

BLACK

LANXESS
Energizing Chemistry

Bayoxide® E
for the Production
of Magnetic
Electrophotographic
Toners

ART

From Xerography

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LANXESS iron oxides involved from the start

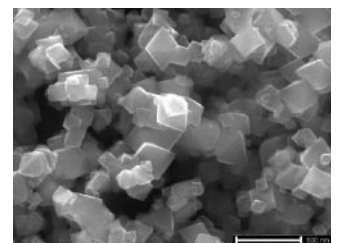
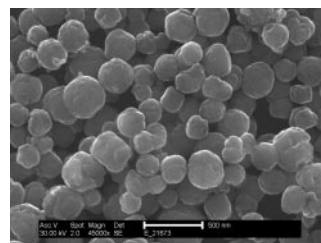
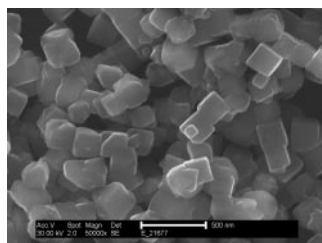
Since Chester F. Carlson demonstrated the principle of the xerographic copier on October 22, 1938, electrophotography has made steep progress, even though the beginnings were rather modest. The first machines worked by the two-component process using a magnetic ferrite carrier for the transportation of the toner powder.

Up until the 1970s, xerography was used exclusively in copying machines, and then, in 1973, the first printing system for computers was introduced. In 1983, a completely new market segment was opened up with the launch of the "Personal Copier" and the first laser printers. These machines work by the one-component process, which allows for the design of particularly compact printers. One-component toners contain 30-60 percent magnetic iron oxide, making the use of a carrier obsolete.

to laser printers

An optimized product range

Tailor-made for printing systems

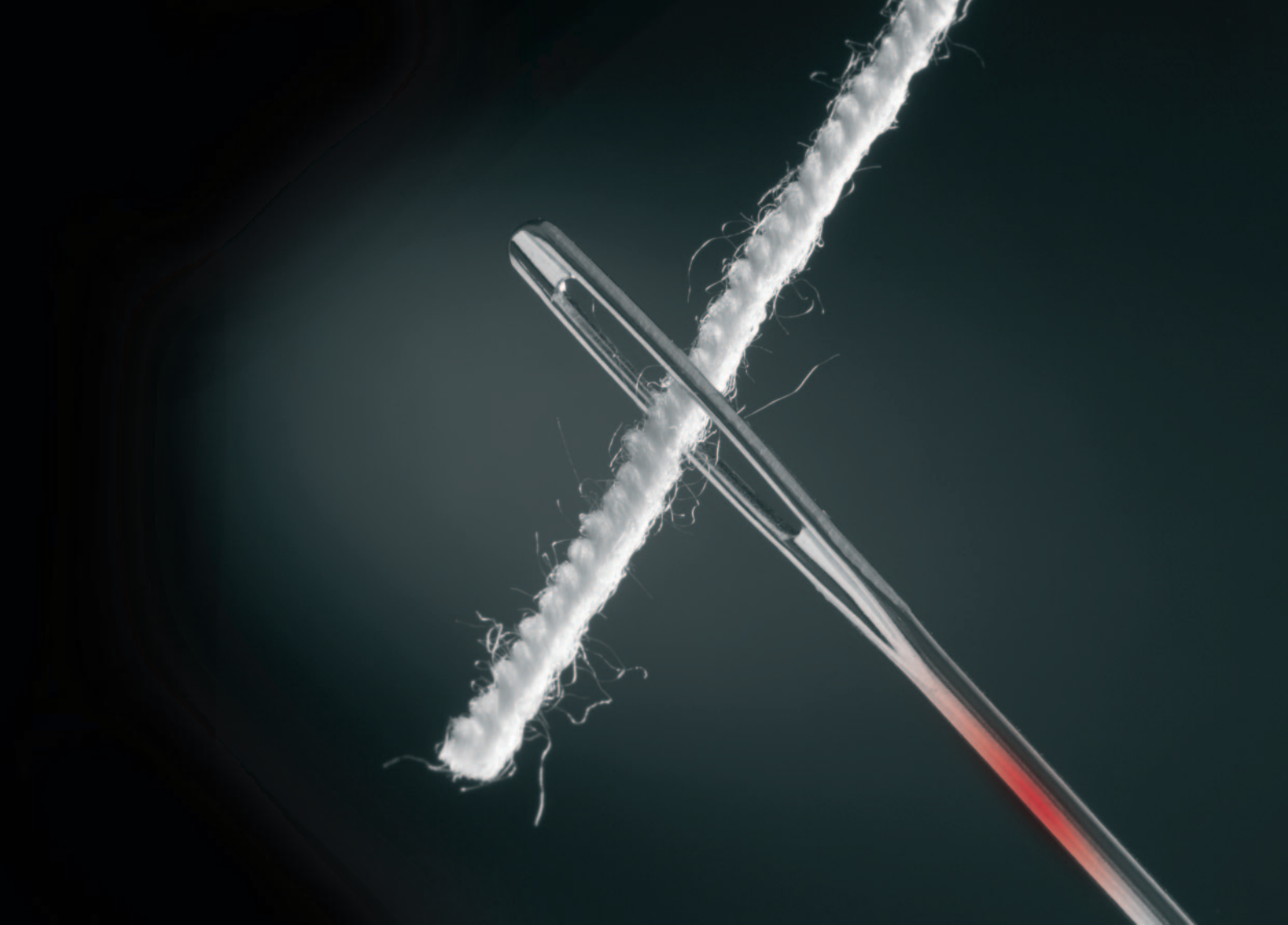


LANXESS is the world's largest manufacturer of synthetic iron oxides. Besides a great variety of color pigments and technical grades, we offer a full range of products developed specifically for the toner industry. Since their launch in 1981, the Bayoxide® E standard grades have established themselves on the Asian, European and American markets.

In 1993 we supplemented our 8600 range with the high-performance Bayoxide® E 8700 grades, which we produce by the precipitation process. Compared with the standard grades, the 8700 types have a particularly narrow particle size distribution, defined particle shape and made-to-measure magnetic properties. The coercivity and remanence of a toner is, to a certain extent, dependent on the type of system used in the copier or printer. To satisfy the requirements of virtually any type of machine, LANXESS offers products in the ranges of 55 Oe, 100 Oe and 130 Oe.

The customer requires toners with a high image density (blackness) at a reasonable yield. While the balance between yield and image density can be influenced by changing the magnetite content of the toner, both – yield and image density – can be optimized if oxides with a high tinting strength are used. Recognizing this, our 8700 grades have an outstanding tinting strength and a bluish black color which is preferred by most consumers.

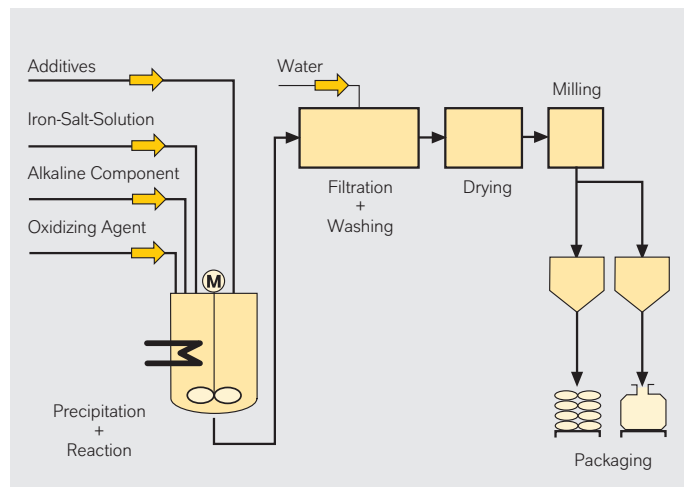
Some products are also available with a special coating to give them water-repellent properties. This significantly reduces moisture adsorption and improves the dispersibility in certain formulations, e.g. polyester based systems.



LANXESS uses two different processes for manufacturing Bayoxide® E toner oxides: the cost-effective Laux process and the precipitation process.

The precipitation process allows the coercivity to be adjusted as a distinctive magnetic feature. Magnetites with extremely homogeneous primary particles, improved dispersibility and good free-flowing properties are available. To ensure that we can continue to offer tailor-made pigments for a wide variety of printing systems in the future, we have a research laboratory dedicated to the development and optimization of every stage of the manufacturing process.

Scientists from the analytical, application technology, research and production departments collaborate with our customers to constantly improve the Bayoxide® product range.



You have the right to expect the best

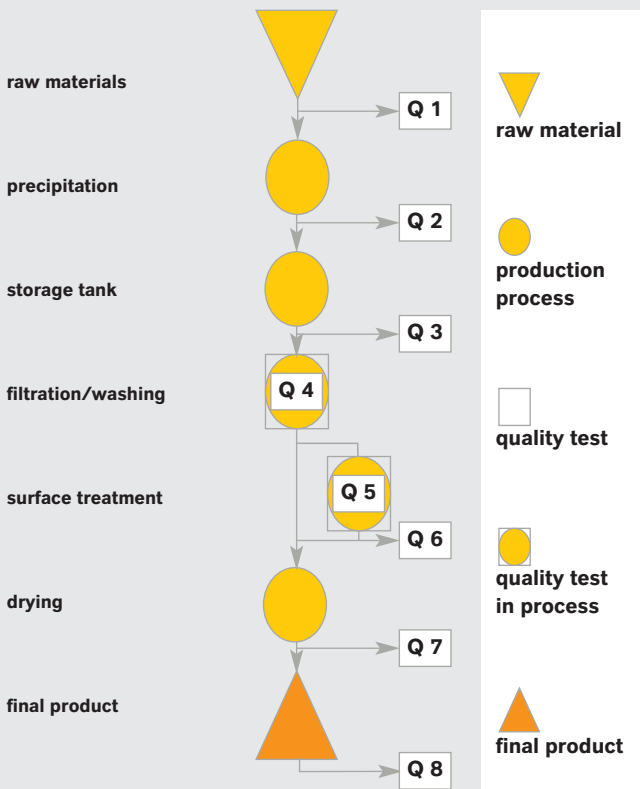
Quality is our business

Quality affects all areas of the company. It means offering products and services that conform to customer requirements. This naturally involves constant monitoring of the production processes. Regular sampling between the individual product stages combined with the final product ensure uniform product quality. Any deviations from the specified values can be identified during production and corrected. The quality of the product is documented by a manufacturer's test certificate that accompanies each consignment.

Certification to DIN EN ISO 9001 was obtained in 1997 and later also to DIN EN ISO 14001. These are monitored by regular audits carried out by the DQS (German Association for the Certification of Management Systems).



Quality Control of Toner Pigments



CERTIFICATE

DQS GmbH
Deutsche Gesellschaft zur Zertifizierung von Managementsystemen

hereby certifies that the company

LANXESS
Engineering Chemistry

Lanxess Deutschland GmbH
51369 Leverkusen

with the Business Units:
Basic Chemicals, Butyl Rubber, Functional Chemicals,
Inorganic Pigments, Ion Exchange Resins, Leather, Material Protection Products,
Polyolefin Rubber, Rubber Chemicals, Semi-Crystalline Products, Styrenic Resins,
Technical Rubber Products, Textile Processing Chemicals,
the Group Functions and Business Unit Entities Initiatives:
the Production sites / affiliates as listed in the annex
and the Regions Europe / Latin America / Middle East / Africa and Asia-Pacific for the scope
Product development, manufacturing, application technology, sales and technical service,
Regional Lanxess Customer Service

has implemented and maintains a
Quality and Environmental Management System.

Audits, documented in a report, have verified that this
management system fulfills the requirements of the following standards:

DIN EN ISO 9001 : 2000 **EN ISO 14001 : 2004**
December 2000 edition November 2004 edition

The environmental management system is based on
the attached environmental policy of the organization.

This certificate is valid until 2009-05-10
Certificate Registration No. 004312 QM UM
Frankfurt am Main 2006-05-11

IONet **DQS** **EFAR**

MANAGING DIRECTORS Dr.-Ing. S. Heesoh

D-60432 Frankfurt am Main, August-Schneer-Strasse 21



Bayoxide® E for the production of magnetic electrophotographic toners

Closely following the special requirements of today's market, Lanxess supplies a range of magnetites for use in toners:

- Bayoxide® E 8611
- Bayoxide® E 8706, 8708, 8709, 8710
- Bayoxide® E 8707 H and 8713 H

These grades are produced in a plant which is dedicated to the manufacture of toner oxides. The special design of the reactors and dryers as well as the use of our proprietary process allows us to produce magnetites with:

- ➔ Different coercivities in the region of 60, 70, 80, 90, 100 and 130 Oe
- ➔ A particle size between 0.15 and 0.5 μm
- ➔ Sharp particle size distribution
- ➔ Good dispersibility
- ➔ High tinting strength which allows for the development of toners with high image density and/or yield
- ➔ Low heavy metal content meeting the requirements of the Japanese Eco Mark and German Blue Angel

The "H"-grades are treated with a silicon organic compound to minimize water adsorption which can occur if the unpacked product comes into contact with humid air. Due to the hydrophobic and lipophilic nature of the surface, the dispersibility is improved in many formulations, particularly in polyester based systems.

The spherical oxide **Bayoxide®E 8706** is well established worldwide and mostly used for the production of LBP and digital copier toners due to its low remanence, coercivity and high tinting strength.

Bayoxide®E 8707 H is a finer version of Bayoxide®E 8706 which is used in some of the newer LBP formulations.

Bayoxide®E 8709 is a cubic oxide with a small particle size. This grade is used in copier toners and more recently in toners for certain types of laser printers, digital copiers and multifunctional machines.

Bayoxide®E 8713 H has an octahedral shape and a small particle size resulting in a high coercivity of 125 Oe as it is found in some analog copiers and professional printers.

Bayoxide®E 8710 and 8611 are octahedral magnetites with a coercivity of 100 Oe. This type of oxide is part of older copier formulations and is used also for other technical applications. Because of the higher tinting strength, we recommend Bayoxide®E 8709 as an alternative.

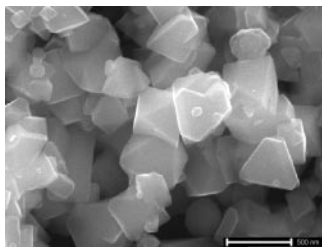


Bayoxide® E Standard Grade



Typical analytical data

The magnetic data were measured with the LANXESS designed magnetometer MA 7 and MA 8 at a maximum field strength of 5 kOe assuming a density of 4.6 g/cm³.



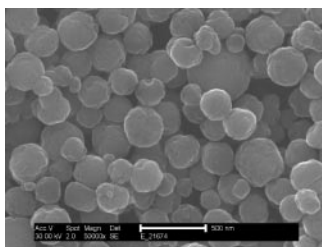
Bayoxide® E 8611:
Electron micrograph,
magnification 30,000 : 1

		Bayoxide® E 8611
Main constituent		Fe ₃ O ₄
Total iron oxide content, determined as Fe ₂ O ₃ (DIN 55 913)	[%]	approx. 99
Specific surface area (BET)	[m ² /g]	approx. 5
Loss on drying over CaCl ₂	[%]	approx. ≤ 1
pH		approx. 7.5
Coercivity (iHc)	[Oe]	approx. 100
Remanence (Br)	[G]	approx. 890
	[emu/g]	approx. 15.4
Saturation magnetisation (Bs)	[G]	approx. 5,200
	[emu/g]	approx. 90

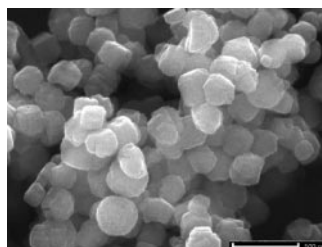
Bayoxide® E

High Performance Grades

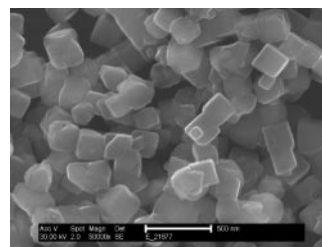
		Bayoxide® E			
		8706	8708	8709	8710
Main constituent		Fe ₃ O ₄	Fe ₃ O ₄	Fe ₃ O ₄	Fe ₃ O ₄
Total iron oxide content, determined as Fe ₂ O ₃ (DIN 55 913)	[%]	approx. 99	98	99	99
Specific surface area (BET)	[m ² /g]	approx. 8	8	7.5	4.5
Loss on drying over CaCl ₂	[%]	approx. ≤ 1	≤ 0.5	≤ 1	≤ 1
pH		approx. 7	6.5	8.5	6
Coercivity (iHc)	[Oe]	approx. 55	76	90	100
Remanence (Br)	[G]	approx. 350	590	760	890
	[emu/g]	approx. 6.0	11.9	13.1	15.4
Saturation magnetisation (Bs)	[G]	approx. 5,260	5,085	5,085	5,085
	[emu/g]	approx. 91.0	88.0	88.0	88.0



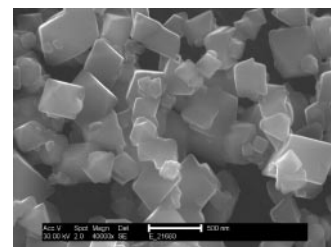
8706



8708

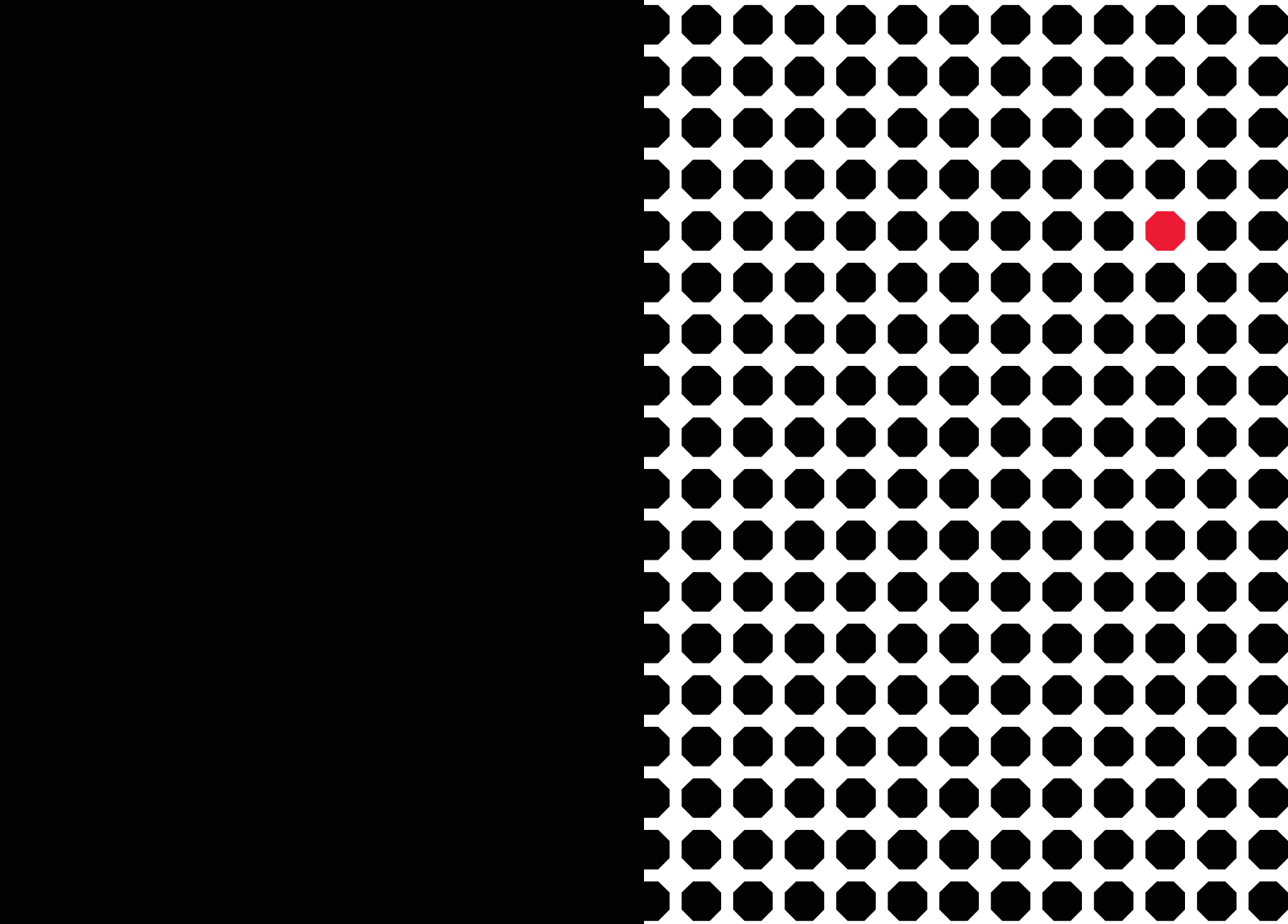


8709



8710

Electron micrographs, (magnification 30,000 : 1) of untreated high-performance Bayoxide® E grades



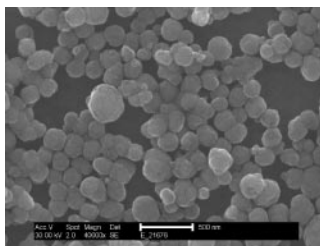
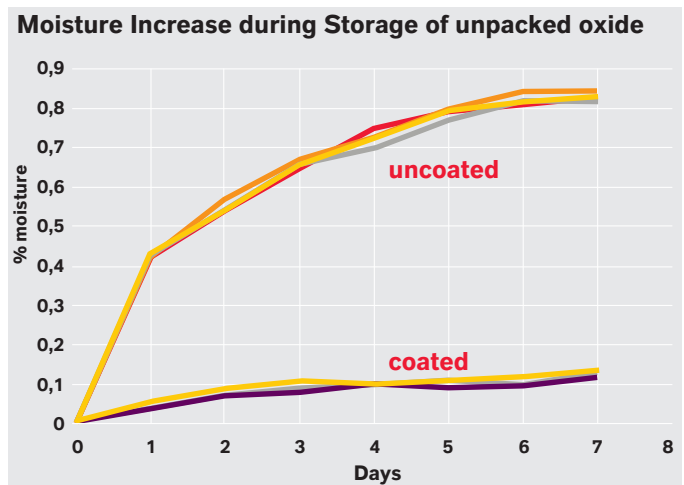
Surface Treated Bayoxide® E High Performance Grades

Typical analytical data of surface treated Bayoxide® E high-performance grades

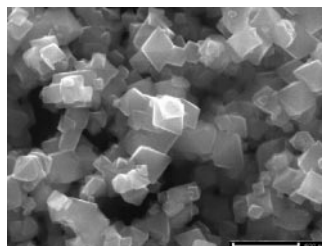
The magnetic data were measured with the LANXESS designed magnetometer MA 7 and MA 8 at a maximum field strength of 5 kOe assuming a density of 4.6 g/cm³.

			Bayoxide® E	
			8707 H	8713 H
Main constituent			Fe ₃ O ₄	Fe ₃ O ₄
Total iron oxide content, determined as Fe ₂ O ₃ (DIN 55 913)	[%]	approx.	96	98
Specific surface area (BET)	[m ² /g]	approx.	6	5
Loss on drying over CaCl ₂	[%]	approx.	≤ 0.5	≤ 0.5
pH		approx.	6	5.5
Coercivity (iHc)	[Oe]	approx.	70	125
Remanence (Br)	[G]	approx.	525	1,170
	[emu/g]	approx.	9.1	20.3
Saturation magnetisation (Bs)	[G]	approx.	5,100	5,100
	[emu/g]	approx.	88.3	88.3

Because of their low fusing temperature, the use of polyester-based formulations allows for the construction of fast printers. However, the dispersion of the pigment requires more energy and time resulting in a lower capacity and higher production cost. Untreated magnetites also adsorb a mono layer of water molecules if the unpacked product is in contact with humid air, as is often found in Asian countries. This can be a problem in water sensitive polyester formulations. It can be solved if surface-treated oxides such as the “H-grades” from Lanxess are used. The hydrophobic and lipophilic nature of these products has a positive impact on wetting and dispersibility and allows for the production of toners with improved fogging characteristics and low humidity sensitivity.



8707 H



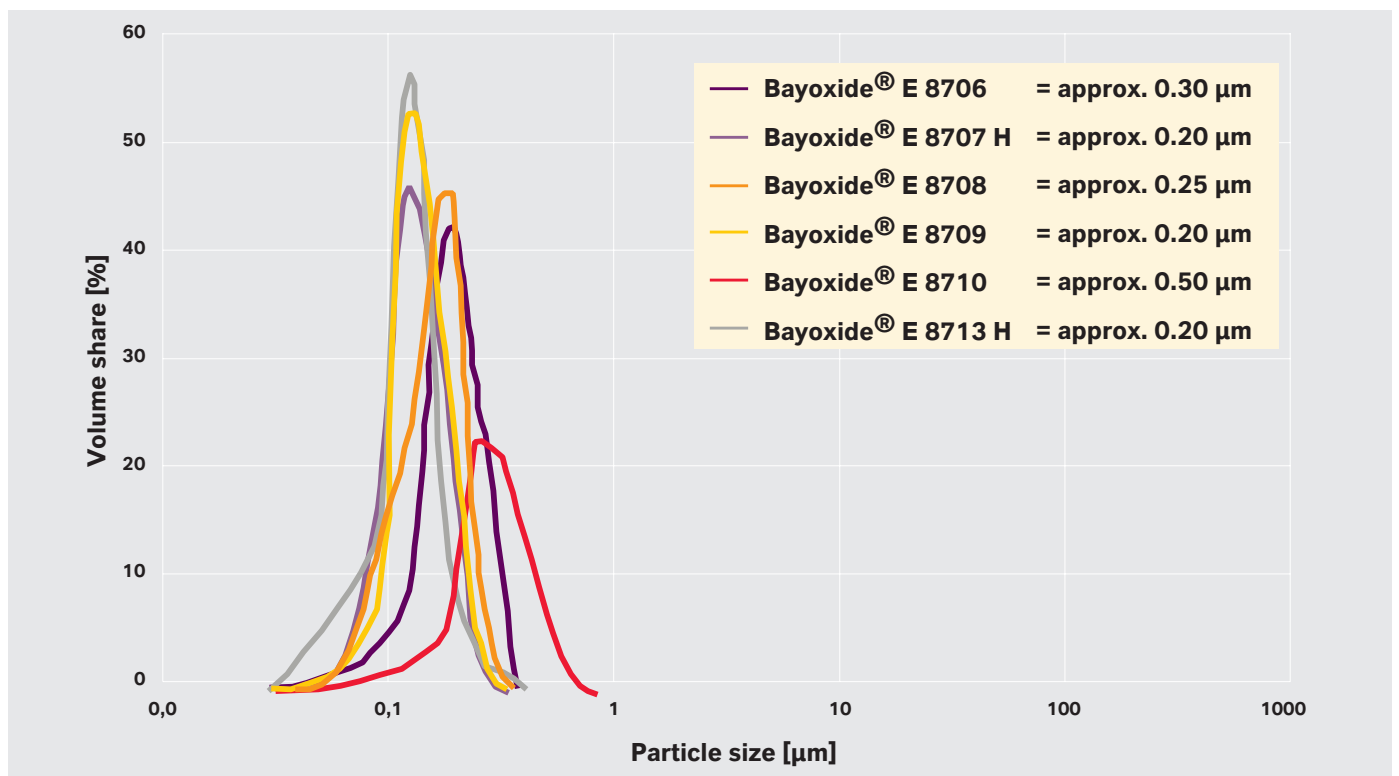
8713 H

Electron micrographs, magnification 30,000 : 1 of untreated high-performance Bayoxide® E grades

Coated toner pigments have improved dispersibility in polyester based formulations:

- no adsorbed water molecules on the surface
- nearly no moisture uptake during handling, storage in silo and blending
- improved wetting behavior because of lipophilic nature of surface

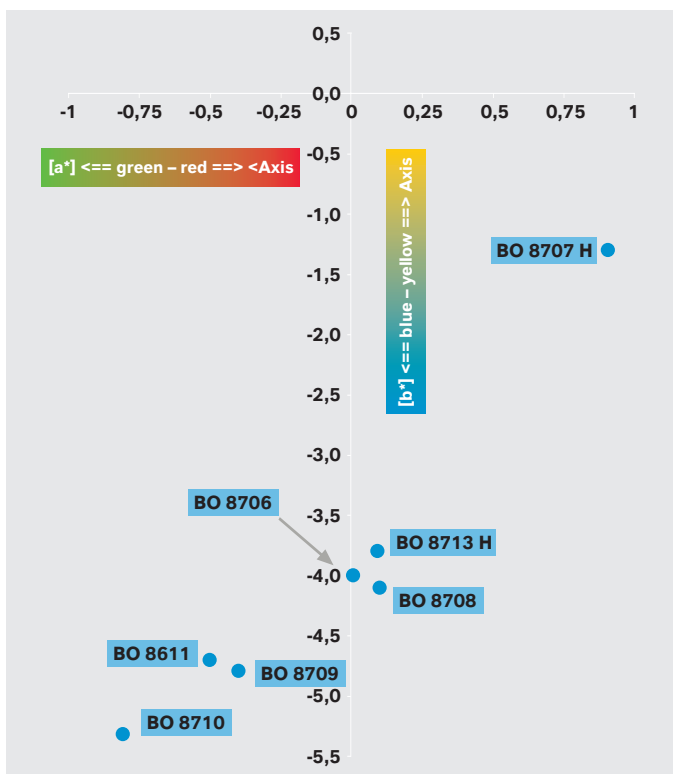
Primary Particle Size Distribution of Bayoxide® E High Performance Grades



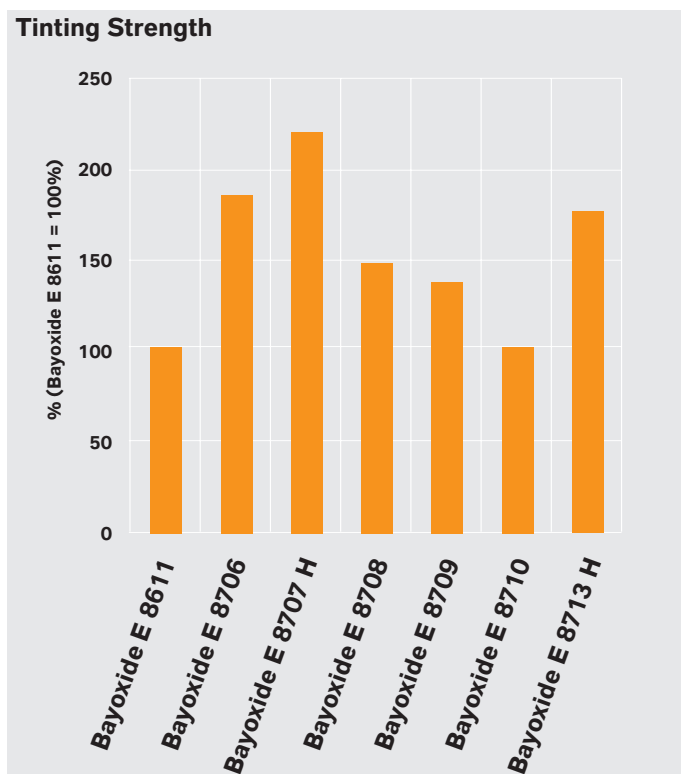
(Test method: Electron microscopy)

Color of Bayoxide® E Toner Oxides

The consumer requires toners with a high image density at a reasonable yield. While the balance between yield and image density can be influenced by changing the magnetite content of the toner, both yield and image density can be optimized at the same time if oxides with high tinting strength are used. In recognition thereof, most of the 8700 grades have an outstanding tinting strength and a bluish black color which is preferred by most people.

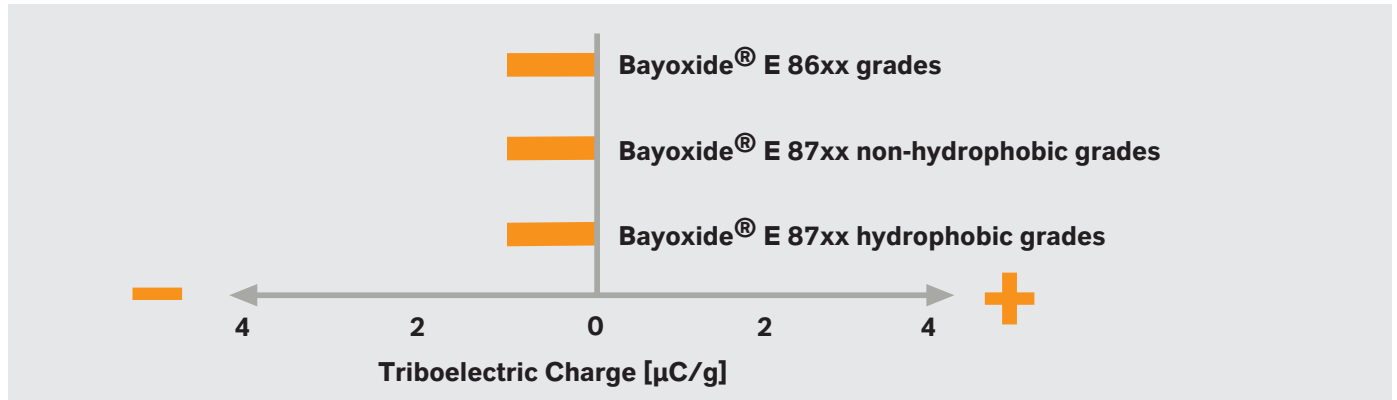


(Reduction 1: 5 TiO₂)



Triboelectric Properties of Bayoxide® E Grades

The triboelectric properties of toners depend on the properties of resins, CCA's, other additives and, to a certain extent, the toner oxide. The following figure will summarize the influence of our Bayoxide® E grades:



The blow-off triboelectric charge was measured with the Powder Charge Measuring Apparatus Toshiba TB-200 using the following test formulation:

48 % pigment

47 % styrene acrylic resin

5 % wax

particle size: 15-20 μm

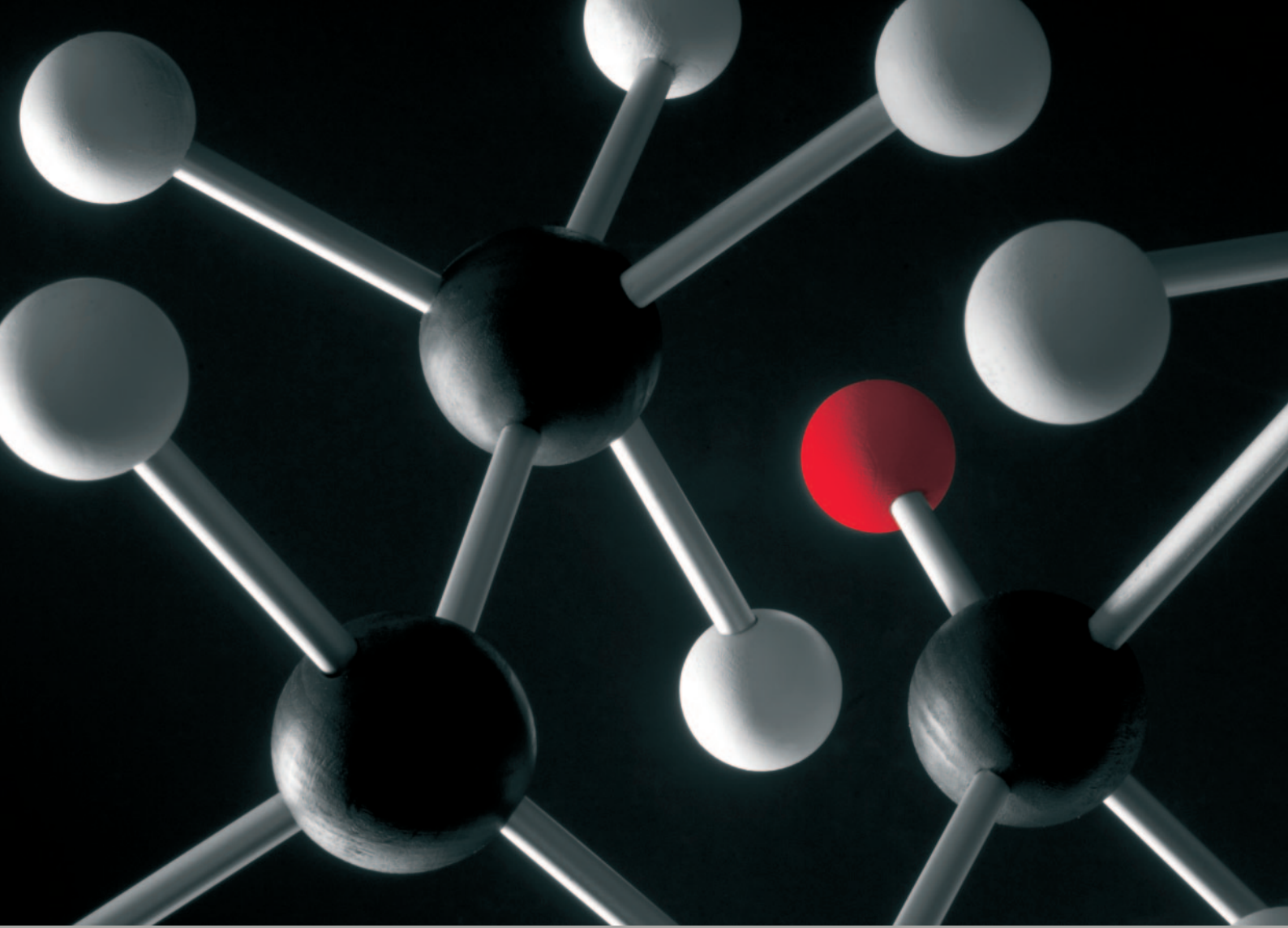
Nitrogen with a pressure of 1 bar was used for blowing-off over a measurement time of 30 seconds.

Specific Resistance of Bayoxide® E Grades

		E8611	E8706	E8707H	E8708	E8709	E8710	E8713H
Specific Resistance	[$\Omega \times \text{cm}$]	10^7	10^7	10^9	10^7	10^7	10^7	10^8
Density*	[g/cm^3]	2,2	2,4	2,4	2,6	1,5	2,9	1,7

* Resistance is measured on dried pressed powder at the given powder density





Heavy Metal Content of Bayoxide® E Grades

The heavy metal content of toners has become a concern¹⁾. Therefore, LANXESS uses selected raw materials for the manufacturing of the **Bayoxide® E** series that allows for the production of magnetites that meet the requirements of the **Blue Angel Label** and the Japanese **ECO Mark**.

The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety can award the environmental **Blue Angel Label** to toner cartridges that are fulfilling certain regulations²⁾. In addition to other requirements the toner must not contain mercury, lead, cadmium or chromium VI containing compounds.

The pigments fulfill also the requirements of the **Carbon Black Directive 2002/95/EG**

¹⁾ Literature: Computer Bild 8/2000 "Krebsgefahr?"

Redakteurin: Doreen Brumme

²⁾ Literature: Grundlage für Umweltzeichenvergabe; RAL-UZ 55a Mehrfachverwendbare Farbbandkassetten und Toner-Kartuschen; Punkt 3.9.1 Anforderungen / Schwermetalle

Product	Lead [ppm]	Mercury [ppm]	Cadmium [ppm]	Chromium VI [ppm]
Bayoxide® E 8611	< 1	< 0.2	< 1	< 1
Bayoxide® E 8706	< 1	< 0.2	< 1	< 1
Bayoxide® E 8707 H	< 1	< 0.2	< 1	< 1
Bayoxide® E 8708	< 1	< 0.2	< 1	< 1
Bayoxide® E 8709	< 1	< 0.2	< 1	< 1
Bayoxide® E 8710	< 1	< 0.2	< 1	< 1
Bayoxide® E 8713 H	< 1	< 0.2	< 1	< 1

Packaging

LANXESS supply iron oxide grades in bulk bags as well as in PE (polyethylene) or PE protected multilayer sacks to the toner industry.

Bulk bags offer the following advantages:

- Low handling costs
- Improved workplace conditions due to reduced dust formation when emptying bulk bags
- Decreased pigment losses because less residue is left in the packaging
- Differentiated pigment metering possible if the appropriate equipment is available.

Converting a plant to handle bulk bags requires a certain amount of investment. However, it is normally offset within a short period of time due to efficiencies gained.

The bulk bags are made of strong, UV stable polypropylene tape fabric, coated with polypropylene. They are provided with an inliner to protect the magnetite against humidity and oxidation. Because Bayoxide® E grades have different bulk densities, container sizes will vary.

Bulk density [g/cm³]

Bayoxide® E 8611	approx. 0.60
Bayoxide® E 8706	approx. 1.10
Bayoxide® E 8707 H	approx. 1.10
Bayoxide® E 8708	approx. 0.70
Bayoxide® E 8709	approx. 1.10
Bayoxide® E 8710	approx. 0.70
Bayoxide® E 8713 H	approx. 0.65



All sacks and bulk bags are shipped on non-returnable wooden pallets (120 x 100 x 15 cm) and are covered with shrink wrap. The labels show the following information:

Labels on sacks (example)

Bayoxide® E

8713 H

CH XXXXXXX

NET: 20 kg

Labels on bulk bags (example)

Bayoxide® E

8706

CH XXXXXXX

Pal. xxx

NET: 700 kg

Transport and storage

Protect from atmospheric conditions: store in a dry place and avoid extreme temperature fluctuations. During the storage of a large quantity of Bayoxide® E a temperature of above 80 °C must be avoided as the product may oxidise.

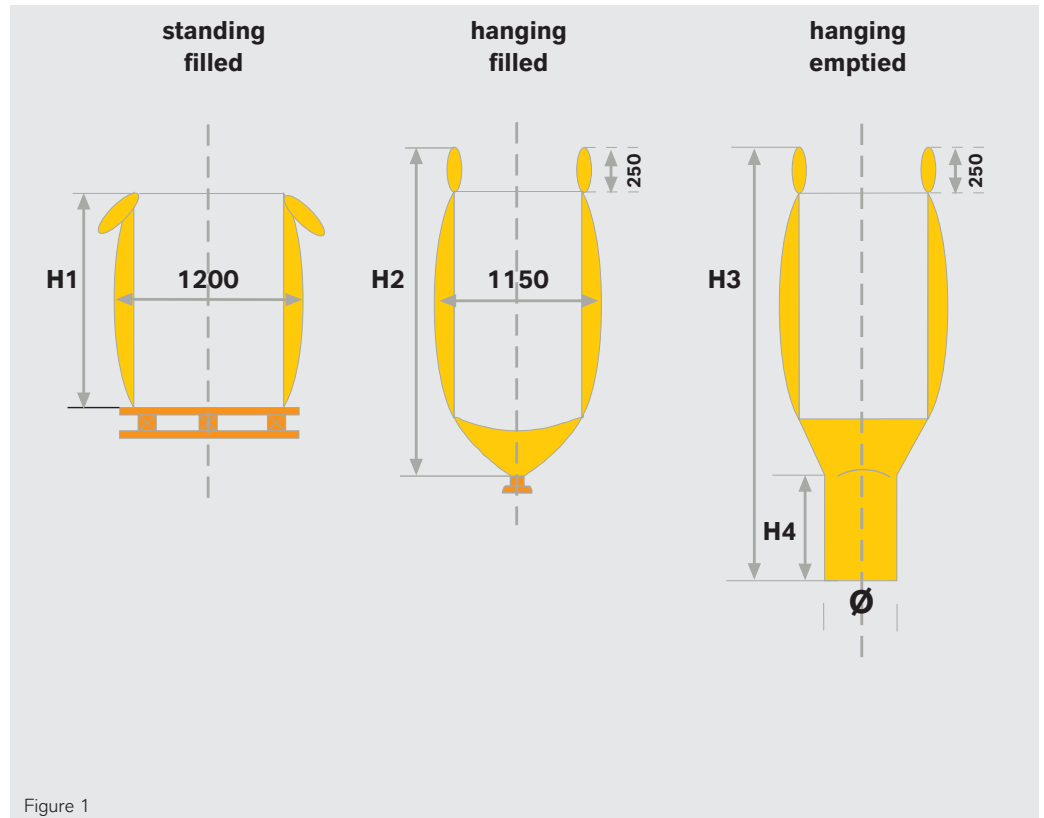
Although bulk bags are made of UV-stabilised polypropylene tape fabric, it is important to protect them against sunlight during prolonged storage. Prolonged exposure to UV radiation will reduce the tear resistance of the fabric. If prolonged outdoor storage is unavoidable, the bags should be protected by a light absorbing cover.

Emptying bulk bags

Bulk bags are emptied through a cylindrical discharge nozzle at the bottom. The dimensions of this nozzle are shown in Figure 1.

The emptying process for Bayoxide® E takes about 2 – 3 minutes. To ensure the bag is emptied entirely, it should be shaken slightly when almost empty.

Toner oxides in bulk bags

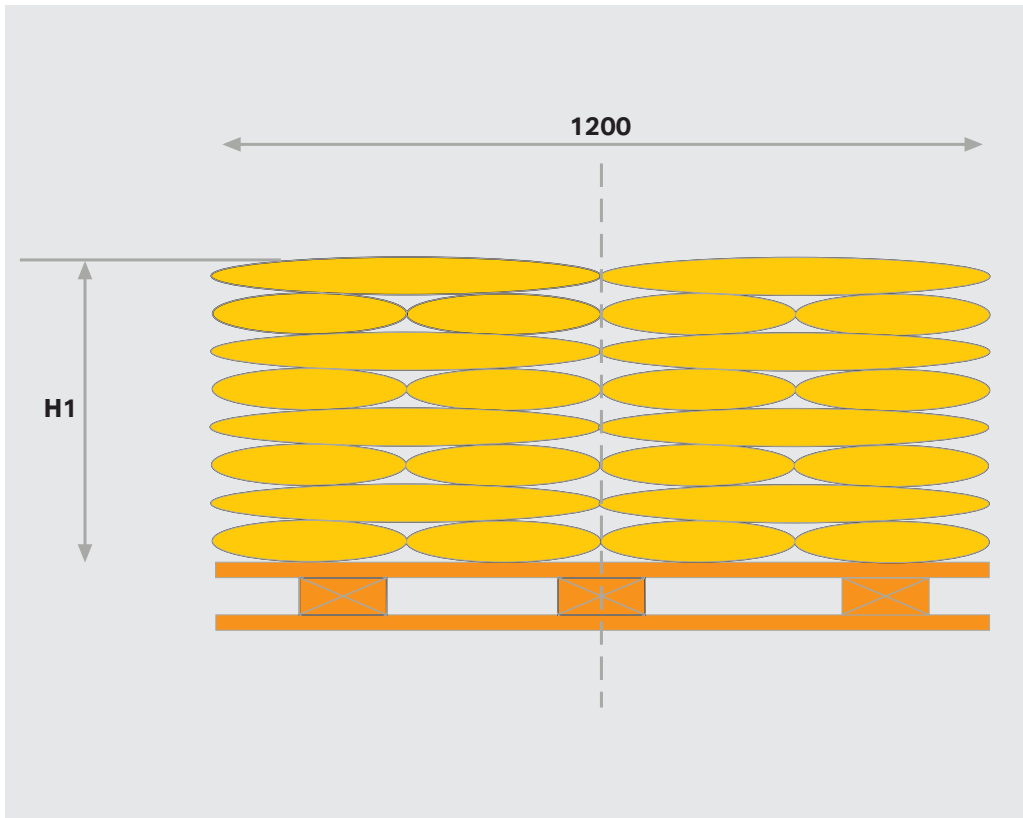


Bayoxide® E in bulk bag



	E 8611 E 8713 H	E 8706 E 8707 H E 8708	E 8709	E 8710
Maximum measures				
Filling weight [kg]	(AL-liner) 500	(PE-liner) 700	(AL-liner) 1000	500
Bag volume [m ³]	1.0		1.3	0.8
Bag, standing, filled height [mm] = H1	800		1300	850
Bag, hanging, filled height [mm] = H2	1350		1700	1400
Bag, standing, emptied height [mm] = H3	1600		2500	1900
Discharge nozzle length [mm] = H4	530		850	800
Discharge nozzle Ø [mm]	380		480	480

Toner oxides in 20 or 25 kg bags



Maximum measures	E 8707 H	E 8706 E 8708	E 8710 E 8611	E 8713 H E 8709
Filling weight [kg], sacks	20	25	20	20
Pallet weight [kg], filled	1000	1000	900	1000
Pallet, standing, filled height [mm] = H1	800	700	1050	1200
Number of sacks on pallet	50	40	45	50

Bayoxide® E in sacks



Country Representatives Inorganic Pigments

Germany

LANXESS Deutschland GmbH
Business Unit
Inorganic Pigments
Rheinuferstrasse 7-9
47812 Krefeld
Germany
Tel.: +49 (0)2151 88 3883
Fax: +49 (0)2151 88 7738

United Kingdom

LANXESS Ltd.
Branston Industrial Estate
Branston
Burton-on-Trent
Staffordshire, DE14 3WH
England
Tel.: +44 (0)1283 714200
Fax: +44 (0)1283 714201

India

LANXESS India Private Ltd
Inorganic Pigments Division
Kolshet Road
THANE – 400 607
Maharashtra
India
Tel.: +91 (0)22 2531 1251
Fax: +91 (0)22 2545 5152

Japan

LANXESS K.K.
Business Unit
Inorganic Pigments
1-6-5, Marunouchi Chiyoda-ku
Tokyo 100-8215
Japan
Tel.: +81(0)3-5293-8017
Fax: +81(0)3-5219-9776

USA

LANXESS Corporation
Business Unit
Inorganic Pigments
111 RIDC Park West Drive
Pittsburgh, PA 15275-1112
USA
Tel.: +1 412 809-2218
Fax: +1 412 809-3599

China

LANXESS Shanghai Pigments Co., Ltd.
Business Unit
Inorganic Pigments
No.845, Qi Lian Shan Road
200331 Shanghai
China
Tel.: + 8621 62500930*11
Fax: + 8621 62501193

South Korea

LANXESS Korea Ltd
Business Unit
Inorganic Pigments
395-62, Shindaebang-Dong
Dong-Jak-Ku
Seoul, 165-712
Republic of Korea (South)
Tel.: +82 2 829 6681
Fax: +82 2 847 3062

Singapore

LANXESS Pte. Ltd.
Business Unit
Inorganic Pigments
No. 9 Benoi Sector
Singapore 629844
Singapore
Tel.: +65-6725 5857
Fax: +65-6266 6959

LANXESS on the Internet: <http://www.lanxess.com>

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For further information contact

LANXESS Deutschland GmbH
Inorganic Pigments
Rheinuferstrasse 7-9
47812 Krefeld / Germany
Tel.: +49 2151 88-3883
Fax: +49 2151 88-7738
E-mail: bayoxide@lanxess.com
www.lanxess.com

LANXESS
Energizing Chemistry