

New Colorant for NIP Applications: Magenta

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Abstract

For electrophotographic printing organic pigments are predominantly used as colorants. Only selected red/magenta pigments are applied for the process color magenta out of hundreds which are commercially available. Besides azo pigments quinacridones play a key role because of their excellent fastness properties.

A newly developed quinacridone toner grade shows improved coloristic as well as electrostatic properties compared to existing standard types.

Introduction

During the last years non-impact printing technologies for full-color printing have developed rapidly.[1] Electrophotography as well as ink jet printing are dominating both for small office/home office (SOHO) and high volume/wide format applications.

Colorants influence the resulting print quality of the toner and ink strongly. They are classified either as pigments or dyes. Pigments are practically insoluble in the medium in which they are incorporated while dyes, unlike pigments, are dissolved during their application.

Table 1. General differences between pigments, dyes and ultrafine pigment dispersions (UFP-dispersions):

Properties	Pigments	Dyes	UFP-Dispersions
Brilliancy	less/moderate	high	good
Transparency	less/moderate	high	good
Fastness (e.g. light)	high	less/moderate	good/high

Today, organic pigments are predominantly used for electrophotographic color toners (yellow, magenta, cyan) whereas dyes are mainly selected for ink jet color printing. From a more general point of view dyes show higher brilliancy and transparency while pigments exhibit higher fastness properties (table 1). Ultrafine pigment dispersions (in liquid form:[2] no particles > 1 µm, d_{95} < 500 nm, d_{50} around 100 nm depending on the pigment) seem to be a way to combine the advantages of both pigments and dyes. The paper will discuss a new magenta solid solution (mixed crystal) quinacridone for toner applications.

Magenta Pigments: Typical Pigments in Use

Pigments are classified according to their structure and Colour Index number,[3] e.g. C.I. Pigment Red 122. Today more than 276 different C.I. Pigment Red types with individual Colour Index numbers are listed in total (table 2).

The ultimate shade of a pigment is highly defined by the pigment concentration in the ink/toner and by the dispersion quality. Standard magenta may be approached, for instance, by azo pigments like P.R. 57:1 or Pigment Red 184 [4]. Table 2 describes the most widely used red/magenta pigments for electrophotographic toner.

Table 2. Typical pigments in use for electrophotographic toners approaching the color magenta:

Color (total C.I. No.)	Pigments in use	Chemical Class
Red/Magenta		
[> 276]	P.R. 57:1	Monoazo
	P.R. 48:2	Monoazo
	P.R. 122	Quinacridone
	P.R. 146	Monoazo
	P.R. 184	Monoazo
	P.V. 1	Rhodamine
	P.V. 19	Quinacridone

It becomes obvious that only selected colorants are suitable for toner applications. Besides azo pigments, polycyclic pigments from the class of quinacridones are specially suitable as colorants in toners. High fastness properties are their main advantage compared to standard azo pigments.

For electrostatically driven development processes even the electrostatic influence of the colorant is important. A moderate to low tribocharge directing behavior within the toner formulation will be required. The tribo (friction) charge of the toner should be controlled e.g. by charge control agents and, under idealized conditions, should not be influenced by the pigment.

New Magenta Pigment

The color and properties of quinacridones may be influenced by:[3]
- the particle size
- crystal modification
- substituents

Furthermore, a method of changing the coloristic properties includes mixed crystal phases, also referred to as "solid solutions". The new magenta pigment which is named as Toner Magenta E 03 VP 2399 and which may be described as a solid solution, exhibits improved coloristic as well as electrostatic properties (Table 3).

Table 3. Selected physical as well as coloristic properties of Toner Magenta E 03 VP 2399:

	Target Application	q/m-value [2] [µC/g]	Shade	Transparency
Toner Magenta E 03	Toner/UFP-Dispersions [1]	-3	bluish magenta	high

[1] Ultrafine pigment dispersion e.g. for ink jet application.
[2] 5 % test toner: resin linear polyester; carrier silicone coated ferrite.

The new quinacridone pigment shows a bluish shade compared to existing P.R. 122 types (e.g. Toner Magenta E 02) as well as enhanced transparency.

Often quinacridones intensively influence the charge conditions within the toner formulation, in most cases with a negative sign. The new pigment exhibits low negative charging influence.

Conclusion

In addition to selected azo pigments, quinacridones are used in toner systems as magenta colorants for full color applications.

A new quinacridone magenta pigment based on the solid solution technology exhibits improved coloristic as well as electrostatic properties. This bluish shade type shows high transparency with improved color strength compared to existing standard types. Furthermore the electrostatic influence in the toner formulation is adjusted to less negative charge directing influence.

References

1. H. Kipphan, "Status and Trends in Multicolor Printing", *IS&T's NIP 13 Proceeding* page 11, Seattle 1997.
2. In general solid as well as liquid dispersions are existing. For instance the Hostafine^{R} sales range on the liquid side (Hostafine Pigment-Preparation: technical dokument; DP 5006/14 DEFS). Solid dispersions like the Permajet^{R} range for organic solvent based pigmented ink jet inks (e.g. PermajetR Magenta E LP 2370/P.R.122) exhibit small differences regarding particle sizes because of different manufacturing conditions.
3. Colour Index, 3rd issue, The Society of Dyers and Colourists, Bradford/UK, 1982. The Colour Index (C.I.) describes and lists the different colorants (pigments + dyes) in terms of running numbers, e.g. Pigment Yellow 155.
4. W. Herbst, K. Hunger, "Industrial Organic Pigments", 2nd edition, VCH Weinheim 1997.

Biography

Ruediger Baur studied chemistry at the Johann-Wolfgang Goethe University, Frankfurt/Main, from 1980 until 1986 (master degree). In 1990 he received his Ph.D in Inorganic Chemistry at the same university. In 1990 he joined the R+D-department for organic color pigments of Hoechst AG. Since the merger between Clariant/CH and Speciality Chemical Divsion/Hoechst has been founded in 1997, he is working for the Technical Marketing Department of the Business Unit Pigments at (new) Clariant.

His main responsibilities are focused on R+D and technical service of charge control agents as well as color pigments for toner applications. Over years, he is a member of the Gesellschaft Deutscher Chemiker (German Chemical Society).