Ofset Baskıda Yüzey Düzgünlüğünün Geri Dönüşümlü Kâğıtlardaki Tram Ton Değerlerine Etkisi

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ÖZET

Normal bir kağıt hamuru hazırlanması aşamasında, birincil lifler kullanılır ve bu lifler uzun ve kısa liflerden oluşmaktadır. Geri dönüşümlü kağıtların üretim aşamasında, kağıt hamuru hazırlanırken hem birincil lifler hem de ikincil lifler kullanılmaktadır. İkincil lifler daha önceden kullanılmış, pre- consumer (tüketim öncesi) ve post-consumer (tüketim sonrası) olarak adlandırılan liflerdir. Yalnız bu lifler daha önce işlem gördüğü için, birincil lifler kadar formal değildir. Bu çalışmada; birinci hamur ve farklı lif yapılarına sahip olan çeşitli geri dönüşümlü kağıtlar üzerine, birinci hamur baskılarda en çok kullanılan çıkış çözünürlükleri olan 133lpi ve 175 lpi değerleri ve %20, %50 ve %70'lik tram ton değerleri mevcut olan baskı kontrol şeridi kullanılmıştır. Basılan tram ton yoğunlukları elektron mikroskobu ile büyültülerek, tram ton değerlerinin her iki baskı çözünürlüğündeki sonuçlarında, görsel olarak farklılıklar tespit edilmiştir. Geri dönüşümlü kağıtlar üzerine yapılan baskıda yüzey pürüzlülüğünün tram ton değerlerine ve mürekkep dağılımına etkisi incelenerek uygulayıcıların hizmetine sunulmuştur.

Keywords: Geri dönüşümlü kağıt, yüzey pürüzlülüğü, tram ton değeri, mürekkep giderme, beyazlatma

The Effects of the Surface Roughness on the Dot Area of Recycled Papers in Offset Printing

ABSTRACT

In the production of normally paper pulp, primary fibers are used. This fibres are consist of both long fibres and short fibres. In recycled paper production however, both primary fibres (short and long fibres) and secondary fibres are used. Secondary fibres divide into pre-consumer and post-consumer fibres. However these fibers are not as formal as primary fibers because of the re-processing.

In this study, the differences in the dot area in offset printing applied to 1st.Pulp and various recycled papers that have differing fibre structures have been identified. With this intention, 133 lpi and 175 lpi output resolutions are widely used for 1st.Pulp and dot gains of 20%, 50% and 70% in test materials have been obtained. With the aim of examining the effect of dot area in printing on recycled papers, enlarged images taken from the scanning electron microscope (SEM) were used. As a result, how does the dot area effect of the differences between the fibre structure and surface roughness of recycled papers, are determined in this study.

Keywords: Recycled paper, surface roughness, dot area, deinking, bleaching

1. INTRODUCTION

With a daily calculation of 5 million tons, each year Europe produces approximately 2 billion tons of used solid waste. Between the years 1970-1980 the increase in the demand for recycled fibres was two times that of what was obtained from cellulose. Today however, the demand for recycled fibres in Western Europe is increasing four times faster than the demand for fibres obtained from raw cellulose. Towards the end of 2001, the proportion of paper thrown away was around 98%. The amount of paper wasted in Eastern Europe is 80% while it is expected to rise at a rate of 41% for the whole world (1).

In recent years recycling has increased. The European Waste Commission is preparing a formal directive on the subject of packaging and waste/rubbish packaging (2). The attention shown by consumers towards used items is at a situation for transforming purchasing habits. Lately, meeting the increased demand for recycled paper and timber has been a matter of concern. Within this scope, the use of improved fibers is increasing more and more (3).

Good quality recycled paper obtained from waste can look very much like papers obtained from raw fibers. However, its physical characteristics and printing qualities can be low. In examples of good quality paper designed as an alternative to coated and non-coated papers, characteristics such as absorption, surface roughness, gloss, opaqueness and volume are moving away from normal levels at a considerable rate (4).

Roughness or smoothness of paper is a very important property for print quality. Surface roughness is usually divided into microscale and macroscale components (5,6). Research groups studying the roughness and its effect on gloss agreed upon the fact that common roughess numbers are isufficient to predict gloss (6,7). It sometimes occurs that the rougher

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surfaces have higher gloss. Correlations between paper roughness and paper and gloss were studied also by Xu et. All (8)

Using cellulose obtained from low intensity and different tree materials, volume and opaqueness can be increased. In proportion to similar used papers, surface roughness and absorption are found to be greater while gloss and the binding strength of fibres have been found to be low. These characteristics depend on the source of the fibre, recycling processes and on the product obtained (9).

Although the production stages of recycled papers are similar to that of papers produced directly from cellulose, they are different in terms of fibre structure, deinking and flatosyon chemical stages. As a result, fibre structure and surface roughness also show a difference (10).

In this study; by enlarging the dot area in offset printing of papers produced by recycling waste papers using an scanning electron microscope, the difference between the dot area of various types of paper is identified.

2. MATERIAL AND METHOD

2.1. Papers Used In The Study

In this study, the printable parameters of recycled papers have been realised after being printed with parameters that were developed for 1st. Pulp paper. With this intention, papers that have good/bad surface roughness, that are white/non-white and that have/have not had deinking applied to it, have been chosen from two companies that sell recycled paper in Turkey.

The first three recycled papers used in the experimental studies, are recycled papers, (P1,P2,P3) that have been produced from 50% waste paper of which 20% of this is classified as post-consumer waste.

One of the last two recycled paper (P4), is made from 65% pre-consumer waste, 10% post-consumer waste and 25% raw cellulose fibres.

The other of the last two recycled paper (P5), is made from 75% recycled waste paper according to NAPM (National Association of Paper Merchants) valuations and 50% when equalized according to Europe EUGROPA values. Consequently, the amount of pre-used and post-used waste has been confused with a value that has not exactly been identified.

Characteristics of papers used in the study:

- 1st. Pulp, 110 g/m2,
- UNIREP, Rhododendron Soft White, 110 g/m2, (named P1)
- UNIREP, Elements Soft White Solid, 110 g/m2 , (named P2)
- UNIREP, Elements Soft White Grain, 110 g/m2 , (named P3)
- TIMAS, Conqueror Recycled Barley White Laid, 100 g/m2, (named P4)
- TIMAS, Countryside Recycled/Mistral, Mineral Quartz 100 g/m2, (named P5)

Alongside being conformed to the printing rules of the first pulp, taking into account structural differences, recycled papers have been separated according to characteristics such as bad surface roughness, unsufficent deinking and low amount of primary fibre/large amount of secondary fibre etc.

2.2. Materials and Equipment

Pre-print preparation and the materials and equipment used in the printing stage are given in Table 1.

Table 1: Materials and Equipment used

PRE-PRINT PREPARATION	
Computer	G4 processor Macintosh (ColorSync system equipment closed)
Programme	Macromedia Freehand 9.0
RIP	Agfa-Taipan 2.02 PCRIP
Film	TYPON Graphic 15 RL, 60 mx35.5 cm. Antistatic 0.10 mm. Polyster, HN Laser+Laser Diode Red 633-670 nm
Developer	Adefo R40 (developer), (10 lt. water+5 lt. develop=15 lt.)
	Adefo FK 600 (Fixer), (15 lt. water+5 lt. develop=20 lt.)
Film Densitometer	Techon film Densitometry
PRINTING	
Printing Cont. Stripts	Techon Printing Control Stripts
Plate	Fuji Plate
Plate developer	Kologom Plate developer
Ink	Fisat-Italian Ink
Printing Machine	Heilderberg Speedmaster SM72 50X70
Damping solutions	Dyo-Aqua Sheet damping solutions
Printing Densitometer	Techon Printing Densitometer

2.3. Printing method

After obtaining a film output and preparing a plate for pre-print preparations and stated print characteristics, printing was carried out by conforming to ISO 12647-2 principles using the offset printing technique for 1st. Pulp papers. Thus, according to 1st. pulp paper standards, 1st. pulp paper printing was done first. The printing of recycled papers has also been carried out with this adjustmet made for 1st. pulp paper. The reason for taking 1st. pulp paper characteristics as a basis is that in terms of structure, 1st. pulp paper, in contrast to glossy paper and mat paper, looks more like recycled paper. Characteristics of recycled papers such as surface roughness, absorption and gloss are considerably similar to that of 1st. pulp papers.

Two different dot frequency and output resolutions have been used. From process colors (CMYK) that one of the magenta is chosen as a measurement colour, 20%, 50%, 70% dot area intensities of the printing that is done with magenta ink is printed with 133 lpi / 2400 dpi (dot per inch) -dot frequency of 54 and 175 lpi/3000 dpi -dot frequency of 70.

The reason for choosing 20%, 50% and 70% dot areas is that in papers made from primary fibres, the measured dot gains of test prints are found at middle and end tones while in recycled papers made from secondary fibres, they arise more at the first quarter values as well as at the middle tones and end quarter tones.

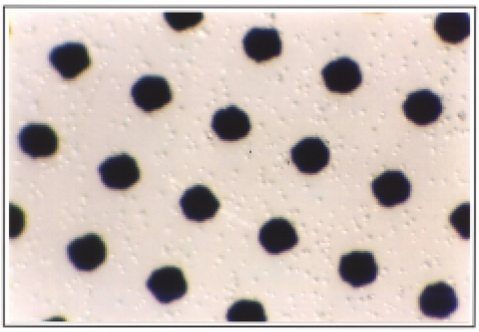
2.4. Evaluation of the Data

The section of the paper printed is examined by enlarging it 118 times using SEM (Scanning Electron Microscope). The dot gain of recycled papers and its surface roughness, the colour of the paper and its variation with primary fibre and secondary fibre proportions have all been evaluated according to the first view of deformations at the first quarter tone.

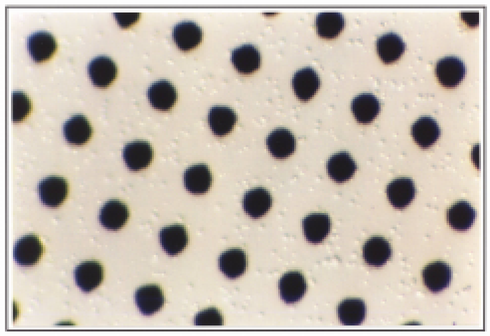
3. EXPERIMENTAL RESULTS

3.1. Images of Dot Area on Film

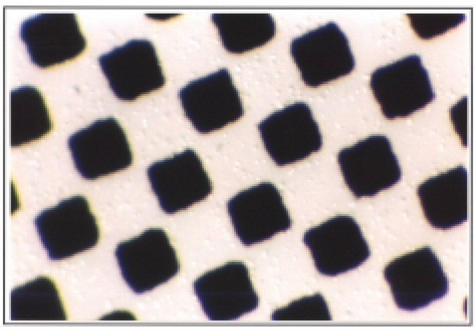
Images of dot area on film in both tram densities is shown in picture 1-picture 6.



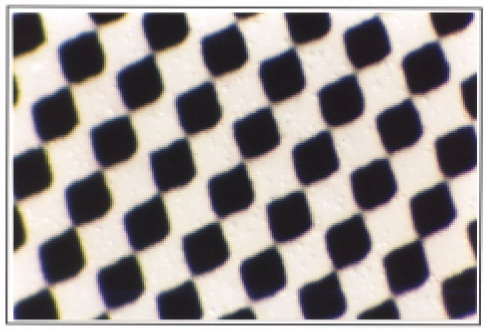
Picture 1. 133 lpi/2400 dpi
Magenta film %20 dot area (x 118)



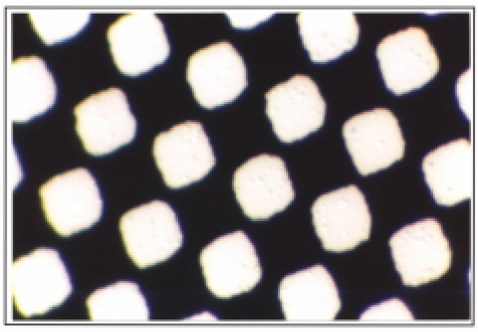
Picture 2. 175 lpi/3000 dpi
Magenta film %20 dot area (x 118)



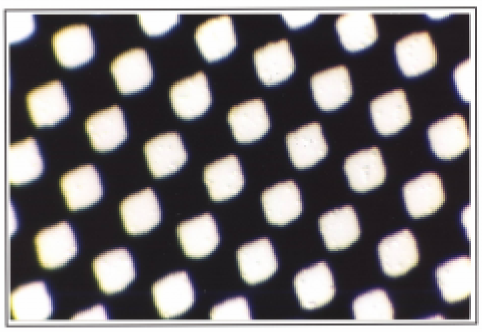
Picture 3. 133 lpi/2400 dpi
Magenta film %50 dot area (x 118)



Picture 4. 175 lpi/3000 dpi
Magenta film %50 dot area (x 118)



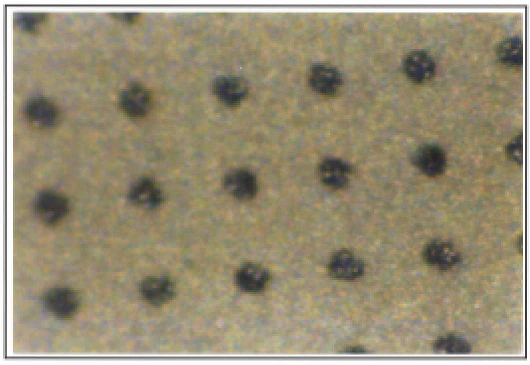
Picture 5. 133 lpi/2400 dpi
Magenta film %70 dot area (x 118)



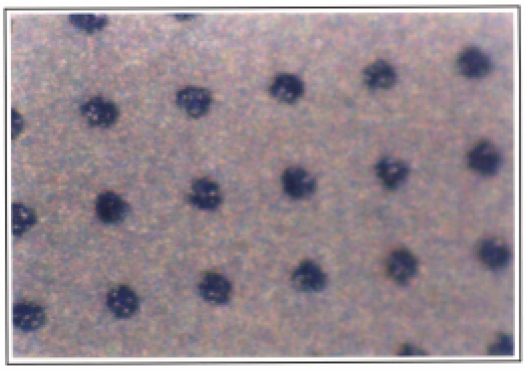
Picture 6. 175 lpi/3000 dpi
Magenta film %70 dot area (x 118)

There are raster dots, prepared in two different resolutions, here. When the characterization on the film is analyzed, it is observed that dot gains are less in 175lpi/300 dpi. It will be observed which one of these print resolutions will give better results.

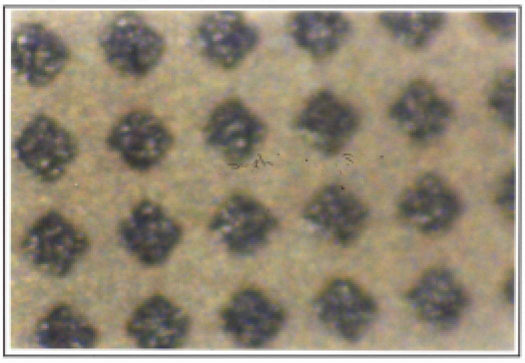
The images of film, prepared with raster dots in different resolutions before, in the blanket which will be used in printing process can be seen. It is observed that dot areas in the blanket get much smaller. This is a normal situation. As there will be dot gain in the printing process, this shifting down in the blanket will draw down the dot gain in the printing as well.



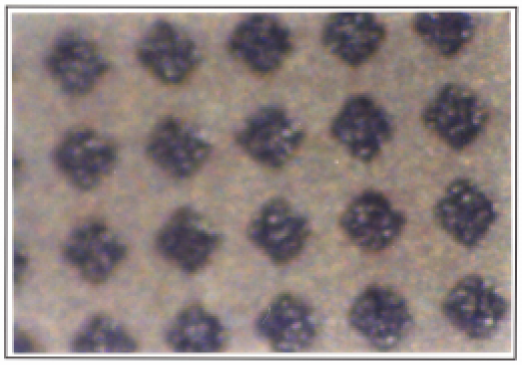
Picture 7. 133 lpi/2400 dpi
Magenta plate %20 dot area (x 118)



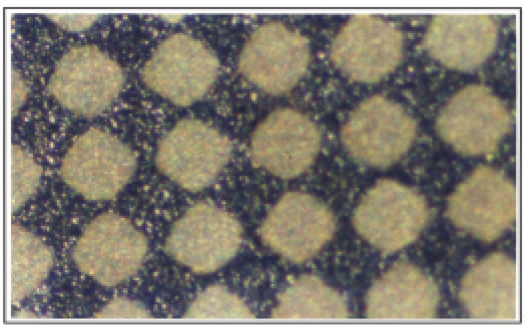
Picture 8. 175 lpi/3000 dpi
Magenta plate %20 dot area (x 118



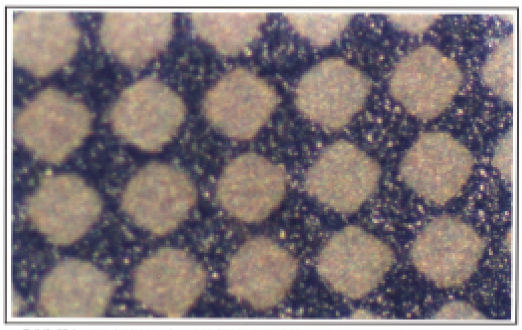
Picture 9. 133 lpi/2400 dpi
Magenta plate %50 dot area (x 118)



Picture 10. 175 lpi/3000 dpi
Magenta plate %50 dot area (x 118)



Picture 11. 133 lpi/2400 dpi
Magenta plate %70 dot area (x 118)



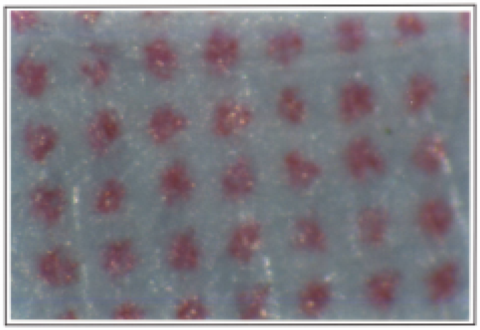
Picture 12. 175 lpi/3000 dpi
Magenta plate %70 dot area (x 118)

3.2. Images of Dot Area on Plate

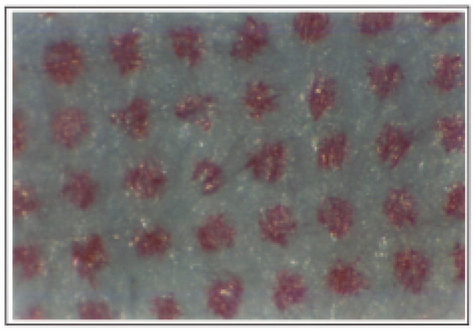
Images of dot area on plate are shown in Picture 7- Picture 12.

3.3. Printed Images of the Dot Area on P1 Paper

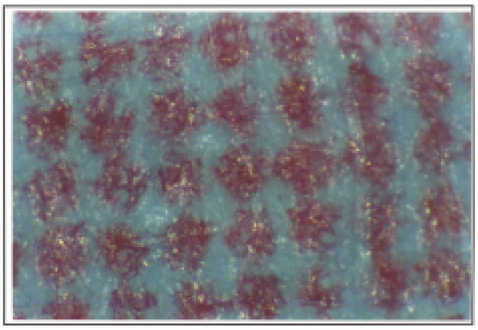
Printed images of the dot area on P1 paper are shown in picture 13-picture 18.



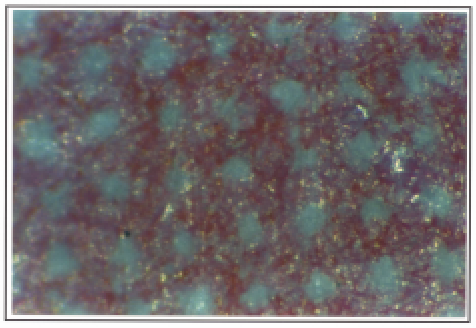
Picture 13. 133 lpi/2400 dpi
P1 magenta %20 dot area (x 118)



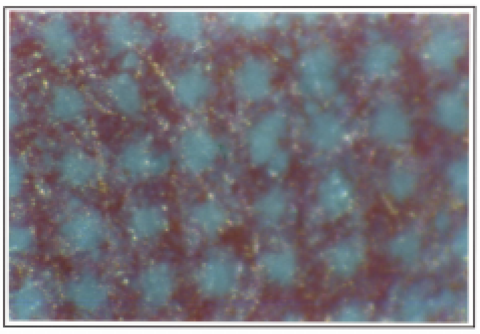
Picture 14. 175 lpi/3000 dpi
P1 magenta %20 dot area (x 118)



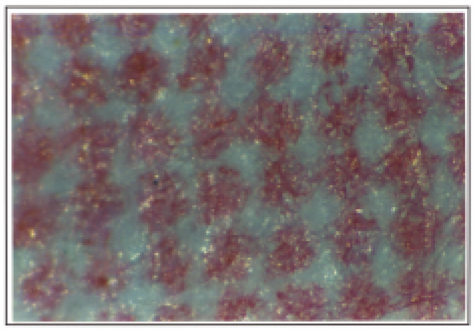
Picture 15. 133 lpi/2400 dpi
P1 magenta %50 dot area (x 118)



Picture 16. 175 lpi/3000 dpi
P1 magenta %50 dot area (x 118)



Picture 17. 133 lpi/2400 dpi
P1 magenta %70 dot area (x 118)

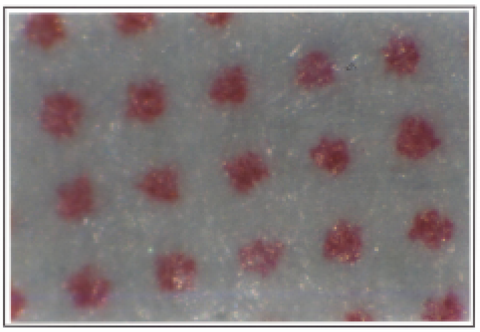


Picture 18. 175 lpi/3000 dpi
P1 magenta %70 dot area (x 118)

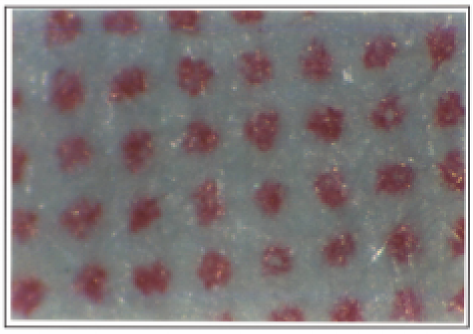
P1; a type of paper with a rough surface and which deinking (ink removal) and bleaching (whitening) has been applied to, has a better dot structure at 133 lpi and greater ink dispersal at 175 lpi. While raster dots in 175 lpi are better in the film and in the blanket, that the surface of the paper is not straight gets the 133 lpi area more correct. As the raster dots are smaller in 175 lpi, it gets lost in small holes of the paper's uneven surface and reduces the color intensity of the print.

3.4. Printed images of the dot area on P2 paper

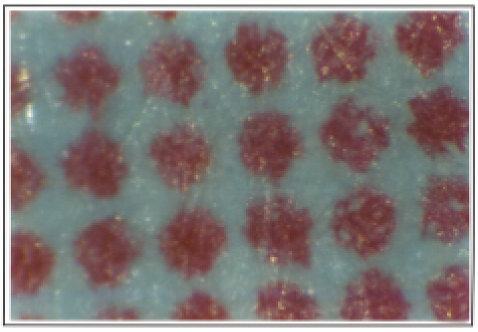
Printed images of the dot area on P2 paper are shown in Picture 19-picture 24



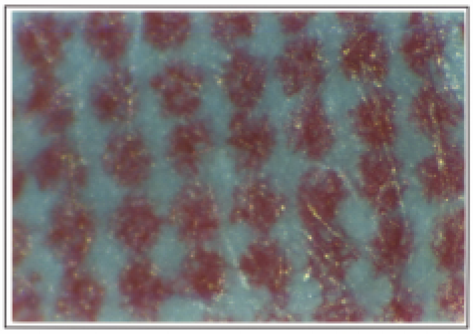
Picture 19. 133 lpi/2400 dpi
P2 magenta %20 dot area (x 118)



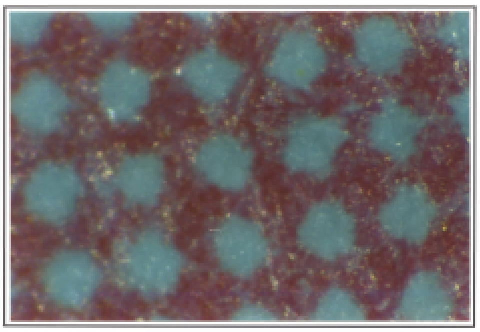
Picture 20. 175 lpi/3000 dpi
P2 magenta %20 dot area (x 118)



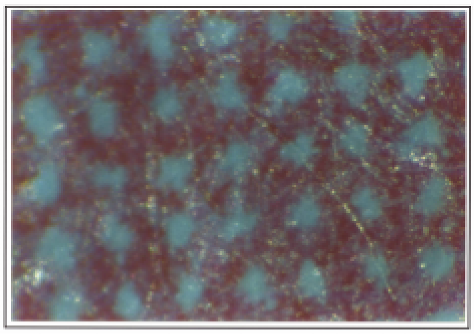
Picture 21. 133 lpi/2400 dpi
P2 magenta %50 dot area (x 118)



Picture 22. 175 lpi/3000 dpi
P2 magenta %50 dot area (x 118)



Picture 23. 133 lpi/2400 dpi
P2 magenta %70 dot area (x 118)

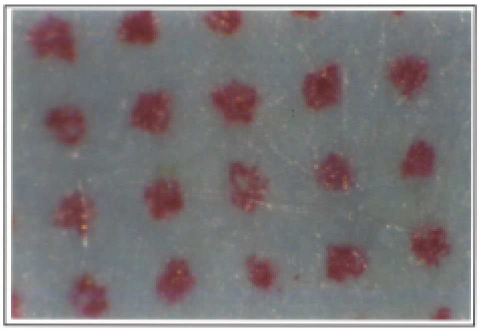


Picture 24. 175 lpi/3000 dpi
P2 magenta %70 dot area (x 118)

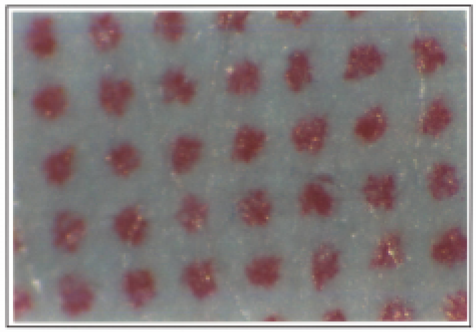
P2 is a slightly broken white, yellowish coloured paper. The surface roughness and structure of P2 is similar to that of smooth mat paper. Due to the surface being smooth and although secondary fibre ratio is being used, its dot structure in proportion to P1 paper is given more accurately. But when the dot areas of %50 and %75 are considered, it is observed that the bottom areas, comparing to the raster tone values in the film, become more stained with ink and that the ink spreads. At the same time, dot gain is less in 133 lpi area.

3.5. Printed Images of the Dot Area on P3 Paper

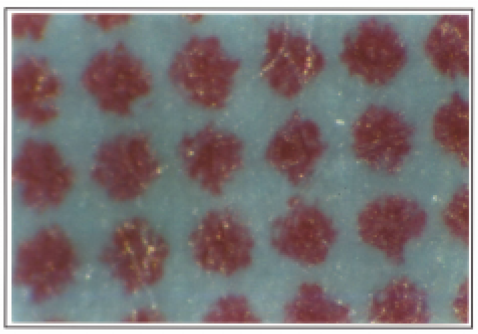
Printed images of the dot area on P3 paper are shown in picture 25-picture 30



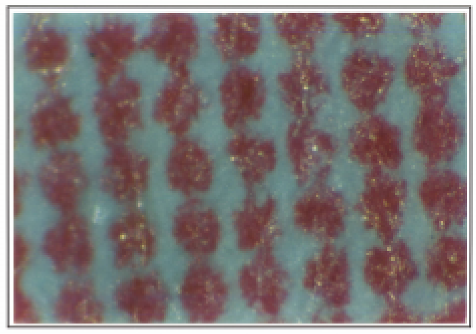
Picture 25. 133 lpi/2400 dpi
P3 magenta %20 dot area (x 118)



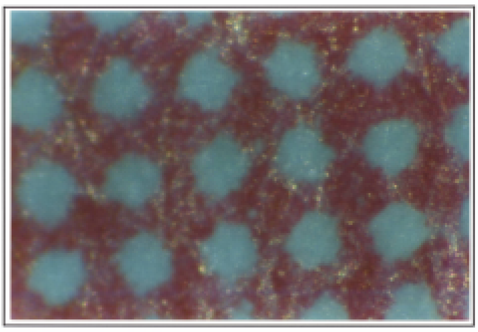
Picture 26. 175 lpi/3000 dpi
P3 magenta %20 dot area (x 118)



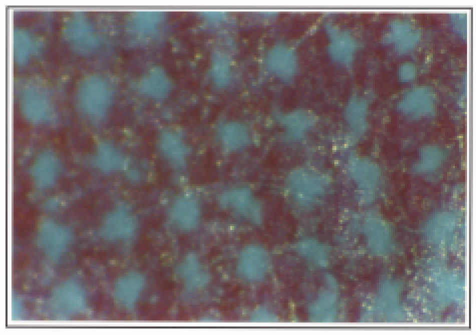
Picture 27. 133 lpi/2400 dpi
P3 magenta %50 dot area (x 118)



Picture 28. 175 lpi/3000 dpi
P3 magenta %50 dot area (x 118)



Picture 29. 133 lpi/2400 dpi
P3 magenta %70 dot area (x 118)



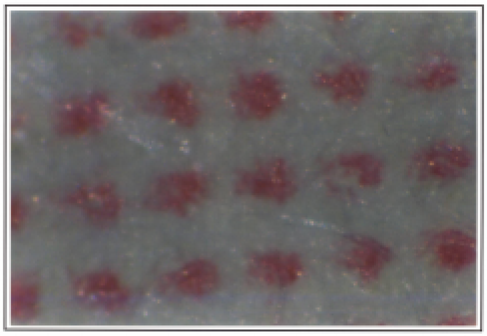
Picture 30. 175 lpi/3000 dpi
P3 magenta %70 dot area (x 118)

P3 is a slightly broken white coloured paper which has a smooth surface where on it remains ink particles as a result of deinking not being fully applied. In places where these ink particles are found, lower amounts of magenta ink and a reduction in ground density is observed. It is mainly the ink particles covering 70% of the area in the bottom right corner that have caused a negative impact on the printing.

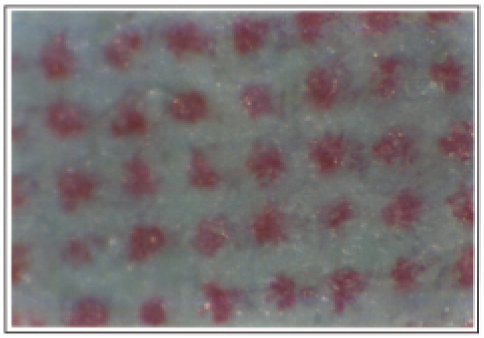
Although a paper type with a straighter surface is chosen and deinking amount is less, straight dot formation on the surface of paper is better in 133 lpi than in 175 lpi.

3.6. Printed Images of the Dot Area on P4 Paper

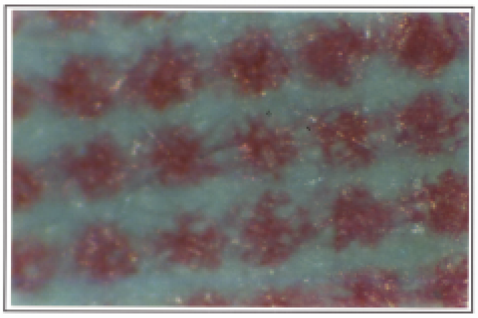
Printed images of the dot area on P4 paper are shown in picture 31-picture 36



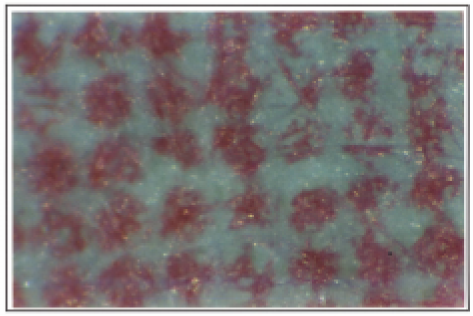
Picture 31. 133 lpi/2400 dpi
P4 magenta %20 dot area (x 118)



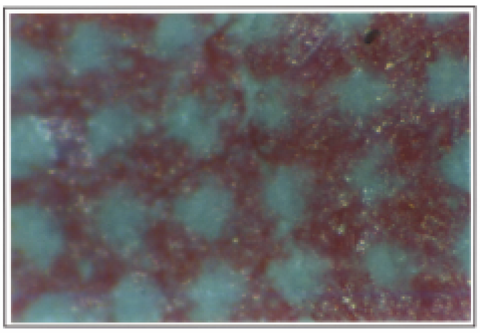
Picture 32. 175 lpi/3000 dpi
P4 magenta %20 dot area (x 118)



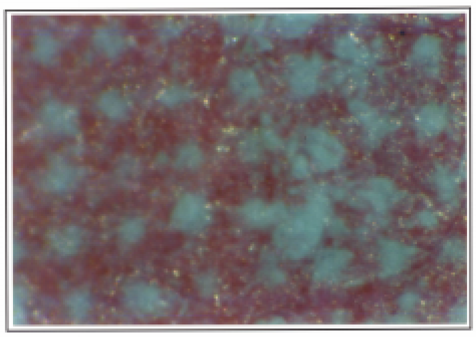
Picture 33. 133 lpi/2400 dpi
P4 magenta %50 dot area (x 118)



Picture 34. 175 lpi/3000 dpi
P4 magenta %50 dot area (x 118)



Picture 35. 133 lpi/2400 dpi
P4 magenta %70 dot area (x 118)

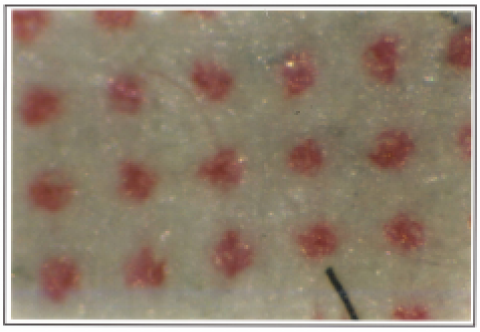


Picture 36. 175 lpi/3000 dpi
P4 magenta %70 dot area (x 118)

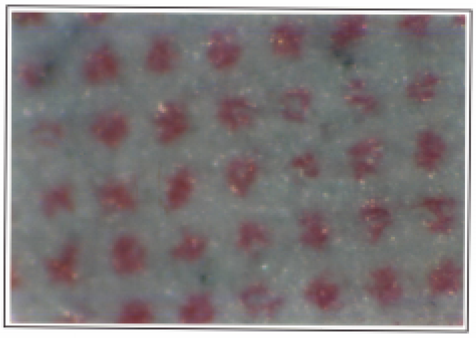
P4 paper is a type of art paper which is yellow and which does not have good surface roughness. Consequently, it is a type of paper where the dot area experiences the most deformation in both 133 lpi and 175 lpi printing. Furthermore, since the secondary fibre ratio being used here is high, printing on some parts of the paper lead to low quality prints. When a 175 lpi 50% dot structure is examined, a high level of breakage is observed. The same conclusion can be made for 70% dot area intensity. However in contrast to these results, values at 133 lpi have been found to be better.

3.7. Printed Images of the Dot Area on P5

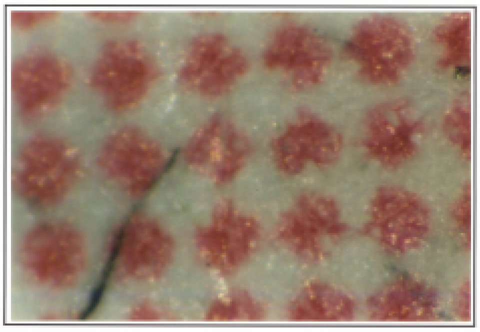
Printed images of the dot area on P5 paper are shown in picture 37-picture 42



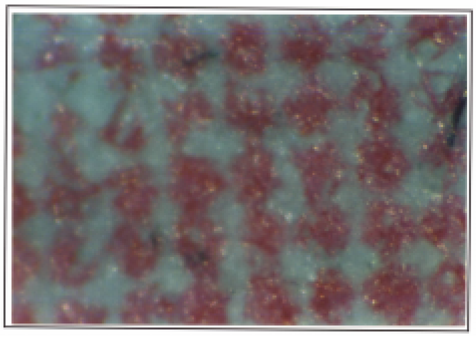
Picture 37. 133 lpi/2400 dpi
P5 magenta %20 dot area (x 118)



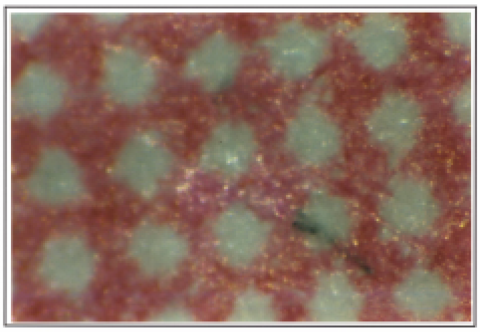
Picture 38. 175 lpi/3000 dpi
P5 magenta %20 dot area (x 118)



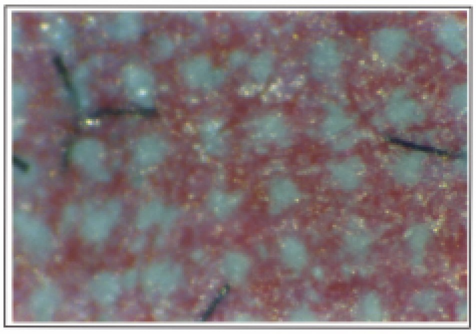
Picture 39. 133 lpi/2400 dpi
P5 magenta %50 dot area (x 118)



Picture 40. 175 lpi/3000 dpi
P5 magenta %50 dot area (x 118)



Picture 41. 133 lpi/2400 dpi
P5 magenta %70 dot area (x 118)



Picture 42. 175 lpi/3000 dpi
P5 magenta %70 dot area (x 118)

P5 is a slightly grey coloured paper. Since the amount of deinking is low compared to P3, the amount of ink particles in its structure is greater. The main characteristic in both lpi values is that since the structure of the ink particles are the same as that of the ink used in the printing, with densitometric measurments, the print density is affected.

But when the two lpi areas are observed, it is seen that dot gain in 133 lpi is less and dot form in 133 lpi is better.

4. CONCLUSIONS

The surface roughness of recycled papers of different physical characteristics affect printing parameters. It can be said that the use of light weighing papers for printing increases volume and opaqueness. Furthermore, according to those who do not use waste paper in production, surface roughness and absorption is greater while gloss and binding strength of the fibres is low. The fibre structure and surface roughness of papers produced using waste paper is different to that of papers produced without the use of waste. The results obtained from this study:

* In the printing carried out, dot gains of papers made from primary fibres are in midle and end quarter tones. In contrast, the dot gains of recycled papers made from secondary fibres come out more in first quarter tone values and are not only seen in middle and end quarter tones.

* After printing, when the dispersion and deformation of dot areas and of the dot gains on the

paper surface are compared with the images of the first quarter tones, more can be observed on recycled papers.

* On P1, dot structure is better at 133 lpi and ink dispersion is greater at 175 lpi. On P2 however, since its surface is smooth its dot formation in proportion to P1 is much more accurate even though secondary fibre ratio is used.

* On P3 paper, in places where ink particles are found, magenta ink has settled less, the density is reduced and the ink particles covering 70% of the area especially in the bottom right corner have caused a negative impact on the printing.

* P4 is a type of paper where the dot area experiences the most deformation in 133 lpi and 175 lpi printing. Here, since the ratio of the secondary fibre being used is high, printing on some parts of the paper has been negatively affected. It can be said that with 175 lpi 50% dot structures a significant amount of breakage occurs. Furthermore, it is assumed that the same results will be obtained for 70% dot area intensities and that values at 133 lpi will be much more appropriate.

Furthermore, since the secondary fibre ratio being used here is high, printing on some parts of the paper lead to low quality prints. When a 175 lpi 50% dot structure is examined, a high level of breakage is observed. The same conclusion can be made for 70% dot area intensity. However, in contrast to these results values at 133 lpi have been found to be better.

* Since the amount of deinking in P5 is low compared to P3, the amount of ink particles in its structure is greater. It is assumed that since the structure of the ink used for printing is the same as that of the ink particles observed in both lpi values then in densitometric measurements the print density is affected in a negative way.

5. REFERENCES

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