

The Effect of Corn Husk Waste Addition in Paper Production on Surface Texture and Printability

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Abstract— Indonesia, as an agrarian country with abundant corn production, generates a significant volume of corn husk waste. This study aims to evaluate the effect of corn husk waste addition on the physical characteristics of recycled paper, particularly surface texture and print quality. Corn husk waste was selected due to its high cellulose content and wide availability in Indonesia. The papermaking process involved delignification using NaOH, bleaching with H₂O₂, and blending recycled paper pulp with corn husk fibers. The test results show that corn husk fibers increase paper thickness and tensile strength, while providing a rougher but still functional surface texture. Printing tests indicated that ink absorption remained adequate, although minor spreading was observed in rougher areas. Overall, the resulting paper has potential as an eco-friendly alternative for simple applications such as handicrafts and non-commercial printing.

Keywords: Corn Husk Waste, Recycled Paper, Paper Quality

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1. Introduction

Paper, as a fundamental element of modern civilization, plays an irreplaceable role across various aspects of human life. Along with the accelerating pace of global development, the paper industry—both worldwide and in Indonesia—has recorded significant growth, driven by an ever-increasing demand each year. The demand for paper spans various essential sectors, ranging from education as a medium for knowledge transfer, office administration and communication, to art as a medium of creative expression, and industry for packaging and production materials [4][5][9][16].

The dominance of wood-based fiber from trees as the primary raw material in conventional paper production, amidst growing global demand, has triggered massive exploitation of natural resources. This practice significantly contributes to deforestation, threatening the balance of natural forest ecosystems [6][12][13][5]. Such conditions underscore the urgent need to explore and implement more sustainable and rapidly renewable raw material alternatives. Agricultural waste, particularly corn husk waste, has emerged as one of the most promising potential candidates [1][3][7][11].

Indonesia, being an agrarian country with high corn production, generates a considerable amount of corn husk waste. Often overlooked and underutilized, this waste holds great potential as a source of cellulose fiber [1][3][7][11]. Its cellulose content opens opportunities for its utilization as an additive in recycled papermaking processes [2][6][10].

The hypothesis underlying this study is that incorporating corn husk waste into recycled paper composition can positively affect the physical properties of the paper, particularly by enhancing surface texture and print quality. Such improvements are expected to directly impact the print output quality on the produced paper [4][9][14].

2. Method

This research employed an experimental approach to produce recycled paper sheets enriched with fibers derived from corn husk waste. The process was carried out through a series of systematic stages, encompassing raw material preparation to final product quality testing. The methodology used in this study refers to established experimental protocols applied in several previous studies [1], [6], [8], [10], [15], particularly regarding the use of sodium hydroxide (NaOH) and hydrogen peroxide (H₂O₂) as key components in the delignification and bleaching of natural fibers.

The tools used in this study included a paper mold made from a screen-printing frame with mosquito netting, scissors or a cutter, a heat-resistant pot, rubber gloves for safety during caustic soda handling, a blender, large basins or containers, old cloths or sponges (chamois), and buckets for the washing process. The materials consisted of 150 grams of dried corn husks, 20 grams of caustic soda (NaOH), 500 ml of hydrogen peroxide solution (H₂O₂), 250 grams of waste paper (such as newspaper and HVS paper), and a sufficient amount of clean water (Figure 1).

The procedure began with cutting the dried corn husks into smaller pieces to enhance the boiling process. Caustic soda was then dissolved in clean water using a heat-resistant pot, while ensuring safety by wearing gloves and working in a well-ventilated area due to the corrosive nature of the chemical. Once the caustic soda solution was ready, the corn husks were boiled in the solution for approximately one hour until the fibers became soft. The boiled corn husk fibers were then rinsed under running water until neutral and free from chemical residues, followed by a bleaching process using an H₂O₂ solution for 1–2 hours. After bleaching, the fibers were rinsed again until clean.

The papermaking process began by soaking the waste paper in water until softened, then blending it until smooth. The resulting paper pulp was mixed with the pre-treated corn husk fibers. This mixture was then cast using a prepared mold by dipping the mold into the pulp mixture and lifting it slowly to ensure an even distribution across the surface. After casting, the paper sheets were left to dry in a ventilated area for 24 hours without removing them from the mold. Once completely dry, the sheets were removed and ready for various applications such as handicrafts or writing media.



Figure 1. Corn husks

After production, the paper samples—comprising blended corn husk fibers and waste paper pulp—were subjected to quality testing. These tests evaluated the surface characteristics of the paper, including abrasion resistance and ink absorbency, which are essential to ensure functionality in real-world applications. The purpose of this testing was to assess whether the paper surface quality meets the standards for printing or crafting uses.

Additionally, a printability test was conducted to evaluate the interaction between the paper surface and printing ink. This test utilized a specific printing method to assess the visual output, including both text and image reproduction. The results of the printability test were used to determine the paper's performance in everyday use, particularly in terms of aesthetics and legibility.

3. Results and Discussion

Following the production and drying processes, the paper samples composed of corn husk waste and recycled paper pulp demonstrated promising physical characteristics for use as printing media or handicraft material [1][3][5][9]. Visual observation using a magnifying glass revealed that the paper surface was relatively rough, with an uneven distribution of fibers. Some areas showed corn husk fibers protruding from the surface; however, the overall paper structure remained dense and intact [4][9][16]. As shown in Figure 2, the resulting paper sheets exhibited a natural appearance with distinctive visual traits due to the addition of corn husk fibers. Furthermore, a comparison with 75 GSM HVS paper in Figure 3 showed that the experimental paper had greater thickness, indicating that corn husk fibers contributed to increased volume and structural integrity of the paper sheets.

In terms of surface quality, the paper was tested for abrasion resistance, ink absorbency, and tensile strength. In the abrasion test, when the paper surface was rubbed with a coarse cloth for approximately 20 seconds, no significant damage such as tearing or fiber detachment was observed. However, slight surface texture changes occurred in areas with coarse fibers, still within acceptable limits [5][9]. The ink absorbency test, performed using an inkjet printer, showed that ink was well absorbed, although minor spreading was noted in fiber-dense areas. Printed text and lines remained legible, albeit with slightly reduced sharpness compared to conventional paper. These findings suggest that the paper is still suitable for simple printing, particularly for craft applications or visual media with a natural aesthetic [4][9]. The visual results of the ink absorbency test are displayed in Figure 4.

Meanwhile, in the manual tensile strength test, the paper sheets demonstrated relatively high tear resistance. The fibrous structure provided by the corn husk contributed to reinforcement, especially in areas with even fiber distribution. The paper did not tear easily when pulled slowly and required more force compared to standard recycled paper without corn husk fiber addition [1][7][13].



Figure 2. Paper made from corn husk fiber



Figure 3. Thickness comparison between corn husk fiber paper and 75 GSM HVS paper

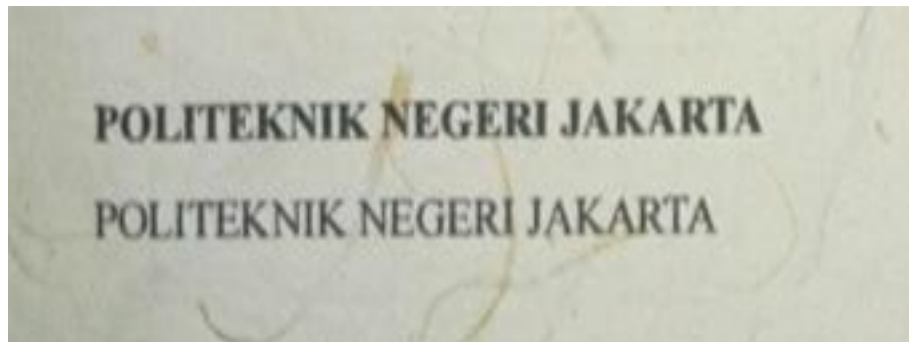


Figure 4. Ink absorbency test results

Overall print testing showed that both text and images could be printed with reasonably good sharpness. Although some uneven color gradation appeared on the rougher surface areas, ink tended to be more concentrated in denser fiber regions and spread slightly in more open areas. These results confirm that corn husk-based recycled paper can be used for simple printing applications such as product labels, rustic-themed invitations, or handwritten notes [4][9][10][16].

4. Conclusion

This study confirms that the addition of corn husk waste in the recycled paper production process affects the physical characteristics of the paper, particularly in surface texture and strength. Corn husk fibers contribute to increased sheet thickness and tensile strength while enhancing the paper's natural appearance. Nevertheless, uneven fiber distribution can lead to a non-homogeneous surface, which impacts ink spreading quality. With appropriate composition and mixing processes, this recycled paper remains functional as a printing medium, especially for informal or craft-based purposes.

From an environmental perspective, utilizing agricultural waste such as corn husks as raw material for papermaking adds value to organic waste management. This approach helps reduce waste accumulation while producing more environmentally friendly paper products. These findings contribute to the development of biomass-based materials that are not only functional but also sustainable, particularly in the context of alternative paper production for daily and creative industry needs.

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