EFFECT OF DIFFERENT FILLER ON PRINTABILITY AND PAPER PROPERTIES

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Abstract
Filler and binder are used together with cellulose fibers during paper production. Mineral fillers, which is clay, precipitated calcium carbonate (PCC) and ground calcium carbonate (GCC), are widely used in the papermaking industry during paper product. Generally, producing in paper is used as kaolin and calcium carbonate filler. Recently, Alkyl ketene dimer (AKD) or Alkenyl succinic anhydride (ASA) and Synthetic glue has been used as binder. Unlike known fillers in our work, we tried perlite as a filler. Three different weights were made of kraft cellulose, using perlite that was broken and micro-sized. Resistance tests and offset printing tests were carried out on papers made in laboratory scale.
As a result, it is seen that resistance and printability properties have improved, but, studies are needed to increase the rate of adherence of perlite to cellulose.
Key words: *Paper, filler, pigment, Perlite, coat weight, printability*

Introduction

Fillers are a big part of papermaking. In nearly every paper and paperboard grade fillers can be found in the furnish. Filling is used in the making of all paper and cardboard types. The amount of fillers can vary up to 30% depending on the paper type. They give special properties for paper products that could not be achieved in any other way [4].

Table 1. *Classification of Major Papermaking Fillers as either Natural or Synthetic [6]*

Mineral Composition	**Natural Products**	**Synthetic Products**
$CaCO_3$	Ground limestone (GCC)	Precipitated calcium carbonate (PCC)
	Chalk (ground)	
$Al_2O_3.2SiO_2.2H_2O$	Clay (hydrous kaolinite)	Precipitated aluminum silicate
TiO_2	-	Titanium dioxide (rutile & anatase forms)
$Mg_3Si_4O_{10}(OH)_2$	Talc	-
$CaSO_4.2H_2O$	-	Gypsum

In paper making, generally inorganic materials are used as filling pigment. As shown in Table 1, it is possible to divide these materials into two main classes, natural and synthetic. Some pigments such as calcium carbonate are available as fillers in both natural and synthetic forms [8]. Other minerals, such as talc and titanium dioxide, are mainly restricted to either the natural or the synthetic category of fillers, respectively [6].

Filling, glue and various paints are added to bleached and beaten pulp to give the paper smoothness, density and durability. Fillers help to create a smooth and homogeneous surface by filling the gaps between the fibers. Also, fillers increase density and print quality [2].

In recent years, many efforts have been made to develop new fillers or new fillers technologies to improve paper production quality and / or reduce production costs. Improving properties of paper has positively affect print quality. Especially, air permeability and surface smoothness are the most important characteristics determining the print quality [9].

In this study, expanded perlite and calcite were used as filling material. After the mechanical processes used are passed through perlite taken from reserves in Turkey. Perlite is provided in the reserve area in Turkey. The grain sizes have been reduced as a result of mechanical processes. There is no chemical treatment. There is no chemical treatment.

Perlite is a generic term for naturally occurring siliceous rock. It is a form of natural glass which like pitchstone, obsidian and other similar contains “combined water”. Perlite (containing 1,9% – 4,8% wt. “chemical” or com-

bined water) was formed over a few million years by the chemical weathering of obsidian at the earth's surface. Perlite deposits that are considered as exploitable for industrial uses, are distinguished in pumiceous (frothier and least dense), granular and onionskin (Table 2).

Table 2: *Typical physical properties of expanded perlite [10]*

Colour	**White**
Refractive Index	1.5
Free Moisture, Maximum	0.5%
pH (of water slurry)	6.5 – 8.0
Specific Gravity	2.2 – 2.5
Loose Bulk Density (LBD)	30–150 kg/m3
Size commercially available	6 mm and finer
Softening Point	870–1095°C
Fusion Point	1260–1345°C
Specific Heat	387 J/kg·K
Thermal Conductivity at 24°C	0.038-0.060 W/m·K
Solubility	• Soluble in hot concentrated alkali and HF. • Moderately soluble (<10%) in 1N aOH Slightly soluble (<3%) in mineral acids (1N) • Very slightly soluble (<1%) in water or weak acids

2. Material and Method

In this study, waste paper (corrugated cardboard waste) and kraft cellulose (bleached *Pinus nigra* cellulose) were used. Two types of paper have made, filled and unfilled.

Perlite and calcite has been used as the filler. In addition, alum and latex are used in filled papers. A sufficient amount of paper is produced with 80 g / m^2 – 90 g / m^2 – 100 g / m^2 and perlite-filled.

Printability

***Table 3**: Densitometric value averages of test prints taken over time*

Paper Type	First measure ement	2 hours later	4 hours later	8 hours later	12 hours later	24 hours later
B1	1,05	0,96	0,96	0,96	0,96	0,96
With Perlite - B1	0,97	0,91	0,90	0,90	0,90	0,90
With calcite - B1	1,01	0,96	0,94	0,93	0,93	0,93
B2	1,22	1,18	1,15	1,14	1,11	1,11
With Perlite - B2	1,07	1,03	1,01	1,01	1,01	1,01
With calcite - B2	1,05	0,99	0,98	0,98	0,98	0,98

Three different papers were produced for this study. Handmade papers were produced as calcite-filled and perlite-filled, without using fillers. IGT - C1 Offset printing test was applied to the obtained paper samples. The paper samples were conditioned for 24 hours at 23°C and 65% relative humidity in the media to be printed. One of each paper sample was taken and the test prints were made in a 300 Newton print pressure in accordance with the ISO 12647-2 standard in IGT - C1 Offset test press with a Michael Huber München Resista Cyan 43F10RS series ink (Figure 1). Tolerance limits are within ± 5%. Densitometric measurements of the samples with test prints were made with Gretag Macbeth spectrophotometer and measurements were recorded. The printing of the other three samples was carried out under the same conditions. While the processes were completed in this way, the densitometric values of the printed samples were examined immediately after printing, 2 hours, 4 hours, 8 hours, 12 hours and 24 hours later, and average densitometric values were determined for 6 types of paper (Table 3). The effect of the paper obtained from different pulps with the determined values on the densitometric value is shown graphically in Figure 2 and Figure 3.

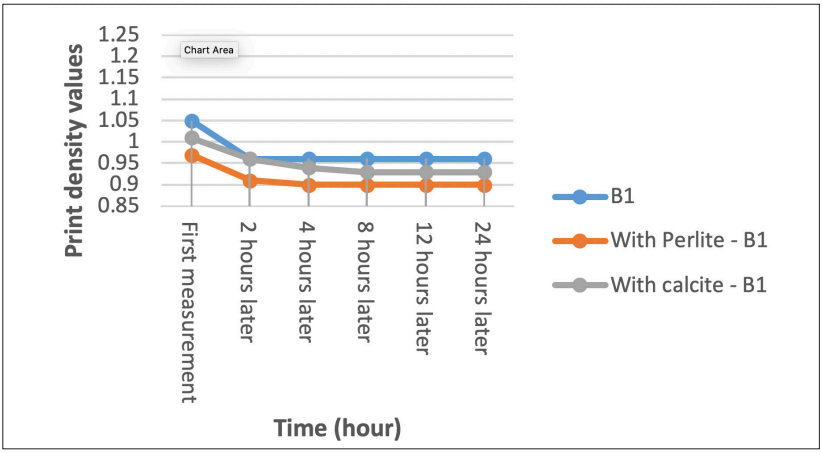

Figure 1. *Graphical view of densitometric value averages of test prints on papers obtained from waste paper without using filler and using Perlite or Calcite.*

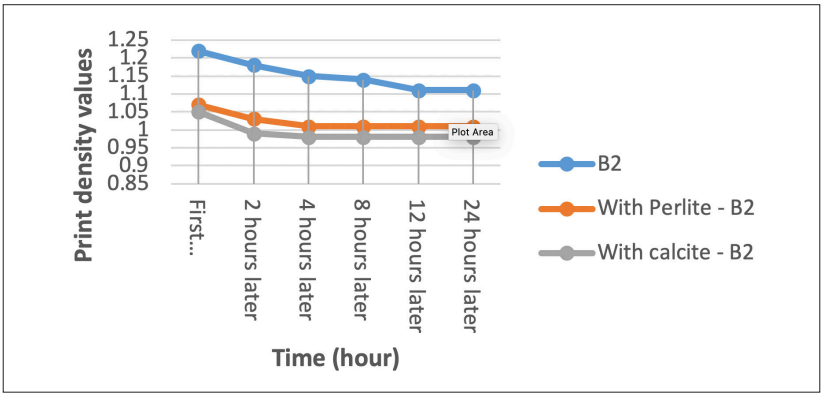

Figure 2. *Graphical view of densitometric value averages of test prints made on paper obtained from raw pulp without using filler and using Perlite or Calcite.*

When the effect of printed ink on densitometric values is evaluated in test prints made on papers obtained from different pulp;

- The densitometric values of the prints made on the papers obtained by using filler into virgine cellulose are higher than those obtained with waste papers. However, in both methods of obtaining paper, the densitometric values obtained on the papers produced without the use of fillers were high.

• Depending on the conditions of the printing environment, the full drying of the ink took place in the literally 8 hours of drying on the papers obtained by using virgine cellulose, while the papers obtained with the waste papers were dry after 2 hours. While the drying of the papers obtained by using filler into the virgine cellulose takes place after 4 hours, the complete drying takes place in the paper produced by using Perlite from the papers produced by adding filler to the waste pulp, after 8 hours in the papers produced by using Calcite.

• While the highest densitometric value is obtained from paper produced with pulp produced with virgine cellulose, the density loss obtained after 24 hours is highest. Density losses after 24 hours are less in papers produced using filler. Densitometric decrease in paper produced using perlite is less than calcite. This decrease is due to the high absorbency property of the calcite pigment.

• The maximum loss of densitometric value two hours after the test print is seen on papers obtained with waste pulp. This decrease in density shows that the absorbency of the paper is high.

• The density value obtained by using Perlite as a filler into raw cellulose is higher than the density value obtained in papers obtained by using Calcite. It is also higher than the paper obtained with waste pulp. However, the density value obtained with calcite filler in waste papers is higher than the density value in papers produced using Perlite.

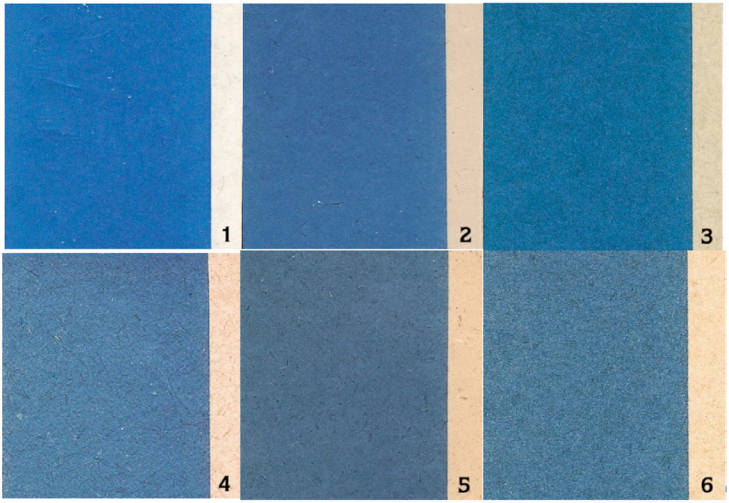

Figure 3: *The images of Printed samples.*

• The color values of the papers greatly influenced the print tonal value obtained. The most important factor in ensuring readability can be achieved by obtaining sufficient contrast between the print color and the paper color. Failure to perceive the characters if sufficient contrast is not provided causes errors in perception, thus causing pauses in reading and perception. Papers 4, 5 and 6 therefore do not have the appropriate tonal value, especially for long-ranging text strings (Figure 3).

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