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The Effect of The Ink Coffee Grounds Material for Black Colour in Screen Printing

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ABSTRAK

*Penggunaan tinta ramah lingkungan dapat mengurangi limbah berdampak pada lingkungan di percetakan. Kandungan karbon pada ampas kopi dapat dimanfaatkan sebagai bahan dasar atau pigmen organik dalam membuat tinta. Teknik cetak yang sering digunakn UMKM adalah Teknik cetak saring untuk mencetak kemasan. Untuk itu, tujuan penelitian ini adalah untuk mengetahui pengaruh variasi komposisi ampas kopi terhadap sifat fisika tinta yaitu viskositas, dan terhadap kualitas cetak yaitu density dan L*a*b. Proses pembuatan tinta dilakukan dengan 4 variasi komposisi ampas kopi yaitu 15, 20, 25, dan 30 gram. Hasil penelitian menunjukkan bahwa penambahan pigmen ampas kopi berpengaruh terhadap nilai density, L*a*b, dan viskositas, Semakin tinggi komposisi ampas kopi maka semakin tinggi pula nilai density, L*a*b, dan viskositas tinta.*

ABSTRACT

*The use of eco-friendly inks can drastically reduce the negative environmental impact of printing. The carbon content in coffee grounds can be utilized as a base material or organic pigment in making ink. The printing technique that is often used by MSMEs is the screen printing technique for printing packaging. For this reason, the aim of this research is to determine the effect of variations in the composition of coffee grounds on the physical properties of the ink, namely viscosity, and on print quality, such as density and L*a*b. The process of making this ink is carried out with 4 variations of the composition of coffee grounds, which are 15, 20, 25, and 30 grams. The results showed that the addition of coffee grounds pigments affected the density, L*a*b, and viscosity values. The higher the composition of coffee grounds, the higher the density, L*a*b, and ink viscosity values*

1. INTRODUCTION

Inks can contain harmful chemicals and volatile organic compounds (VOCs) or hazardous air pollutants (HAP) that are during release in the atmosphere. The use of eco-friendly inks can drastically reduce the negative environmental impact of printing. Water-based inks are becoming increasingly popular for their lower VOC emissions and reduced environmental impact (Aydemir & Ozsoy, 2020). These inks are biodegradable and less harmful to both human health and the environment. The use of eco-friendly ecofriendly inks can drastically reduce the negative environmental consequences of printing. Food grade ink can use organic ink using water-based ink where the ink comes from natural materials or living creatures. One component of organic ink can use materials such as leaf waste, fruit peels, etc. According to Farida (2020), dragon fruit skin can be used as magenta and white ink, and according be *food grade.* Not only that, the ink used must also be *food grade ,* especially if it comes into direct contact with the contents of the packaging because it can transfer dangerous substances to the food.

Screen printing or screen printing has been known as a printing technique in the graphics industry that uses gas cloth which is framed or screened for the printing process. The screen is installed on top of the frame, then covered with emulsion and dried, then given a pattern derived from a negative design made on HVS or tracing paper and then given photoresist and exposed to light, then the screen must be doused with high pressure water to pattern is visible and parts will be formed that the ink can pass through (Kipphan, 2001). Technically, screen printing can be applied to print on various surfaces such as surfaces made from paper, plastic, wood, rubber, glass, metal, cloth, and so on (Supatmo, 2015).

The use of screen printing continues to grow over time and the printing industry competes to find friendlier inks environment. The screen printing technique can be used for packaging products made of paper or cardboard which are usually used for food packaging where the packaging must to Novitasari (2020) black ink can also be made from coconut shell charcoal. Apart from coconut shells, coffee grounds can also be used as a component to make black ink. Currently in Indonesia coffee has become a trend and lifestyle in big cities among teenagers and adults. The large amount of coffee consumption results in a large amount of coffee drink waste being wasted and the innovation that can be carried out is the use of coffee grounds as an alternative to organic ink in the filter printing process.

Coffee Grounds

Coffee grounds have carbon properties, meaning they carry a black color and can be used as a pigment. The organic pigments found in coffee grounds can be recycled recycled into ink such as printing, writing, stamping, and even marker ink made by Rengganis et al (2017).

Good print quality is achieving high quality results for several parameters such as *density* so that you can determine the color results of organic ink from coffee grounds applied to the print media. The pigment content in the ink can affect *the density* of a printed product, where the amount of pigment contained in the printing ink can affect the color power that will be produced. The higher the amount of pigment, then *the density* will increase and this can also affect the flow properties of the ink when printing and affect the ink transfer process. This is one of the important parameters used to control the quality of the print results so that the final print results match the proofing results.

Apart from *density,* to control the quality of print results there is *CIE L*a*b* which is used to determine the color of print results from organic ink by looking at the L*, a*, and b* values and getting the delta E value to find out the color comparison of print results from organic ink with predetermined standard colors (Novitasari, 2020). By utilizing the substances contained in coffee grounds, such as carbon, coffee grounds can be used as material for making ink and can be used as a new source for making ink that is safe and environmentally friendly. For this reason, research was conducted with the title "The Effect of The Ink Coffee Grounds Material For Black Colour in *Screen Printing".*

2. METHOD

The method in this research is to make black pigment from coffee grounds with 5 variations in pigment composition, then measure the viscosity value of the ink using a Zahn cup number 4 viscometer, apply the ink to duplex cardboard using a filter printing technique, then measure the *density* and L* values. a*b using spectrodens.

Testing Work Steps

1) Making Black Ink from Coffee Grounds
   a) Coffee grounds in the oven at 100°C for 120 minutes to remove the water content.

b) The coffee grounds are ground using a mortar & pestle, to smooth the coffee sediment.
c) Filter the coffee grounds with a T100 mesh screen so that the coffee grounds are homogeneous
d) Weighing the ingredients that make up the ink with the composition

Tabel 1. The Coffee grounds formula

No	Coffee grounds	Gum Arabic	Aquades	Arrowroot flour
1	15	10	45	20
2	20	10	45	20
3	25	10	45	20
4	30	10	45	20

e) Mix the coffee grounds pigment with distilled water in *a beaker glass* then stir until evenly distributed.
f) Add gum arabic to the pigment solution, and use a hot plate and magnetic stirrer to dissolve the gum arabic.
g) Mix the coffee grounds pigment with distilled water in *a beaker glass* then stir until evenly distributed.
h) Add gum arabic to the pigment solution, and use a hot plate and magnetic stirrer to dissolve the gum arabic.
i) Add arrowroot flour to the beaker glass which already contains the pigment solution and gum arabic then stir until evenly mixed.
j) Place the ink that has been mixed and evenly distributed into a plastic container according to the pigment variations.

Figure 1. Process making formula of coffee grounds

2) **Viscosity Test**

In this study, for viscosity testing, a Zahn cup number 4 viscometer was used. Measurements were made by calculating the time (seconds) required for the ink to flow from the boundary on the viscometer tube until it runs out using stopwatch.

3) **Screen Printing Process**

Print the formula coffee ground in to the screen printing process with manual (using screen and rakel).

4) **Density Test**

Using spectrodens on printed samples aims to determine the color density of the filter printed samples that have been made. The *density* value can be influenced by several factors, including the percentage of pigment in the printing ink. The more pigment in the ink formulation, the *density* will increase [6].

5) **L*a*b test**

Measuring the L*a*b* value on printed samples using spectrodens aims to determine the color of printed results from organic ink by looking at the L*, a*, and b* values of organic ink printed samples with standard colors.

Tabel 2. Result test of coffee grounds formula

Sample of coffee grounds	Viscosity (sekon)	Density (Average)	L*a*b (Average)		
			L	a*	b*
10 gr	258	0,90	44,42	2,22	3,90
15 gr	264	1,26	40,73	2,32	3,81

20 gr	286	1,90	30,93	1,68	2,65
25 gr	297	2	29,05	1,63	2,49
30 gr	318	2.27	24,44	1,28	2,14

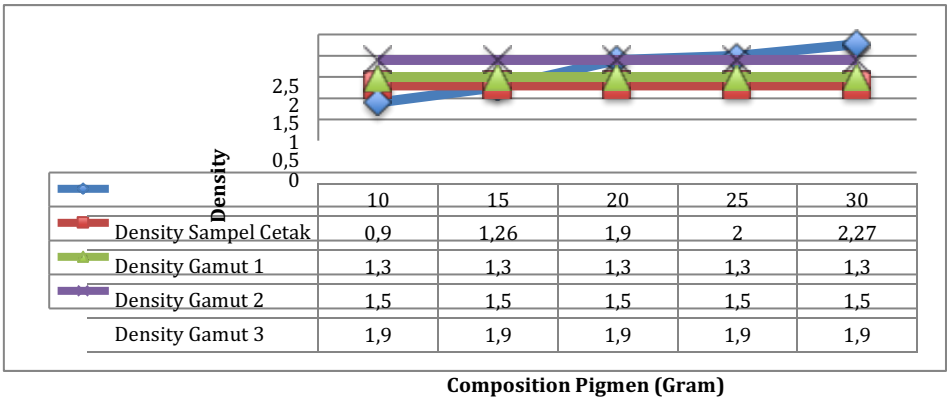
3. RESULT AND DISCUSSION

Result

These results and discussion aim to see the effect of pigment composition and the achievement of black color from coffee grounds ink on the ISO 12647-standard 5:2001 or ISO *Screen Printing*. To achieve filter printing ink quality, it must meet the *density* value the standard one. From the research results, a *density* comparison graph was obtained Mark The standard and *density* of the composition of various pigments are as follows. The research results show that the ink produced is still below the reference standard. The research results show that the greater the amount of pigment, the higher the resulting viscosity also and the ink looks thicker. This happens because the more particles dissolved, the higher the friction between the particles and the viscosity will increase (Rengganis, at al, 2017).

Discussion

The *density* value for black according to the ISO 12647-5:2001 standard shows that there are three color gamuts, namely gamut 1 with a *density* value of 1.3, gamut 2 of 1.5, and gamut 3 of 1.9. *The density* of print results that meet ISO standards (which corresponds to gamut 3, namely 1.9) is ink with a pigment composition of 20 grams, which is also 1.9.

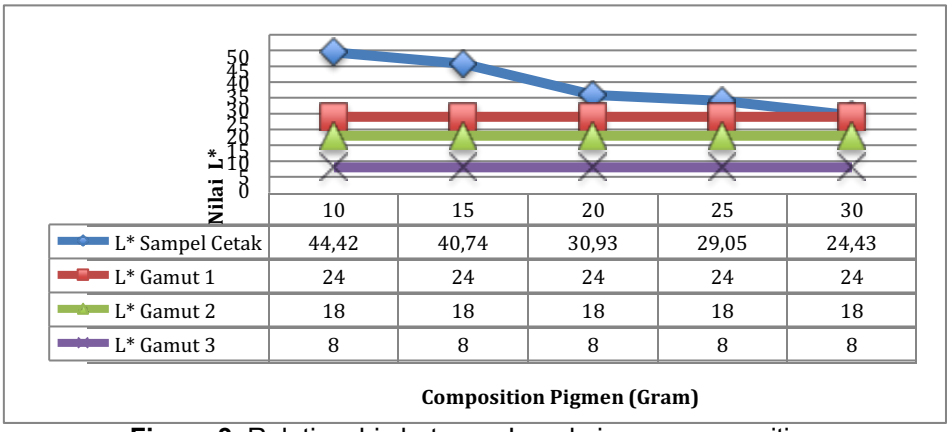


	10	15	20	25	30
Density Sampel Cetak	0,9	1,26	1,9	2	2,27
Density Gamut 1	1,3	1,3	1,3	1,3	1,3
Density Gamut 2	1,5	1,5	1,5	1,5	1,5
Density Gamut 3	1,9	1,9	1,9	1,9	1,9

Figure 2. Relationship between Density and pigmen composition

Ink Pigment from Coffee Grounds L*a*b test

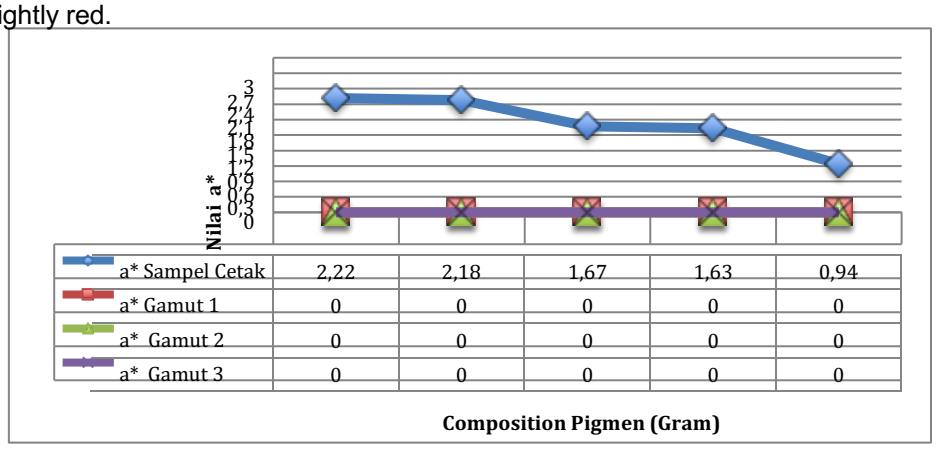
The purpose of measuring the L* value on a printed sample is to indicate the lightness or darkness of the ink color on the print sample that has been printed using the filter printing technique. The L* value for black according to the ISO 12647-5:2001 standard shows that there are three color gamuts, namely gamut 1 with an L* value of 24, gamut 2 with an L* value of 18, and gamut 3 with an L* value of 8. Pigment composition which meets the L* value of the ISO standard (according to gamut 1, namely 24), namely pigment with a composition of 30 grams because it has an average value of 24.43.



	10	15	20	25	30
L* Sampel Cetak	44,42	40,74	30,93	29,05	24,43
L* Gamut 1	24	24	24	24	24
L* Gamut 2	18	18	18	18	18
L* Gamut 3	8	8	8	8	8

Figure 3. Relationship between L and pigmen composition

The a* value for black according to the ISO 12647-5:2001 standard indicates the existence of three color gamuts. The three gamuts have the same a* value, namely 0. The pigment composition is almost reaches the ISO standard a* value, namely pigment with a composition of 30 grams because it has an average a* value of 0.94. For ink pigment composition other than 30 grams it has not reached the standard because the a* value is above the ISO 12647 standard 5:2001. This is due to the influence of other constituent ingredients such as flour which makes the color of the printed sample slightly red.



	10	15	20	25	30
a* Sampel Cetak	2,22	2,18	1,67	1,63	0,94
a* Gamut 1	0	0	0	0	0
a* Gamut 2	0	0	0	0	0
a* Gamut 3	0	0	0	0	0

Figure 4. Relationship between a* and pigmen composition

The b* value for black according to the ISO 12647-5:2001 standard indicates the existence of three color gamuts. The three gamuts have the same b* value, namely 0. None of the print samples with pigment compositions of 10 grams, 15 grams, 20 grams, 25 grams and 30 grams meet the ISO 12647-5:2001 standard. This is due to the influence of other constituent ingredients such as arrowroot flour or gum arabic which makes the color of the printed sample turn yellow.

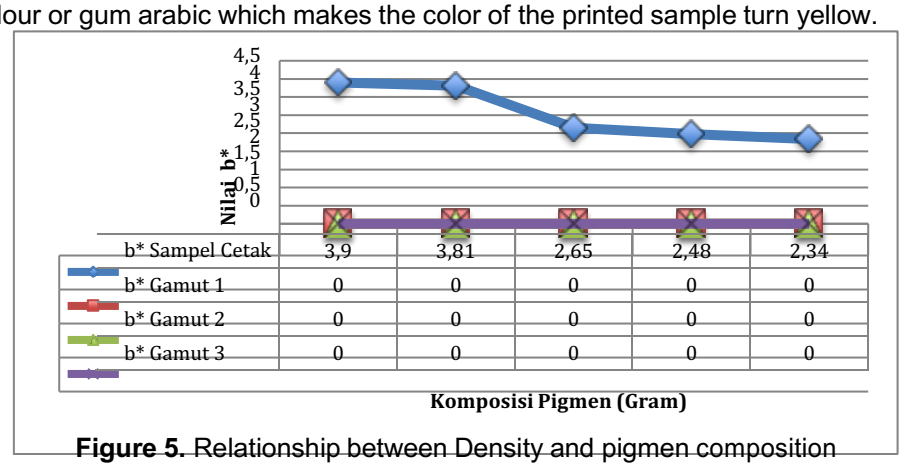


Figure 5. Relationship between Density and pigmen composition

4. CONCLUSION

Based on the research that has been carried out, it can be concluded that, The pigment composition of coffee grounds is directly proportional to the viscosity value of the ink and the *density* value of the printed sample, where the more pigment composition, the higher the viscosity value and *density* value. Meanwhile, L*a*b* measurements show that the greater the amount of pigment composition in the ink being made, the lower the L*a*b* value and closer to the ISO 12647-5:2001 black color standard. Optimal ink that approaches ISO 12647-5:2001 standards is a pigment composition of 30 grams.

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