +1 (978) 663-3455  
 Tel.: (800) 462-2313 (Technical Service)  
 Fax: +1 (978) 670-7035 (Technical Service)  
 Tel.: (800) 222-6745 (FMO Customer Service)

**Europe:**

Cabot GmbH  
 Kronenstrasse 2  
 D-79618 Rheinfelden  
 GERMANY  
 Tel.: +49 7623 707 0  
 Fax: +49 7623 707 530  
 Customer Care Center: +32 16 39 24 00

**South America:**

Cabot Latin America Division  
 Av. Joao Castaldi 88  
 04517-900 Sao Paulo, SP  
 BRAZIL  
 Tel.: +55 11 5091 8300  
 Customer service:  
 Tel.: 0800 19 5859  
 Fax: +55 11 5542 6037

**Middle East/Africa:**

Cabot Specialty Chem. Inc.  
 Jebel Ali Free Zone  
 LOB 15, Office 424  
 Dubai  
 UNITED ARAB EMIRATES  
 Tel.: +971 4 8871 800  
 Fax: +971 4 8871 801

**Asia/Pacific:**

Cabot Specialty Chemicals Inc.  
 Level 21 MNI Tower 2  
 11, Jalan Pinang  
 50450 Kuala Lumpur  
 MALAYSIA  
 Tel.: +60 3 2164-8352  
 Fax: +60 3 2162-0253

Cabot Specialty Chemicals Inc.  
 Shiba Boat Bldg. 5F  
 3-1-15 Shiba, Minato-ku  
 Tokyo 105-0014  
 JAPAN  
 Tel.: +81 3 3457 7354  
 Fax: +81 3 3457 7658

Notice and Disclaimer. The data and conclusions contained herein are based on work believed to be reliable; however, Cabot cannot and does not guarantee that similar results and/or conclusions will be obtained by others. This information is provided as a convenience and for informational purposes only. No guarantee or warranty as to this information, or any product to which it relates, is given or implied. CABOT DISCLAIMS ALL WARRANTIES EXPRESS OR IMPLIED, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AS TO (i) SUCH INFORMATION, (ii) ANY PRODUCT OR (iii) INTELLECTUAL PROPERTY INFRINGEMENT. In no event is Cabot responsible for, and Cabot does not accept and hereby disclaims liability for, any damages whatsoever in connection with the use of or reliance on this information or any product to which it relates.

© Cabot Corporation, MA , U.S.A. All rights reserved 2004  
 CAB-O-SPERSE® and CAB-O-SIL® are registered trademarks of Cabot Corporation  
 SpectraAI™ is a trademark of Cabot Corporation

To receive Cabot materials Product Data Sheets or/and Material Safety Data Sheets,  
 please contact your local Cabot representative or visit our Inkjet Media pages at:  
**[www.cabot-corp.com/inkjetmedia](http://www.cabot-corp.com/inkjetmedia)**

