

Improvement and quality enhancement of gravure printing technology

Xiancang Zhang ¹, Maohong Xia ¹, Jifeng Yang ², Shiqiang Yu ³, Yuanyuan Chen ³

¹Wenzhou Haoge Anti Counterfeiting Technology Co., Ltd., 325802, China

²Rui'an Shangfeng Ribbon Co., Ltd., 325200, China

³Zhejiang Liqiang Packaging Technology Co., Ltd 325000, China

Abstract

This article thoroughly and deeply explores the improvement methods of gravure printing technology and practical and effective ways to enhance quality. Through a comprehensive and in-depth analysis and understanding of the principle of gravure printing, a series of key issues in the current process have been analyzed in detail, such as uneven accuracy in plate production, urgent need for ink performance optimization, and improper debugging of printing equipment. Specific and detailed improvement measures have been proposed from multiple dimensions, including careful planning of pre press design, precise selection of materials, scientific adjustment of process parameters, and meticulous maintenance and timely updates of equipment. It also deeply elaborates on how to effectively ensure the continuous and stable improvement of printing quality through strengthening the construction of quality control system and effective personnel training. Intended to provide valuable and meaningful references for the flourishing development of the gravure printing industry, effectively promoting the significant improvement of printing quality and the overall progress of the industry.

Keywords

Gravure printing; Process improvement; Quality improvement.

1. Introduction

As a printing method that occupies an important position in the modern printing field, gravure printing has extensive and in-depth applications in many fields such as packaging, decoration, and publishing. However, with the increasing diversification of market demand and the rising expectations of consumers for the quality of printed materials, gravure printing technology is facing unprecedented challenges. How to improve the process in a targeted manner and comprehensively enhance the printing quality has become a core issue that urgently needs to be addressed in the gravure printing industry. This not only relates to the survival and development of enterprises, but also has a profound impact on the future direction of the entire industry.

2. Principle and characteristics of gravure printing

2.1. Printing principle

The core principle of gravure printing is to use the mesh holes on the surface of the printing plate to store ink, and then under the clever action of printing pressure, the ink is accurately and evenly transferred to the surface of the substrate, thereby achieving clear reproduction of graphics and text. This process may seem simple, but it actually involves complex physical and chemical changes, requiring precise control over the characteristics of the ink, the structure of the printing plate, and the printing pressure.

2.2. Characteristics

Gravure printing has many significant advantages, such as the ability to form a thick and full ink layer, resulting in a vibrant and highly saturated color effect on printed materials, giving people a strong visual impact. At the same time, it has excellent printing accuracy and can delicately reproduce complex graphic and textual details, providing strong technical support for the production of high-quality printed materials. However, it cannot be ignored that gravure printing also has some obvious shortcomings, among which the high cost of plate making is a prominent problem, mainly due to the need for high-precision equipment and complex processes in the plate making process. In addition, the process flow of gravure printing is relatively complex, requiring high technical level and experience from operators, which to some extent increases the difficulty and cost of production.

3. Current problems in gravure printing technology

3.1. Insufficient precision in printing plate production

As the core component of gravure printing, the precision of the printing plate directly determines the quality of the printed product. However, in current practical production, the mesh shape, depth, and density of printing plates often exhibit unevenness. This unevenness can seriously affect the consistency and accuracy of ink transfer, leading to quality problems such as uneven ink color and blurry graphics and text in printed materials. For example, when printing fine lines and dots, due to uneven mesh holes, there may be situations such as line breakage and dot loss, greatly reducing the clarity and aesthetics of the printed product.

3.2. Ink performance needs to be optimized

Ink plays a crucial role in gravure printing, and its performance directly affects the printing quality. However, there are a wide variety of ink types on the current market with uneven performance. Many inks have key properties such as viscosity, drying speed, and adhesion that are difficult to perfectly match specific printing requirements. This mismatch can cause a series of printing quality problems, such as ink adhesion caused by incomplete ink drying, poor ink transfer caused by inappropriate viscosity, and ink peeling caused by insufficient adhesion. These issues not only affect the appearance quality of printed materials, but may also reduce their lifespan and performance.

3.3. Improper debugging of printing equipment

The debugging of printing equipment is a key link to ensure the quality and production efficiency of gravure printing. However, in practical operation, due to unreasonable settings of printing pressure, speed, temperature and other parameters, it often leads to unsatisfactory printing results and low production efficiency. For example, if the printing pressure is too high, it may lead to increased wear of the printing plate, deformation of the substrate, and even the occurrence of through printing; If the printing pressure is too low, it will lead to insufficient ink transfer, resulting in problems such as weak ink color and unclear graphics and text. Similarly, if the printing speed is too fast, it may result in delayed ink drying and uneven surface of the printed material; If the printing speed is too slow, it will reduce production efficiency and increase production costs. In addition, the temperature setting is also crucial. If the temperature is too high or too low, it will affect the performance and drying speed of the ink, thereby affecting the printing quality.

3.4. Imperfect quality control system

The quality control system is an important means to ensure the stability of the quality of printed materials. However, in the current gravure printing industry, many enterprises lack effective quality inspection methods and clear and unified quality standards. This makes it difficult to

timely and accurately detect and evaluate the quality of printed materials during the production process, and to effectively identify and solve potential quality problems. For example, some companies may rely solely on manual visual observation to determine the quality of printed materials, which is not only inefficient but also difficult to guarantee accuracy. In addition, due to the lack of clear quality standards, there may be significant differences in the quality of printed materials from different batches, making it difficult to meet customers' consistency requirements, thereby affecting the reputation and market competitiveness of the enterprise.

4. Improvement measures for gravure printing process

4.1. Pre press design optimization

4.1.1. Reasonably plan the layout of graphics and text, avoiding overly dense lines and dots.

Reasonable graphic and textual layout planning is crucial in the pre press design stage. To ensure printing quality and production efficiency, it is necessary to avoid excessively small and dense lines and dots in the design. This is because overly small lines are prone to breakage or blurring during the printing process, while overly dense dots may lead to problems such as ink accumulation and poor drying. For example, in packaging design, if the lines of product description text are too thin, it may be difficult to distinguish them clearly after printing; In pattern design, if the dots are too dense, there may be phenomena such as dot expansion and color distortion. Therefore, designers should fully consider the characteristics and process limitations of gravure printing when conceptualizing and creating, and achieve a design effect that is both beautiful and easy to print by adjusting the proportion, spacing, and distribution of graphics and text.

4.1.2. Adopt advanced design software to improve the accuracy and precision of plate making documents.

With the continuous advancement of technology, advanced design software plays an increasingly important role in prepress design. These software have powerful functions and precise algorithms, which can significantly improve the accuracy and precision of plate making files. For example, professional graphics processing software can achieve higher resolution image editing and processing, ensuring image clarity and detail representation; And typesetting software can provide more accurate font and text typesetting effects, avoiding problems such as text deformation and misalignment. In addition, some design software also supports direct integration with printing equipment, which can set and optimize parameters based on the characteristics of the equipment, further improving the adaptability and printing effect of plate making files.

4.2. Improvement of Printing Plate Production Technology

4.2.1. Introduce high-precision plate making equipment and processes, such as laser engraving, electron beam engraving, etc.

One of the key measures to improve the production accuracy and quality of printing plates is to introduce advanced plate making equipment and processes. Laser engraving and electron beam engraving technologies have extremely high precision and resolution, and can create mesh holes with regular shapes, uniform depths, and consistent densities on the surface of printing plates. For example, laser engraving technology can achieve high-precision processing of printing plates by precisely controlling the energy and focal point of the laser beam, producing small and fine mesh structures; Electron beam engraving technology utilizes the high energy and high focusing properties of electron beams to engrave deeper and finer mesh holes on printing plates, thereby improving the storage and transfer capabilities of ink. The application

of these advanced technologies can significantly improve the quality of printed materials, especially when printing fine patterns and small text.

4.2.2. Strengthen the quality inspection of printing plates to ensure that the shape, depth, and density of the mesh holes meet the requirements.

Printing plate quality inspection is an important step in ensuring the accuracy and quality of printing plate production. By using advanced detection equipment and methods such as electron microscopes, laser measuring instruments, etc., the mesh shape, depth, and density of the printing plate can be accurately measured and analyzed. For example, an electron microscope can clearly observe the microstructure of the mesh and detect defects such as deformation and blockage in the mesh; Laser measuring instruments can quickly and accurately measure the depth and density of mesh holes, ensuring that they meet design requirements. For printing plates that fail the inspection, they should be repaired or remade in a timely manner to ensure that the quality of the plates put into use reaches the best state, thus laying a solid foundation for high-quality printing production.

5. Ink performance improvement

5.1.1. Select the appropriate ink type and brand based on printing materials and process requirements.

In gravure printing, the selection of ink should fully consider the characteristics of printing materials and process requirements. Different printing materials, such as paper, plastic film, metal foil, etc., have different requirements for ink adhesion, drying speed, resistance, and other properties. For example, when printing paper, ink with good permeability and drying properties should be selected; When printing plastic film, it is necessary to choose ink with good adhesion and flexibility. At the same time, different brands of ink also have differences in quality and performance, so it is necessary to select high-quality ink brands suitable for specific printing tasks through actual testing and comparison.

5.2 Optimize ink formula, adjust ink viscosity, drying speed, adhesion and other properties.

It is necessary to optimize the ink formula in order to meet specific printing requirements. By adjusting the proportions of pigments, resins, solvents, and other components in ink, key properties such as viscosity, drying speed, and adhesion can be altered. For example, increasing the proportion of solvent can reduce the viscosity of ink, making it easier to transfer on the printing plate and spread on the substrate; Adjusting the type and content of resin can improve the adhesion and resistance of ink; Choosing the appropriate desiccant can control the drying speed of ink, avoiding clogging caused by too fast drying or adhesion caused by too slow drying. In addition, some additives such as defoamers, leveling agents, etc. can be added to improve the printability and quality of the ink.

6. Debugging and maintenance of printing equipment

6.1. Accurately adjust parameters such as printing pressure, speed, and temperature to achieve the best printing effect.

Printing pressure, speed, and temperature are important parameters that affect the gravure printing effect and require precise adjustment. The magnitude of printing pressure directly affects the transfer amount of ink and the clarity of printed materials. Excessive pressure may cause plate wear and substrate deformation, while insufficient pressure may result in insufficient ink transfer. For example, when printing thick substrates, it is necessary to increase the pressure appropriately to ensure sufficient ink penetration; When printing thin materials, it is necessary to reduce pressure to avoid material deformation. The selection of printing speed should comprehensively consider the drying speed of ink, the accuracy requirements of printed

materials, and production efficiency. Too fast speed may lead to insufficient ink drying and defects in printed materials, while too slow speed may reduce production efficiency. The control of temperature is crucial for the drying and performance of ink. Different types of inks and substrates require different temperature conditions. By precisely adjusting the temperature, it is possible to ensure that the ink dries in the appropriate time while maintaining good performance.

6.2. Regularly maintain and upkeep printing equipment to ensure its stable operation.

Regular equipment maintenance and upkeep are key measures to ensure the stable operation of gravure printing equipment, extend its service life, and ensure printing quality. Maintenance work includes cleaning, lubrication, component inspection, and replacement of equipment. For example, regularly cleaning residual ink and impurities in the printing plate cylinder, impression cylinder, and ink system to prevent clogging and affect printing quality; Lubricate the transmission components of the equipment to reduce wear and reduce the occurrence of malfunctions; Check the connection and performance of the electrical system to ensure the normal power supply and control of the equipment; Regularly replace vulnerable parts such as scrapers, rubber blankets, etc. to ensure the stability of printing effects. By establishing a comprehensive equipment maintenance plan and system, and strictly implementing them, it is possible to effectively reduce equipment failures, improve production efficiency, and reduce maintenance costs.

7. Material selection and management

7.1. Select high-quality printing materials to ensure their surface smoothness and ink absorption performance.

The quality of printing materials directly affects the effect and quality of gravure printing. Choosing high-quality printing materials, such as paper, plastic film, or metal foil with high surface flatness and good ink absorption performance, can ensure even ink adhesion and penetration, thereby obtaining clear and vivid printed images. For example, uneven surface printing materials may lead to uneven ink distribution, resulting in varying shades of ink; Materials with poor ink absorption performance may cause slow ink drying, affecting the stacking and subsequent processing of printed materials. Therefore, when selecting printing materials, strict testing and evaluation should be carried out according to printing requirements to ensure that their quality meets the standards.

7.2. Establish strict material procurement and inventory management systems to ensure the quality and stability of materials.

Establishing strict material procurement and inventory management systems is crucial for ensuring printing quality and smooth production. In the procurement process, suppliers with good reputation and reliable quality should be selected, and strict quality inspection and acceptance should be carried out on the purchased materials. At the same time, it is necessary to arrange the procurement quantity reasonably according to the production plan to avoid excessive inventory leading to material aging and deterioration. In terms of inventory management, it is necessary to establish a comprehensive inventory record and identification system, classify and store materials of different batches and specifications, and conduct regular inventory and inspection to ensure the accuracy of the quality and quantity of inventory materials. Effective material management can ensure stable quality of materials used in the printing process, reducing fluctuations in printing quality and production delays caused by material issues.

8. Ways to improve quality

8.1. Establish a comprehensive quality control system

8.1.1. Develop clear quality standards and testing procedures, covering all stages of pre press, in press, and post press.

Establishing a comprehensive quality control system is the foundation for ensuring the quality of gravure printing. Firstly, it is necessary to establish clear, detailed, and actionable quality standards that cover multiple aspects such as color, clarity, overlay accuracy, ink layer thickness, and adhesion of printed materials. At the same time, corresponding testing procedures and methods will be developed for each stage of pre press, in press, and post press. For example, in the pre press stage, it is necessary to carefully inspect the plate making documents to ensure that the graphic and textual content is accurate and the resolution meets the requirements; During the printing process, it is necessary to regularly sample and inspect the quality of printed materials, and adjust printing parameters in a timely manner; After printing, a comprehensive quality inspection of the finished product is required, including visual inspection, physical performance testing, etc. Through clear quality standards and rigorous testing processes, quality issues can be identified and resolved in a timely manner, ensuring that every process meets quality requirements.

8.1.2. Equipped with advanced quality inspection equipment, such as colorimeters, density meters, magnifying glasses, etc.

In order to achieve accurate and efficient quality testing, it is essential to equip advanced testing equipment. The colorimeter can accurately measure the color differences of printed materials, ensuring the accuracy and consistency of colors; The densitometer can measure the density of the ink layer to determine whether the transfer amount of ink meets the standard; Magnifying glasses are used to inspect the details of printed materials, such as the clarity of dots and the smoothness of lines. In addition, professional equipment such as spectrophotometers and abrasion testing machines can be used to conduct more in-depth testing and analysis of the optical properties and friction resistance of printed materials. These advanced detection equipment can provide objective and accurate data, providing strong support for quality control, helping enterprises to timely discover potential quality problems and take effective improvement measures.

8.2. Strengthen personnel training and management

8.2.1. Regularly provide technical training to operators to improve their operational skills and quality awareness.

The technical level and quality awareness of operators directly affect the quality of gravure printing. Therefore, enterprises should regularly organize operators to participate in technical training, so that they can understand the latest printing technology and processes, master advanced equipment operation methods and maintenance skills. For example, industry experts can be invited to give lectures, internal training courses can be organized, and operators can be arranged to visit and learn from advanced enterprises. At the same time, through training, cultivate the quality awareness of operators, so that they fully realize the importance of quality for the survival and development of enterprises, and consciously abide by operating procedures and strictly control quality in their work.

8.2.2. Establish a performance evaluation system to motivate employees to improve work quality and efficiency.

Establishing a scientific and reasonable performance evaluation system can effectively motivate employees to improve work quality and efficiency. Performance evaluation indicators should include multiple aspects such as the quality of printed materials, production efficiency,

equipment maintenance, and cost control. For employees who perform well in quality control, corresponding rewards such as bonuses, promotions, and honors will be given; Employees who encounter quality problems should be criticized, educated, and punished accordingly. Through this incentive mechanism, employees' enthusiasm and initiative are stimulated, prompting them to continuously improve their business level and work quality, and create greater value for the enterprise.

9. Conclusion

The improvement and quality enhancement of gravure printing technology is a complex and systematic project that requires comprehensive consideration of multiple factors such as pre press design, plate production, ink selection, equipment debugging, material management, quality control, and personnel training. Only through comprehensive and multi angle efforts, taking practical and effective improvement measures and quality enhancement approaches, can the quality of gravure printing products be significantly improved, meet the increasingly demanding market demand, promote the steady development of the gravure printing industry in fierce market competition, and achieve sustainable prosperity.

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