

Handmade Paper Industry in Anhui, China: Technological Diversity, Material Systems, and Conservation Applicability

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Abstract

Qianlong's West Lake Handscroll is a Qing dynasty court painting with significant Handmade paper is an important material carrier of traditional Chinese papermaking technology and plays a significant role in calligraphy, painting, and cultural heritage conservation. Based on field investigation and process analysis, this study examines representative handmade paper producers in Anhui Province, including traditional Xuan paper factories, conservation-oriented paper workshops, and industrialized paper enterprises. The research focuses on raw material systems, bleaching technologies, manual sheet forming, intelligent sheet-forming equipment, and conservation applicability. Results show that differences in fiber materials, processing methods, and papermaking techniques directly affect paper structure, durability, and restoration compatibility. Traditional Xuan paper systems represented by Hongxing and Taoji exhibit strong material compatibility, while Yixuange and Shoujin handmade papers show significant potential for conservation-oriented applications. The study suggests that future development of handmade paper should integrate traditional craftsmanship with materials science and conservation research to promote the scientific preservation and sustainable development of traditional papermaking technology.

Keywords: Handmade paper; Xuan paper; manual sheet forming; conservation paper; traditional papermaking; cultural heritage conservation; intelligent papermaking equipment

1 Introduction

Handmade paper is one of the most important material carriers of traditional Chinese papermaking technology. Its technological system integrates multiple processes, including plant fiber extraction, chemical modification, pulping, sheet formation, and drying. Among these, Xuan paper produced in Jingxian County is the most representative type, traditionally made from blue sandalwood bark (Qingtan bark) and straw fibers through complex processes such as cooking, bleaching, aging, and sheet forming.

Due to its excellent ink absorption, durability, and stability, Xuan paper has long been regarded as an essential material for Chinese calligraphy, painting, and paper-based cultural heritage conservation.

In recent decades, however, the handmade paper industry has been increasingly influenced by industrial papermaking technologies and market demands. Some enterprises have introduced mechanized processes to improve efficiency, while others continue to maintain traditional craft systems. This coexistence has led to a diversified industrial structure and significant differences in product quality and performance.

Existing research has primarily focused on historical development and craft description, while systematic comparative studies of different production systems and their implications for conservation materials remain insufficient. Therefore, this study conducts an empirical investigation of representative handmade paper producers in Anhui Province.

2 Research Methods and Investigated Subjects

2.1 Research Methods

This study is based on field investigation, interviews, and process documentation conducted in Jingxian County and surrounding regions. The research objects include enterprises, workshops, and related industrial chain units such as raw material suppliers and tool manufacturers.

The investigation focuses on:

- Raw material sources and preprocessing methods
- Pulping and bleaching technologies
- Sheet-forming methods and production organization
- Product types and application scenarios

Data were obtained through on-site observation, interviews with craftsmen, and comparative process analysis.

2.2 Overview of Investigated Enterprises

Yixuan Pavilion (艺宣阁), established in 1999, specializes in handcrafted decorative paper and restoration-oriented reproduction of ancient papers. It combines traditional techniques with modern mechanical imitation sheet-forming systems and is representative of craft modernization.



Figure 1. Yixuan Pavilion

Mingxing Xuan Paper Factory (明星宣纸厂), founded in 1983, is one of the earliest private large-scale enterprises in Jingxian. It mainly produces machine-based calligraphy and painting paper, representing industrial transformation.



Figure 2. Mingxing Xuan Paper Factory

Taoji Xuan Paper Factory (桃记宣纸厂) inherits the historical “Taoji” brand dating back to the Qing Dynasty. It maintains relatively complete traditional production processes and produces multiple grades of Xuan paper.



Figure 3. Taoji Xuan Paper Factory

China Xuan Paper Co., Ltd. (红星集团) is the leading enterprise in the industry, integrating production, research, cultural tourism, and heritage exhibition. It operates large-scale raw material bases and preserves traditional dual-person sheet-forming techniques.



Figure 4. China Xuan Paper Co., Ltd.

In addition, small workshops in Xiaoling village, family-run enterprises, and related industries such as paper frame weaving and oil-paper umbrella production were also included in the investigation.

3 Technological Systems of Handmade Paper in Anhui

3.1 Classification of Production Types

Based on production logic and material systems, Anhui handmade paper enterprises can be categorized into three types:

1. **Traditional craft continuation system**

Represented by China Xuan Paper Co., Ltd. and Taoji Factory, maintaining bark–straw composite raw materials and dual-person sheet forming.



Figure 5. manual sheet forming

2. **Traditional craft improvement system**

Represented by Yixuan Pavilion and Shoujin paper workshop, integrating hydrogen peroxide bleaching and mechanical imitation sheet forming.



Figure 6. intelligent sheet-forming system

3. Industrial transformation system

Represented by Mingxing Factory, relying on industrial pulp boards and mechanized production.



Figure 7. mechanized production

3.2 Raw Material Systems and Regional Dependence

Traditional Xuan paper relies on Qintan bark and straw fibers. China Xuan Paper Co., Ltd. has established raw material plantations and straw processing bases, enabling aging cycles of 3–5 years, which allow natural fiber degradation and stabilization.

Taoji Factory maintains a bark–straw–paper additive system, including kiwi vine-based natural sizing agents. Yixuan Pavilion and Shoujin Workshop diversify fiber sources, including bamboo and bast fibers.

In contrast, industrialized producers rely on purchased pulp boards composed mainly of wood pulp and reed fibers, which significantly differ from traditional fiber structures.

3.3 Bleaching and Pulping Evolution

Three bleaching systems coexist:

- Natural sun bleaching (straw exposure system)
- Chlorine-based bleaching (calcium hypochlorite)
- Hydrogen peroxide / non-chlorine bleaching

Taoji and China Xuan Paper Co., Ltd. use chlorine-based bleaching combined with traditional logic of impurity removal. Yixuan Pavilion and Shoujin Paper Factory adopt milder hydrogen peroxide and ash-based processes, emphasizing fiber preservation.

3.4 Sheet Formation Techniques

Traditional factories use **dual-person sheet forming**, requiring coordinated lifting and shaking of bamboo screens.

Yixuan Pavilion introduces **mechanized imitation sheet forming**, simulating human motion patterns.

Mingxing Factory employs **industrial paper machines**, enabling continuous production.

Small workshops rely on single-person manual forming, leading to variability in sheet quality.

3.5 Product Stratification and Application Fields

Xuan paper products show clear stratification:

- Traditional high-end calligraphy and painting paper (China Xuan, Taoji)
- Conservation-oriented and reproduction papers (Yixuan Pavilion, Shoujin Workshop)
- Industrial writing and practice paper (Mingxing Factory)

In addition, paper frame weaving and oil-paper umbrella industries extend the application of

handmade paper into functional domains.

4 Material Mechanisms and Conservation Applicability

4.1 Fiber Structure and Material Coupling

Traditional bark–straw systems form a multi-scale fiber network with high mechanical stability. Long aging cycles promote partial cellulose degradation and network rearrangement.

Industrial pulp systems, however, show more uniform but less historically compatible fiber distributions.

Bleaching agents also significantly affect fiber integrity. Hydrogen peroxide preserves fiber structure better than chlorine-based systems.

4.2 Sheet Formation and Network Morphology

Traditional sheet forming generates anisotropic fiber networks that enhance ink diffusion and absorption. Mechanical systems tend to reduce structural heterogeneity, affecting ink behavior.

4.3 Applicability in Cultural Heritage Conservation

From a conservation perspective:

- **High compatibility papers:** China Xuan Paper system and Taoji system
- **Adaptable modified papers:** Yixuan Pavilion and Shoujin Paper Workshop
- **Auxiliary industrial papers:** Mingxing system

Shoujin handmade paper and Yixuan Pavilion papers show particularly strong potential for conservation applications due to controllable fiber structures and compatibility with traditional material logic.

5 Discussion: Technological Transformation of Handmade Paper

The Anhui handmade paper industry demonstrates a multi-path evolution:

- Preservation of traditional craftsmanship
- Hybridization of modern techniques
- Industrial-scale transformation

Raw material aging, fiber processing, and sheet-forming technologies remain key determinants of final paper performance. However, systematic evaluation methods for conservation applicability are still lacking.

Future research should integrate material science, conservation science, and traditional craft studies to establish quantitative evaluation systems for handmade paper.

6 Conclusion

This study reveals that:

1. Anhui handmade paper exhibits three coexisting technological systems: traditional, improved, and industrialized.
2. Raw material systems and processing techniques jointly determine fiber structure and paper performance.
3. Sheet-forming methods significantly influence fiber network morphology and ink behavior.
4. Conservation applicability varies across production systems, with traditional and improved systems showing higher compatibility.

Overall, Anhui handmade paper industry is undergoing a complex transformation between tradition and modernization. Scientific interpretation of traditional processes is essential for sustainable development and conservation applications.

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