Секция 1
ПРОИЗВОДСТВО ТЕКСТИЛЬНЫХ МАТЕРИАЛОВ

UDC 677.027.6

METAL EFFECT PIGMENT COATINGS FOR FUNCTIONALIZATION OF TEXTILES

Mahltig, Boris, Prof. Dr.
HochschuleNiederrhein, University of Applied Sciences, Faculty of Textile and Clothing Technology, Webschulstrasse 31, 41065 Mönchengladbach, Germany

Keywords: optical effect, antimicrobial, conductive, electromagnetic shielding, light management, UV-protection

Abstract. *Metal effect pigments are industrial products designed and used as additives in manifold materials to realize advantageous optical effects. Most prominent examples are probable applications in the automotive sector. Also in the textile and clothing industry, metal effect pigments are used to reach special optical effects, e.g. printings with metallic appearance. Probably most prominent are so-called gold bronze pigments. The actual contribution is related to effect pigment applications on textiles going beyond the traditional optical effects. After a short introduction into the material properties, applications as antimicrobial, conductive or electromagnetic shielding functional materials are presented. A special view is given on textile materials used for UV-protection and as light management systems. Altogether, it will be clear that metal effect pigments can be a powerful tool to functionalize textiles to a broad range of different applications.*

Introduction

Effect pigments are commonly utilized to realize special optical effects. The gained optical effects can be described as intensive reflection or metallized look. The anisotropic shape of the effect pigments causes these special reflective properties [1]. Usually, they contain a plain geometry with diameter of several micrometres while the thickness of these plates is less than 100 nanometres. As a short overview, in Figure 1 some microscopic images of different types of effect pigments are presented. In this image are presented traditional gold bronze pigments, aluminium pigments for reflection of infrared light and a pearlescent pigment used for coloration purposes.

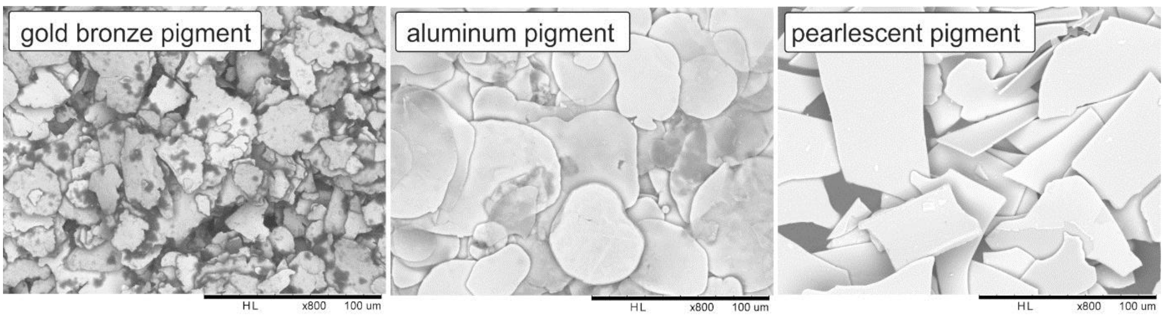

Figure 1 – Overview on three types of effect pigments

The plain geometry of the effect pigments leads to a mirror like reflectance of light, so this geometry is essential for the wished optical effect. Usually two types of effect pigments are distinguished; there are metal effect pigments and pearlescent effect pigments [1, 2]. Metal effect pigments are e.g. supplied by Eckart GmbH (Hartenstein, Germany) and are related to traditional gold bronze pigments. In contrast pearlescent pigments are built up by combination of different metal oxides arranged in layers. Interference effects here cause the colour effect. One supplier for such pearlescent effect pigments is the company Merck KGaA (Darmstadt, Germany). Effect pigments can be applied together with a binder system as a pigment print onto textiles [3, 4]. A common industrial application is here a print with a metallic look, with e.g. copper like or golden coloration

[4]. Beside this traditional application, effect pigments can be applied onto textiles to realize manifold advantageous properties, which are described in following section [3, 5, 6].

Functional properties

The possible functional properties are related to the shape and the composition of the effect pigments. Roughly, they can be distinguished into four main categories as presented in figure 2.

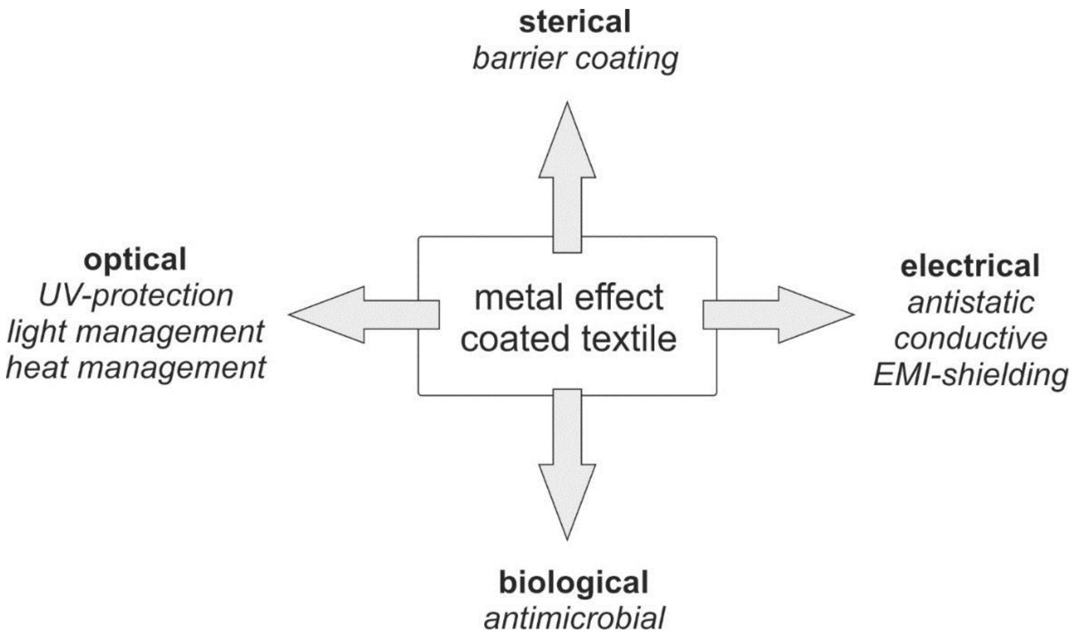

Figure 2 – Overview on functional properties realizable by application of metal effect pigment containing coatings onto textile substrates

As example for a sterical function a barrier coating can be mentioned. In such a coating the plain pigments decreases the permeability of a coated material for the transmission of gases. This property is mainly determined by the geometry of the pigments. In contrast the biological properties are mainly related to the chemical composition of the pigments. Pigments containing metals like silver or copper act antimicrobial. However, this antimicrobial activity can be significantly decreased, if the pigment surface is itself coated by an anticorrosive layer. The term optical function summarizes all properties related to the interaction with electromagnetic radiation. Main applications are here UV blocking for skin protection and infrared reflection for heat management. The term "light management" describes coatings with high transmission for visible light compared to lower transmission for UV- and IR-light. Here, successful coatings are based on aluminium flake pigments combined with titanium dioxide white pigments. Also suitable are special interference pigments. The electrical function leads to a decrease in the electrical resistance of the coated substrate. For this, a plain pigment geometry in combination with metallic copper or silver material is most advantageous. Especially mentioned should be copper based pigments containing a very thin silver layer on the pigment surface. These highly conductive coatings can be also used to realize textile materials with a shielding function against microwave and radio wave radiation. This type of shielding is often also named as EMI-shielding.

Conclusions

Many different functional properties can be realized onto textiles by effect pigment containing coatings. The effectivity of applied functions are related to pigment shape and chemical composition. However, two other parameters have to be which are also of high importance but often underestimated. First, this is the surface of the pigments, which is often modified to reach a stabilisation against corrosion. Second, this is the binder system, which should have a high affinity to both materials effect pigment and the coated textile substrates.

Acknowledgements: Many thanks are owed to K. Topp, J. Zhang, L. Wu, D. Darko& M. Wendt (all from HochschuleNiederrhein), Prof. Dr.HajoHaase from TU Berlin and Dr. P. Wissling from Eckart GmbH.

References

1. P. Wißling et al. (2006). Metallic effect pigments: Fundamentals and applications. Vincentz Network GmbH & Co KG, Hannover.
2. F.J. Maile, G. Pfaff, P. Reynders, Progr. Org. Coat. (2005) 54:150-163.
3. B. Mahltig, J. Zhang, L. Wu, D. Darko, M. Wendt, E.Lempa, M. Rabe, H. Haase, J. Coat. Technol. Res. (2017) 14:35-55.
4. B. Mahltig, D. Darko, K. Günther, H. Haase, J. Fashion Technol. & Textile Eng. (2015) 3/1:1-10.
5. K. Topp, H. Haase, C. Degen, G. Illing, B. Mahltig,J. Coat. Technol. Res. (2014) 11:943-957.
6. B. Mahltig, J. Zhang, M. Huth, A. Fahmi, J. Textile Institute (2017) 108:538-542.

УДК 677.022.481

PREPARATION OF FLAX FIBER FOR THE PRODUCTION OF COMPOSITE MATERIAL

Marko Wischnowski[1], Alexander Janssen[1], Karl-Heinz Lehmann[1], Viktor Reimer[1], Andrey Dyagilev[2], Denis Bykouski[2], Thomas Gries[1]

[1]Institut fuer Textiltechnik (ITA) of RWTH Aachen University, Aachen, Germany
[2]Vitebsk State Technological University, Vitebsk, Belarus

Keywords: composite material, polyamide yarn, natural fibers, self-optimizing system.

Abstract. *The article describes the technology of preparing a fibrous product for the formation of composite materials. The developed technology allows the maximum use of the strength characteristics of natural fibers in the formation of composite materials.*

Currently, in the formation of composite materials, along with chemical fibers, natural fibers are widely used. Since natural fibers, as a rule, are inferior to chemical fibers in strength characteristics [1, 2], an urgent task is to maximize the strength of natural fibers during the formation of composite material [3–6]. For this, it is necessary that the fibers in the composite material be straightened and positioned in a direction that maximizes the use of the strength of the fibers when they stretch during bending of the composite material.

Thus, in the production of composite material using natural fibers, it is necessary to form a layer of parallel straightened fibers. Today, there is no industrial technology that allows fully automating the process of forming a fibrous layer of unbound fibers that would allow the formation of composite material of complex spatial structure: sports equipment, dashboards and car body parts, etc. The formation of such materials requires the use of a lot of manual labor.

In the industrial production of composite materials, woven and braided preforms are widely used. Woven preforms are widely used in the formation of flat and curved composite materials. Braided preforms allow the formation of composite materials of complex shape. For example, woven preforms made of natural fibers are used to strengthen hockey sticks. They form a woven texture of natural fibers on the surface of the product [7, 8]. Composite materials are widely used in the automotive industry [9]. For example, a composite material formed by weaving a drive shaft of a car with carbon fiber can significantly increase the maximum allowable torque without increasing the diameter and weight of the drive shaft.

For the production of preforms using the technological processes of weaving and braiding, yarn and threads are used that have strength characteristics that can withstand the mechanical stresses that arise during their formation. Yarn from natural fibers, as a rule, has sufficient strength characteristics, which are achieved due to its twisting. The strength of the yarn is achieved by increasing the friction force arising between the fibers during the twisting process. The use of yarn for reinforcing composite materials does not allow the full use of the strength of the fibers from which it is formed, since the fibers as a result of twisting are not in a straightened state, and they form spiral or helical curves [10]. In this regard, the formation of a composite material requires the use of fibrous products, the fibers of which are parallel to each other or have minimal twist. It can be linen