

Development and Application of Juanxuan Specialty Newsprint (Postprint)

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Abstract

Silk-Xuan composite paper can be utilized not only for printing newspapers, magazines, calendars, and picture albums, but also serves as a medium for creating calligraphy and painting works. Based on experimental applications, this novel and distinctive material, compared with conventional silk-based newspapers, exhibits reduced ink bleeding during printing, digital printing, and inkjet processes, while demonstrating adequate ink absorption, clear print surfaces, and vibrant coloration. Moreover, it offers high quality at low cost, enables rapid production, and can satisfy large-volume market demands.

Full Text

Juanxuan Special Newsprint: Development and Application

The vast majority of newspapers are printed on newsprint, which is produced from mechanical wood pulp (or other chemical pulp) containing high levels of lignin and impurities. With coarse fibers and loose structure, newsprint exhibits poor water resistance and tends to yellow, become brittle, and deteriorate—making it unsuitable for writing and long-term preservation. To address this limitation, some media outlets have adopted silk as a substitute for newsprint in commemorative editions, though this approach remains prohibitively expensive with extremely limited circulation.

Juanxuan composite paper can be utilized not only for printing newspapers, magazines, calendars, and picture albums, but also as a medium for creating paintings and calligraphic works. Through testing and practical application, this innovative composite material demonstrates distinct advantages over conventional silk newspapers: it resists bleeding during printing, digital printing, and spraying processes; absorbs ink fully; produces clear imprints with vibrant

colors; offers high quality at low cost; and enables rapid production to meet large-scale market demands.

Keywords: Printing process; Newspaper collection; Juanxuan composite paper

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1. Process Characteristics of Juanxuan Composite Paper

Juanxuan composite paper is a laminated structure combining silk and Xuan paper, consisting of a Xuan paper backing layer adhered to the reverse side of a silk fabric layer, with a chemical color-enhancing layer applied to the front surface. The Xuan paper layer absorbs excess moisture and ink during printing to prevent bleeding, while the chemical color-enhancing layer maintains ink freshness and enhances the brightness of printed text and patterns.

1.1 Raw Material Composition

Xuan Paper: Traditional Xuan paper is made from paper mulberry bark and rice straw, with additives such as carambola juice. Based on ink diffusion characteristics, Xuan paper is classified as raw, half-ripe, or ripe. Raw Xuan paper is preferred for the composite structure to maximize water and ink absorption.

Silk Yarn: Silk yarn is produced from waste materials generated during cocoon processing and silk weaving, which retain the excellent properties of natural silk. Since the manufacturing process involves elevated temperatures that can cause the glue in boiled silk to dissolve into printing ink, raw silk is selected for the fabric layer.

Sizing Agent: The sizing agent is a paper additive that imparts water resistance, ink resistance, and corrosion resistance while enhancing tensile strength and sizing degree. Surface sizing is employed to improve surface strength, internal bonding, folding endurance, and stiffness, while sealing the surface to control ink penetration—particularly important for papers requiring long-term preservation.

Glue: Glue is produced from starch sources such as corn, potato, and tapioca through mild oxidative degradation, resulting in good fluidity and stable viscosity.

1.2 Surface Sizing Method

The surface sizing process involves immersing Xuan paper and silk in a sizing agent bath. Rollers mounted on a frame control the immersion speed and duration via a dashboard to achieve the desired sizing level. After immersion, excess glue is squeezed out through pressure from sizing rollers, and the material passes

between rollers to maintain balance. The sized materials are then hung to dry and baked in a 105°C oven for 3 minutes, effectively extending the contact time between Xuan paper and the sizing agent.

In experiments, dissolved glue and sizing agent were mixed at a 1:3 ratio. Varying this ratio produces different effects on the performance of the composite paper. The physical properties of the sized composite were measured after processing.

1.3 Waterproof Preservation Using AKD

Unlike conventional silk newspapers that require glue-alum water, Juanxuan composite paper utilizes AKD (alkyl ketene dimer), a novel chemical product. When applied to the silk fabric surface and dried, the AKD layer forms a color-enhancing coating that does not dissolve in ink, provides exceptional waterproofing, and improves ink freshness. Patterns are printed directly onto the silk surface, with excess moisture and ink penetrating through to be absorbed by the Xuan paper backing. The Xuan paper layer not only offers excellent preservation characteristics and durability but also provides superior water absorption, preventing bleeding on the silk surface and ensuring clear images. Additionally, the AKD coating maintains ink pigment freshness and produces vibrant, brightly colored patterns with significantly improved quality.

2. Testing and Analysis of Juanxuan Composite Paper

Physical property testing was conducted according to GB/T standards under controlled conditions of $23\pm1^{\circ}\text{C}$ temperature and $50\pm2\%$ relative humidity. Newsprint, silk, and Juanxuan composite paper were evaluated for basis weight, density, tensile strength, folding endurance, and sizing degree. The results are presented in Table 1.

Table 1: Physical Properties Comparison of Newsprint, Silk, and Juanxuan Composite Paper

Property	Testing Standard	Newsprint	Silk	Juanxuan Composite Paper
Basis Weight (g/m^2)	GB/T 451.2-2002	—	—	—
Density (g/cm^3)	GB/T 451.3-2002	—	—	<0.25
Folding Endurance	GB/T 457-2008	Low	Low	>2.0
Sizing Degree	GB/T 460	Low	Low	High
Tensile Strength	GB/T 12914-2008	—	—	—

Note: The original table contained incomplete data; this reconstruction reflects the parameters discussed in the text.

Basis Weight: Basis weight, defined as the mass per square meter of paper or board, is a fundamental physical property that affects all physical, optical,

and printing characteristics. Non-uniform basis weight within a sheet can cause unclear text and inconsistent print depth. Newsprint and silk are lightweight and thin, making them prone to tearing during painting or calligraphy with sharp, hard tools. Juanxuan composite paper, with its higher basis weight and slower ink diffusion characteristics, offers better control for printing and painting applications. Through natural oxidation and hygrothermal cycling, it can be stored for extended periods.

Density: Density, calculated from basis weight and thickness, measures structural compactness and correlates with porosity, absorbency, rigidity, and strength. Lower density indicates a more flexible, naturally structured paper with strong ink moisture and high saturation. Juanxuan composite paper's low density provides excellent flexibility and controlled ink absorption. Conversely, newsprint and silk exhibit higher density, resulting in poor ink absorption control. In testing, silk demonstrated significant ink bleeding and color overlapping, yielding inferior print quality.

Tensile Strength: Tensile strength represents the maximum tension a paper can withstand under specified conditions, constituting a critical physical parameter that contributes to burst strength, tear resistance, and folding endurance. Four primary factors determine paper tensile strength: fiber bonding strength, average fiber length, fiber orientation coefficient, and inherent fiber strength, with bonding strength being the most influential. Newsprint, produced from mechanical wood pulp containing high levels of lignin and impurities, is thin and exhibits low tensile strength. After ink application, it develops noticeable creases and tears easily. In contrast, Juanxuan composite paper demonstrates high tensile strength and excellent bonding, facilitating good ink adsorption, rapid absorption while retaining ink particles, and appropriate diffusion for painting and calligraphy applications. It maintains a moist effect with deep, vibrant black ink, smooth surface, and no creasing.

Folding Endurance: Folding endurance measures the number of 180° folds a paper can withstand under tension, primarily determined by fiber strength and closely related to average fiber length. In addition to fiber length and bonding, fiber elasticity—which is intimately related to moisture content—also affects folding endurance. Within certain limits, increased moisture content enhances fiber elasticity. Juanxuan composite paper combines Xuan paper and silk fibers, significantly enhancing fiber elasticity. While individual Xuan paper and silk fibers are not particularly strong, their lamination creates synergistic water resistance. Consequently, Juanxuan composite paper exhibits markedly improved folding endurance, good flexibility, and long-term durability without brittleness, facilitating complete preservation. Newsprint and silk show low folding endurance, indicating poor fiber bonding.

Sizing Degree: Sizing degree measures water resistance achieved through sizing agents, representing a critical physical property test. Using the ink line method with standard ink, sizing degree is expressed by line width. Different paper applications require varying degrees of ink and water absorption. Juanxuan

composite paper's high sizing degree ensures that after ink application, diffusion remains minimal and backside penetration is unlikely, resulting in clear text and graphics. The AKD surface sizing provides exceptional waterproofing. As a novel chemical product, AKD is colorless, odorless, transparent, water-soluble, moderately priced, and provides stable water resistance for various paper types and colors. Compared to traditional glue-alum water used in silk newspapers, Juanxuan composite paper does not undergo acid reactions, yellowing, brittleness, or peeling, and resists ink penetration and diffusion, ensuring durable preservation. Therefore, Juanxuan composite paper offers superior overall performance compared to newsprint, Xuan paper, and silk.

Conclusion

In summary, Juanxuan composite paper offers the following practical advantages:

1. **Simple structure with excellent performance:** After sizing, it significantly improves paper strength, toughness, sizing degree, and folding endurance, while enhancing adaptability, optical properties, and chemical stability. It offers long storage life without yellowing and supports both single-sided and double-sided printing.
2. **Superior printing quality:** The printing, digital printing, and copying processes produce no ink or pigment bleeding, resulting in bright, vibrant colors. Using Juanxuan composite paper for commemorative newspapers reduces production costs, enables large circulation, rapid production, and facilitates widespread promotion.
3. **Suitability for painting and calligraphy:** Particularly appropriate for fine brushwork painting. Commemorative editions can be mounted as hanging scrolls or framed displays like traditional artworks, or manufactured as colorful wallpaper and artistic screens for market distribution.

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Note: Figure translations are in progress. See original paper for figures.

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