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Research Article

Comparison of the Quality of Ink Prints on the Market on Coated and Uncoated Paper

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Abstract.
Printing inks of various brands are available in the field. Available colors include Cyan, Magenta, Yellow, and Black. Ink is an important parameter in determining print quality. Optical density is one of the important parameters used to control print quality. The optical density of the printed material is a form of ink–paper interaction. This research is oriented toward investigating the optical density value of Cyan printing ink on coated and non-coated paper. The main objective of this research is to analyze the effect of printing ink thickness on the optimal density value. Optical density values of Cyan prints were obtained using densitometer measurements, printed with the IGT method on coated and uncoated paper. The optical density values of several types of ink on the market that have been printed on coated and uncoated paper have never been reported before.

Keywords: printing ink, coated paper, uncoated paper

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1. INTRODUCTION

In the printing industry, paper and ink are the two most important raw materials for producing printed matter. The visual quality of the printed product is very important. Printing images on paper with high-resolution ink depends on the quality of the interface between paper and ink [1]. The world of printing has progressed very quickly. We are now more familiar with digital printing techniques. Offset printing technology is a technology that existed before. Simply put, if you need a small number of prints, digital printing is the way to go. However, if you need to print large quantities, offset printing remains the choice, for example for printing books and newspapers. This offset printing process falls into the category of conventional printing because it still requires quite lengthy process steps. Offset printing is a printing process in which drying occurs late

as the liquid part of the ink evaporates and is absorbed by the paper [2]. In this study, the factors influencing image quality when printing on uncoated and coated paper were investigated through laboratory-scale printing experiments using offset printing techniques. The value of the optical density of printing materials as a form of interaction between ink and printing materials, especially paper, is also important to investigate. The optical density value is generally called optical density or ink density. Ink density is one of the important parameters for controlling the quality of printing results [3]. Color density data is required during the proofing process of print results and quality control of print results [4]. In the offset printing process, the density value is measured through several series of processes, namely through the process of transferring the printing ink to the printing paper through the roller, plate and rubber blanket. The series of processes and multiple materials involved in the printing process each contribute to achieving the optical density value of the ink. This study is also important to assess the quality of printing inks available on the market and the printing results when printing on coated and uncoated paper.

2. METHODOLOGY/ MATERIALS

The materials used in this research include cyan offset printing inks of brands A and B (two brands commonly used in the Indonesian printing industry), coated paper including art board and matte paper, uncoated paper, namely HVS paper and newsprint. Tests are also carried out on the technical specifications of the paper, including weight, thickness, volume factor, ash content, water content, gloss and opacity. The principle of the weight test is to obtain the weight in grams/100 cm^2 by weighing a 10 cm x 10 cm sample, which is then multiplied by 100 to obtain the basic weight in grams/m^2 [5]. When testing the thickness, the principle of the thickness test is to place a 10 cm x 10 cm sample sheet between the two surfaces of the micrometer instrument. The thickness of the sample can be read directly from the scale displayed by the instrument. Water content and ash content were tested using the gravimetric method, while opacity and brightness were measured using the light reflection method using the Yante color data tool. The density value of the cyan printing ink layer on coated and uncoated paper was determined by measurement with a reflection densitometer. Measurements were made at five points on pieces of paper (2.5 cm x 27 cm) inked with cyan ink using IGT AE and IGT A1-3 color units with a constant pressure of 40 kgf and Ink thickness variations of 0.8 were printed – 9.6 microns.

3. RESULTS AND DISCUSSIONS

Before printing ink on paper, we first carried out tests to find out the specifications of the paper we used in this research. The test includes physical, chemical and optical properties. The paper specifications from the test results are listed in Table 1. In this study, we used four different types of paper, namely Newsprint (uncoated paper), HVS (uncoated paper), Art Carton (coated paper) and Matte paper (coated paper). These four types of paper will be printed with 2 brands of offset printing ink commonly used on the market. The physical properties tested are grammage and thickness. Table 1 shows that the grammage of art carton, newsprint, HVS and matte paper are respectively 216.09g/m^2, 51.81g/m^2, 81.42g/m^2 and 63.39g/m^2, while the thickness are 0.1994 mm, 0.0842mm, 0.1501mm and 0.074mm. By checking the grammage and thickness, bulk factor values are determined for each paper type. Mass is the volume of the sheet of paper in cubic centimeters divided by the mass of the sheet of paper in grams. The bulk factor values for art carton, newsprint, HVS and matte paper are respectively 0.92 cm^3/g, 1.62cm^3/g, 1.29cm^3/g and 1,16cm^3/g.

TABLE 1: Printing test paper specifications.

Characteristic	Art Carton	Newsprint	HVS	Matte paper
pH	8.5	8.6	8.75	8
Grammage (g/m^2)	216.09	51.81	81.42	63.39
Thickness (mm)	0.1994	0.0842	0.1501	0.074
Water content (%)	3.19	4.55	5.33	4.57
Opacity (%)	99.6	98.06	92.48	93.426
Brightness (%)	78.75	46.71	84.23	72.824
Ash content (%)	22.53	8.28	16.95	38.1
Bulk factor (cm^3/g)	0.92	1.62	1.29	1.16

The chemical properties pH, water content and ash content are checked for testing. pH test results for all paper types show almost the same results. The water content test results for art carton, newsprint, HVS and matte paper showed values of 3.19%, 4.55%, 5.33% and 4.57%, while for the ash content test they were 22.53%, 8.28%, 16.95% and 38.1%. The optical properties tested are opacity and brightness. Opacity test results for art carton, newsprint, HVS and matte paper were 99.6%, 98.06%, 92.48% and 93.426%, while brightness tests were respectively 78.75%, 46.71% and 84.23%.

In optical density testing, we use variations in ink layer thickness based on the volume of ink applied to the inking unit, namely 0.8 μm – 9.6 μm. The optical density

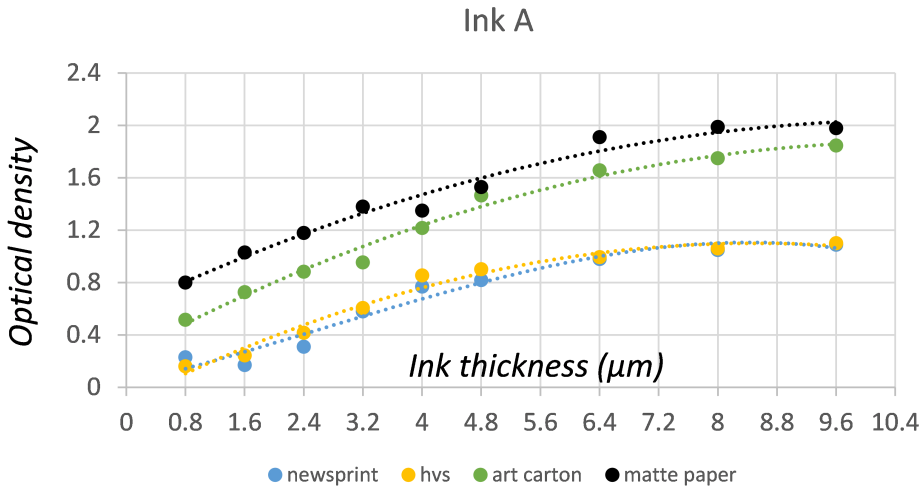

Figure 1: Graph of ink thickness against optical density.

measurement results for ink A cyan ink prints are shown in Figure ??. The thickness of the printing ink layer affects the optical density value. The density value increases as the thickness of the ink layer increases, up to a certain point which is called the optimum density. After obtaining the density graph, the Minimum Density, Optimal Density and Maximum Density values are obtained which are shown in Table 2.

TABLE 2: Minimum Density, Optimal Density and Maximum Density.

Characteristic	Art Carton	Newsprint	HVS	Matte paper
Maximum Density (D_{max})	1.86	1.04	1.0	2
Optimum Density (D_{opt})	1.2	0.65	0.5	1.2
Minimum Density (D_{min})	0.56	0.196	0.2	0.8

The Minimum Density value for art carton paper is 0.56 with an ink thickness of 0.8 microns, the Optimal Density is 1.2 with an ink thickness of 2.4 microns and the Maximum Density is 1.86 with an ink thickness of 7.6 microns. As for newsprint paper, the Minimum Density value is 0.196 with an ink thickness of 0.8 microns, Optimal Density is 0.65 with an ink thickness of 3.2 microns and Maximum Density is 1.04 with an ink thickness of 8.0 microns. This shows that there is no need to increase the thickness of the ink to increase the color density value, related to the offset printing process for material (ink) efficiency during production. The optimum density data shows that the printing process on coated paper only requires less ink to get optimal color [6].

Optimal thickness value is the value/point where the ink prints as thinly as possible but is able to cover the entire surface of the paper easily [7]. If the printed ink is too thick, there is a possibility of set off or the prints sticking to each other. The test results

can be seen in the graph that the overall density value of the ink layer on printed coated paper (art carton and matte paper) is higher than without coating (HVS and newsprint). This is related to the porosity of the paper. Uncoated paper absorbs more varnish in the ink layer, so the optical density on the uncoated paper surface is lower compared to coated paper. Ink absorption is influenced by the porous nature of the paper [8]. This is supported by the results of testing paper specifications which show that the bulk factor value (cm^3/g) of uncoated paper (HVS and newsprint) is higher than coated paper (art carton and matte paper), so that uncoated paper has a higher volumetric mass density lower because it has more pores on the surface of the paper.

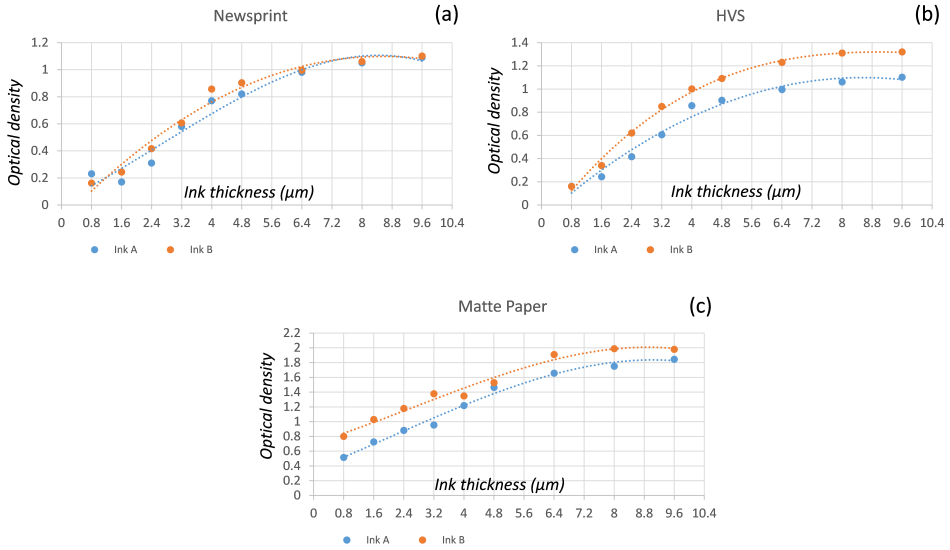

Figure 2: Graph of ink thickness against optical density (Compare Ink A dan Ink B).

We also carried out printing trials with a different brand of ink (Ink B) to prove the effect of the printing ink used. Print trials were carried out on coated (matte paper) and uncoated (HVS and newspaper) paper. We measured the optical density of the test print results and compared them with the results printed using the previous brand of ink (Ink A). Figure ??. Shows the effect of ink thickness on the average optical density value on HVS paper, newspaper and Matte paper printed with 2 different brands of ink (Ink A and Ink B). The results show that there is not much difference between paper printed using Ink A and Ink B. These results also confirm that the optical density value printed using coated paper is higher than uncoated paper.

4. CONCLUSION AND RECOMMENDATION

The optimum point for the thickness of the ink layer on HVS paper and Newsprint reaches 3.2 μm, while on Art Carton and Matte Paper the ink layer thickness of 2.4

μm is already at the optimum point. This means that if it is more than this value, the increase in density value with increasing ink thickness tends to be constant. This shows that there is no need to increase the thickness of the ink to increase the color density value, related to the offset printing process for material (ink) efficiency during production. The optical density of the ink layer on coated paper is higher than on uncoated paper. This is also proven when paper printed with 2 different brands (Ink A dan Ink B) still produces optical density values that are not much different.

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