Functional Toners for Five Module Digital Press

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Abstract

Digital printing so far is mainly used for transfer of information. Due to the high quality of today's full color digital presses applications become more important where not only an information transfer is done. Examples are discussed where toners have an additional function besides imaging:

In full color book printing e.g. aesthetic viewpoints become relevant. It maybe necessary that toner – like printing inks – transmit other info to the user like perfume smell.

Products preferably should be packed visible for the customer that means by use of transparent foils. Vegetables and specially packed products made of meat of vegetables tend to deteriorate under influence of light (and oxygen). Small amounts of natural dyes are incorporated into a substantially clear toner to absorb damaging wavelength ranges.

Introduction

Digital printing so far is mainly used for transfer of information. Due to the high quality of today's full color digital presses applications become more important where not only an information transfer is done. In full color book printing e.g. aesthetic viewpoints become relevant. It maybe useful in the preparation of catalogs that toner – like printing inks – transmit other infos to the user like perfume smell. Imagine a car brochure that smells of a new car or a menu that smell of food. (It would also make the print shop smell good!)

Products preferably should be packed visible for the customer that means by use of transparent foils. Vegetables and specially packed products made of meat of vegetables tend to deteriorate under influence of light (and oxygen). Small amounts of natural dyes are incorporated into a substantially clear toner to absorb damaging wavelength ranges.

These special toners maybe applied in conventional four color digital presses. Smells maybe combined with one of the colors but in this case smell and color cannot be addressed separately. The use semitransparent toners or metal hue tones in a four-color engine need reduction of colors to three, which limits applications drastically.

These limitations can be overcome by use of engines with more than four prints units, which are available in the market in two basically different versions:

1. Repetitive color engines. These print engines repeat the print process for each color with toner collection on an intermediate transfer media or on the web.[1] The print velocity is the process speed divided by the number of colors. Additional functional toners would reduce the print speed.
2. Tandem color engines: The colors are collected when the paper passes the print engines.[2,3,4] Additional functional toners do not reduce the print speed.

In this paper functional toners are discussed in exemplary applications as dry toner. Analog application maybe possible for digital print engines using liquid toner or jetted ink. Already known is white toner[5] that is printed on a transparent foil as base layer in a window as background for four-color text and logo.

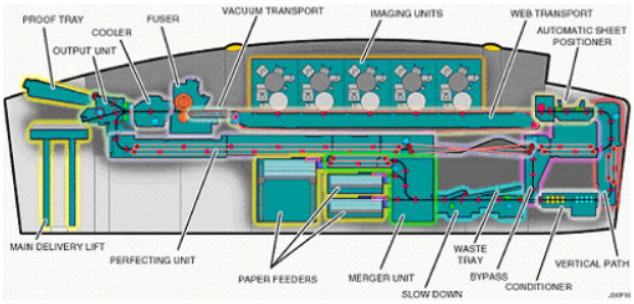

Figure 1. NexPress 2100 digital press equipped with 5 print units.

Among other presses the NexPress 2100 is specially suited for these applications as it is optionally available with a fifth print unit. In addition to the printing units which transfer toner for the colors cyan (C), magenta (M), yellow (Y), and black (K) onto a printing medium, this printing ma-

chine incorporates a fifth printing unit, which transfers a fifth –functional- toner onto the printing medium (Figure 1). Finally the toner is fused on the printing medium.

Toner with Flavor

It is well known that smells have a positive effect upon people. Pleasant smelling scent stations are set up in department stores or supermarkets to make people feel better. It is not even necessary that the smell be easily perceptible. During the Christmas season, aromatic oils or incense-burning mannequins are used to create moods. Oils that smell, for example, likes oranges or cinnamon are heated in incense burners.

If, then, the smell of a printing medium and/or a printing format is at least influenced then it is possible for the printed product to have a special scent that is different from its natural odor and that can create a desired impression. This scent can be limited to certain areas of the printed product or it can extend throughout the entire printed product.

By such means, it is beneficially possible to improve the impression created by these advertisements and to further improve a reader's already favorable reaction to the advertised product.

It is also possible to influence the smell of a Christmas card such that it smells like cinnamon, oranges, and cardamom so that both the sender and the recipient are automatically reminded of Christmas as they handle and smell the card. By this means, the sale of such Christmas cards can be increased.

Most favourable and flexible is to use essentially colorless toners, which contain at least one aromatic substance.

In this way, a conventional printing process can be performed using traditional toners that - aside from their natural scent - are odorless. Afterwards, the olfactory impression made by the printed product can at least be influenced by means of additional toners that are essentially colorless and thus do not change the optical characteristics of the printing format.

It can also be possible to apply the aromatic substances by means of colorless toners that will very decidedly change the optical impression created by the printing format, in that they affect the glossiness of the printing format to the extent desired.

In this way, it becomes unnecessary that different combinations of colors and scents be compiled for toners, each of which would have to be purchased by the consumer. A consumer can continue to use the toner that he has been using and then, as needed, add an aromatic substance of his choice to a toner of his choice.

This is a particularly flexible production process that is also financially advantageous for the consumer.

A wide range of aromatic substances are available that can be added to a toner:

Lemon oil, clove, geranium, lavender, peppermint, rosemary, eucalyptus, thyme, pine needle, ilang-ilang, cinnamon, orange, cardamom, and rum.

However, more complicated aromatic substances are also possible as follows:

Cat food, dog food, soap, leather, freshly mown grass, or the like.

There are, in fact, no limits with respect to the aromatic substances that may be used.

The printing medium can be a Christmas card as shown in Figure 2.

Figure 2. Example of a Christmas card where the cinnamon cake smells only

In order to assure that the scent emitted from the cake area can continue to be recognized over the course of time, the concentration of aromatic substance in the toner or in the ink should be 15 to be 10 to 100 times greater than the threshold concentration required for the scent to be generally detectable.

Partial decomposition of the aromatic substance by conventional extruded toners maybe avoided by use of capsule toner technology.[6] The use of non-contact fusing[7] may avoid the high surface temperature caused by roller fusion.

Toner with Natural Dye

Introduction

Dyes, particularly chlorophyll dyes, are usually present in foodstuffs, cosmetics, and pharmaceuticals. In the presence of light, they absorb certain wavelengths there from. The quality of these products can be adversely affected by such light absorption, particularly in connection with carbon dioxide. As a consequence, such products are in practice frequently packaged in opaque packaging materials. However, there is also a need to examine the products, for exam-

ple, to make quality determinations. Consequently, it is proposed that the same natural dyes that absorb adverse light in the products, or instead, pseudo-natural dyes that are essentially identical to the natural dyes, be incorporated[8] into the packaging materials, whereby the packaging materials themselves remain at least partially translucent. We extended this technology to digital printing, which allows producing at least partially translucent packaging materials that contain natural dyes or pseudo-natural dyes, chlorophyll in particular. We added natural dyes or pseudo-natural dyes to a clear toner formulation and finally applied the dyed toner to the packaging material in an electrophotographic printing machine. The dyes that should preferably be chosen are those mentioned in Ref. 8.

Generally, packaging materials are imprinted with information pertaining to the brand and/or the product specifications. If the dyed toner is applied to the packaging material in one step with the toner to be imprinted this imprinting step can also be used to provide better means of protecting the packaged product from deleterious light.

The essentially colorless toner that contains the added dyes can then be applied to the entire visible area of the packaging material. Accordingly, the translucency of the packaging material is only slightly limited by the added dye. Often the entire space that is enclosed by the packaging material is now protected from light with wavelengths that are deleterious, and any product inside the packaging remains easily identifiable for evaluation.

Toners with Natural Dyes

Specific toners were developed for use in this process to which natural dyes or pseudo-natural dyes, preferably chlorophyll, are added to correspond to the properties of the dyes contained in a product to be packaged which are mainly responsible for light absorption.

The toner's natural dye or pseudo-natural dye is not required to be completely identical to the dye contained in the product in order to be packaged. Such dye can be, specifically, a synthetic, pseudo-natural dye with absorption properties that at least essentially correspond to the properties of a natural dye or pseudo-natural dye contained in the product.

In this approach, light of the wavelength that would otherwise be absorbed by the packaged product causing signs of aging, can instead be absorbed by the toner in or on the packaging material. The substance is a colorless toner formulation to which the desired natural dyes and/or pseudo-natural dyes are added. This toner is applied to the entire packaging material without adversely affecting its translucent properties beyond that which is necessary.

The dye that is to be added to the colorless toner is selected on the basis of the composition of its wavelengths. Ideally its wavelengths are identical to the dye that is responsible for the light absorption in the product to be packaged. In the example described above that pertains to a vegetable product that is to be packaged, the dye that is added to the colorless toner, for example, is Chorphyllin Erka Type 111, a powder containing 24 – 26% Na-Cu-Chlorophylline or Type 100/2 containing 7.5% Cu-Chlorophylline complex in hydrogenated peanut oil.

Four sample toners are discussed more in detail. They were prepared using both dyed in two concentrations in a toner matrix. The raw materials are melt-kneaded, grinded size. Patches of app 0,60mg/m² were printed on transparent and classified to receive a toner with app. 8µm median particle film using a Nex-Press2100.printer.

The spectral absorbance of these patches was measured and their differential negative logarithm on base 10 of is plotted in picture 3.

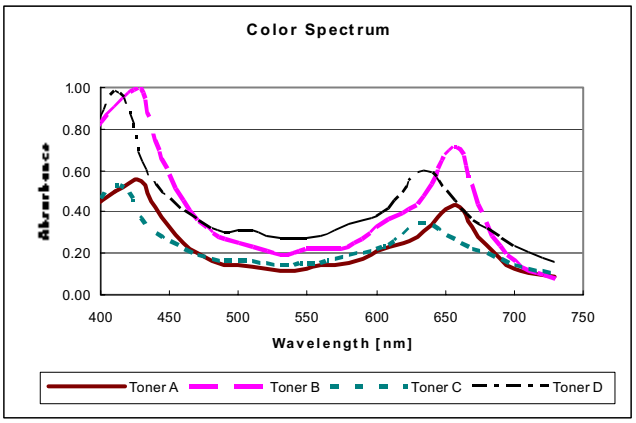

Figure 3. Spectral absorbance of four toners made with chlorophyll-dyes

These results are in the same range as the data for light absorption of chlorophyll incorporated in the packaging material published,[9] which show significant improvement of the stability of products like olive oil or herb containing vegetables.

Using this kind of coating exactly the critical frequency spectrum of the light is absorbed by the toner on the foil that else would be absorbed by the chlorophyll-containing product. Lifetime of a product protected by a plastic foil covered with chlorophyll containing toner is significantly prolonged as first the chlorophyll in the toner has to be disintegrated by the light before the product starts to disintegrate.

On the other hand the subjective transparency of the film is not significantly reduced. The products are clearly visible without significant change of the color.

Conclusion

We have discussed specific functional toners to be printed in a dry toner based digital press specifically a NexPress 2100. These toner allows to achieve additional effects beside information transfer by printing.

We presented an example where the cinnamon scent had been imparted to a cake on a Christmas card.

Another example described toner with natural dyes, for prolonging shelf live of a vegetable visible through a transparent window in packaging.

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Biographies

Detlef Schulze-Hagenest received his Ph.D. in Physics from Kaiserslautern-University in 1980. Since 1980 he is working in the field of processes and materials for electrophotography. He is currently Senior Engineer Advanced Technology at NexPress GmbH, Kiel, Germany. He is a member of the IS&T.

Dinesh Tyagi received his Ph.D. degree from Virginia Tech in 1985 from the Department of Chemical Engineering. After one year of post-doctoral position there, he joined Eastman Kodak Company and in 1993 he was appointed Research Associate. In 1999 he joined NexPress Solutions and has continued to work in the area of toners and electrophotography. He has over 60 patents worldwide.