Original Article

The past, present and future of printing technology

—Preface to the monograph titled *Standards and Energy Saving in Printing Ink Curing and Drying Processes*

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Abstract

Advances in science and technology, people's pursuit of aesthetics, and evolution of anti-counterfeiting techniques have driven changes in printing substrates, inks, and printing processes. With increasing printing speeds, the requirements for ink curing and drying have become more stringent. The factors affecting ink curing and drying are complex and energy-intensive. This book primarily discusses how to develop printing process standards to address these challenges.

Key words: standardized processes; multifactorial; drying standards; energy-saving

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1. Introduction

Over the past decade, the rapid development of online media has gradually replaced traditional print media, leading to a decline in print volumes for paper publications. However, the demand for commercial printing, such as packaging, labels, and tags, has been steadily increasing. Currently, the prominent changes in China's printing industry are reflected in the following aspects:

- **Diverse substrates:** New packaging and label materials are constantly emerging alongside innovations in products and anti-counterfeiting methods.
- **Increased print volume:** With China's industrial scale expanding globally, product output has surged, resulting in a significant increase in the number of printed materials and necessitating faster printing speeds.
- **Higher quality standards:** As the quality of Chinese industrial products reaches international standards, corresponding printed materials, such as packaging, labels, and instructions, must meet equally high standards.
- **Stricter environmental requirements:** Energy conservation and environmental protection in printing production have become increasingly critical, with green printing standards continuously rising.

These changes collectively demand high-quality and rapid ink drying during high-speed printing, requiring inks to not only dry quickly but also form high-quality, environmentally friendly films.
Currently, factors hindering or restricting printing companies from meeting these requirements include issues such as incomplete or improper curing and drying of inks and subpar film formation quality. These issues involve multiple factors, including drying and curing equipment, ink, substrates, plates, ambient temperature and humidity, fountain solutions, printing press roller pressure, dot shapes, mesh structures, and depths.
In late 2023, we conducted research at eight companies involved in printing, ink manufacturing, and composite paper production. We discovered that printing companies often lack a dedicated process department to develop a comprehensive product process before production. Instead, they rely on ink and material suppliers to conduct trial-and-error experiments for each order. Success leads to production, while failure results in order rejection. This fragmented approach to process development makes it impossible to achieve optimal printing results.
Workshop technicians revealed that, to minimize waste and secure bonuses, they are forced to reduce printing speeds, compromising efficiency and consuming more energy.

6. Discussion

Energy conservation and cost reduction are not only environmental imperatives but also crucial factors for reducing printing costs. As printing enterprises scale up and printing speeds increase, especially for UV-cured or thermally dried gravure and flexographic prints, energy consumption has become a significant cost factor. Developing optimal printing processes and establishing standards can help printing machines operate at their best, enhancing competitiveness and profitability. For instance, even a slight decrease in printing speed due to curing and drying issues can proportionally increase equipment and management costs.

During our discussions, we also noted few a shortages of printing professionals in the industry as follows: There are few university graduates specializing in printing, and workshop technicians are predominantly vocational college graduates. Automation in modern printing presses has reduced the demand for technical expertise, as operating these machines now resembles driving smart cars. Previously, operating a press required at least three people, but now one operator and one technician suffice.

Our investigations into ink manufacturers, substrate suppliers, and printing press manufacturers revealed that these companies rarely involve printing process professionals in their design and development. Ink technicians typically specialize in polymers, chemical engineering, or testing, while printing machine technicians come from mechanical and electrical engineering backgrounds. Consequently, product design often fails to consider the intricacies of the printing process, relying instead on basic feedback from printing companies, which is insufficient.

Printing is a highly specialized and complex process. Printing presses, inks, plates, and substrates are all advanced technologies produced by only few countries worldwide. Multiple factors and dynamic interactions involved make achieving ideal print quality a significant challenge. Printed products serve both as industrial applications and works of art, adding endless allure and driving the pursuit of perfection.

China's printing industry has witnessed rapid hardware advancements and substantial volume growth. However, the lag in process technology remains a weakness in enterprise management. Establishing industry standards is essential for industrial upgrading and serves as the "hoop iron" that reinforces the industry's framework.

3. Conclusions

This book, Standards and Energy Saving in Printing Ink Curing and Drying Processes, focuses on how to establish standardized ink curing and drying processes. By integrating the factors discussed above into a comprehensive system, it aims to inspire printing process engineers and machine operators to approach process design systematically. Before commencing production, printing companies should develop a thorough process plan through detailed discussions with clients. The finalized process, with its unique characteristics tailored to the specific product, should then be strictly implemented by machine operators.

Additionally, this book serves as a reference for equipment and material suppliers. Suppliers must consider related factors and customer requirements when providing products, rather than relying solely on the demands of printing companies or end customers. Failure to understand the relevant process factors can lead to product defects and associated losses.

About the preface author

Guorui Zhang, Editor-in-Chief, the monograph titled *Standards and Energy Saving in Printing Ink Curing and Drying Processes***.** Main contributions to the monograph: Overall framework design and writing. Background and achievements: Former physics teacher and guest professor at Beijing Institute of Graphic Communication; 20 years of research on UV curing and thermal drying processes, along with equipment development; Recipient of the National Science and Technology Progress Award (Third Prize) and four provincial and ministerial science and technology progress awards; Conducted research on surface material modification of substrates and developed printing enterprise management software, earning a ministerial-level award; Published UV Curing Technology in Printing Applications (2006) and Q&A on UV Curing Technology in Printing Applications (2001); Authored numerous articles in printing journals and holds multiple patents.

Data availability

The data that support the findings of this study is available from the author upon reasonable request.

Declaration of competing interest

The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Use of AI tools declaration

The author declares that he has not used Artificial Intelligence (AI) tools in the creation of this article.