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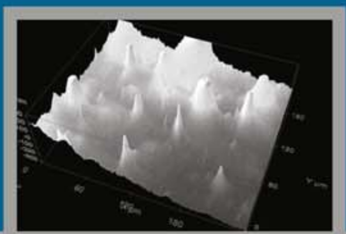
# Printing on Polymers

## Fundamentals and Applications



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# PRINTING ON POLYMERS

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Joanna Izdebska

Sabu Thomas

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# Preface

The purpose of this book is to prepare a comprehensive, structured publication gathering together both scattered knowledge and the results of studies in the field of polymeric materials conducted in the research centers all around the world.

I met Prof. Sabu Thomas during the Third International Multicomponent Polymer Conference (Third IMPC) in India in 2012. From the beginning, we knew that the areas of our interests complement each other very well. We immediately understood each other well and felt that by combining mutual knowledge and interests we can establish a successful and long-lasting cooperation.

Last year, Prof. Sabu Thomas as a visiting professor lectured at the Warsaw University of Technology, Faculty of Engineering, where I am currently working. It was then when we have decided to coauthor a book. Professor's experience in the field of polymeric materials in combination with my knowledge in printing and inks enabled us to outline the book, which just came to your hands. With the help of our scientist friends from around the world, working in the field of printing, materials science and physical—chemical processes, we were able to prepare this publication. We would like to thank all of them for the excellent cooperation and the knowledge that they wanted to share.

There are books about printing available on the market, but ours is exceptional in a sense that it is entirely dedicated to printing on plastics, both classic and biodegradable. These materials are becoming increasingly important as printing substrates, and their application is growing in the recent years. Furthermore, polymers are replacing other materials used so far in many different areas, such as packaging, agriculture, or automotive industry. Properly selected plastics can substitute other materials such as metal, paper, and glass.

Modern printing industry is very interdisciplinary and draws knowledge from multitude of disciplines. High-quality printing requires employment of knowledge of material science, physical—chemical phenomena, printing techniques, preparation of the polymers surface before printing, and factors affecting the printing process, among others. Print quality is today a key aspect of aesthetics and marketing, testifies to the quality of the product, distinguishes it, and may decide about its attractiveness or contribute to its individual character.

Authors and editors have made every effort to create a compendium of knowledge on application of polymer materials in printing that is at the same time practical, comprehensive, exhaustive, yet remains an accessible publication. Furthermore, the aim of the book is to be the source of the current information and latest developments in the field for the moment of publication. We have designed the book so that the reader may acquire not only broad and deep knowledge, but also find fundamentals and explanations of the basic phenomena that many times are difficult to explain and often overlooked. This book should become an invaluable help not only for students and lecturers, but also for printers, manufacturers of printing materials, and other industries associated with the use of printed plastics.

**Joanna Izdebska**
Warsaw, June 2015

# 15 Screen Printing

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OUTLINE



## 15.1 Fundamentals of Screen Printing

Screen printing is a stencil process where the printing involves closed nonimage areas and open-image areas. In screen printing, ink is forced through a screen by resilient squeegee (Figure 15.1). Also, we can say that the screen printing consists of the screen, the frame covered with the screen fabric, and the stencil containing the printed information. The stencil/plate is most commonly made from a light-sensitive emulsion, photographically imaged, so the printing areas are washed away, while the nonimage areas are made permanent. The stencil is processed on a fine fabric, which holds the parts of the design in place. The screen is a fine fabric made of natural silk, plastic, or metal fibers/threads. Ink is transferred through the open mesh that is not covered with the stencil. The screen printing plate is, therefore, a combination of screen and stencil (Kipphan, 2001).

The stencil on the fabric defines the actual print image. The stencil is on the side of the screen opposite to the side on which the squeegee (blade) works, to avoid damage and wear of the stencil (Kipphan, 2001). Combination of stencil, screen, and printed image in screen printing is shown in Figure 15.2.

Also, an important parameter in platemaking is frame. Today, screen frames are usually made of aluminum, although we can find in some companies wood and steel frames. When a screen printing frame is selected, its characteristics to be considered include the frame size, durability, stability, cost, and stretching method (Ingram, 1999).

A squeegee is a tool used to push the ink through the stencil produced on the screen. They are usually made from rubber or polymer and have a wooden or plastic handle in the case of manual printing. A squeegee should be an inch or two shorter than the width of the screen (Novaković & Kašiković, 2013).

The basic elements of screen printing are shown in Figure 15.3.

In practice, three methods are used for screen printing (Figure 15.4):

- *The flat-to-flat method (flatbed)*: the printing plate and the printing substrate are both

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