Asian Journal of Chemistry; Vol. 23, No. 6 (2011), 2685-2687

ASIAN JOURNAL OF CHEMISTRY

www.asianjournalofchemistry.co.in

Comparison of Brightness and Colour Characteristics of Mineral and Vegetable Oil-Based Offset Printing Ink

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(*Received*: 2 September 2010; *Accepted*: 18 February 2011) AJC-9639

Offset printing is a commonly used printing technique where the inked image is transferred from a printing plate to a rubber blanket, then to the printing surface. The inks used in the offset process are made basically of a mixture of resins, vegetable or mineral oils, pigments and solvents. The use of vegetable oil in the offset printing inks is gradually increasing each day, in terms of protecting environment and human health and print quality results. However, vegetable-based inks give good results in terms of print quality. The brightness of the inks printed on paper or cardboard by offset printing are among the basic criterias of the quality. Gloss can also be a measure of the quality of a surface. The maximum colour tone of the CMYK process inks that could be depicted on colour picture printing is also among the basic quality criterias. In the study, mineral oil-based and vegetable oil-based inks were prepared specifically for the offset printing. Printing plates were prepared by being exposed with picture of ISO300 standard, specifically-prepared scale and CtP (computer to plate). Test printings were performed on two types of papers, matt and glossy-coated, which are frequently used in the production of printed goods in offset printing with mineral and vegetable oil-based inks with the help of a computer-controlled machine. In the process of printing, the printing was made with standardized parameters by measuring the values of L*a*b* by means of spectrophotometer. As a result of the measurements performed on the printed surface by glossmeter, it was determined that vegetable-based ink is more glossy than the mineral-based ink and that the only colour gamut it can simulate is broader.

Key Words: Printing ink, Brightness, Colour space, Offset printing.

INTRODUCTION

Offset printing is a commonly used printing technique where the inked image is transferred from a printing plate to a rubber blanket, then to the printing surface. The inks used in the offset process are made basically of a mixture of resins, vegetal or mineral oils, pigments and solvents.

Increasing the environmental and qualitative demands has resulted in the development of printing inks based on vegetable oils derived from soy beans, rapeseed, castor, linseed or canola instead of mineral oil and they are widely used globally[1-3].

In recent years, there has been a growing trend in using vegetable oils as raw materials in resin production[4]. In particular, they play a significant role in ink, varnish and paint manufacture[5]. Vegetable oils play an important role in today's sheetfed printing ink market. They are used in replacement of petroleum distillates to produce ink that is more environmentally friendly. With the increasing cost of crude oil, it is likely that the use of vegetable oils will continue to grow, especially within the sheetfed ink market[6].

All lithographic printing inks contain pigments, resins, oils, waxes, driers and other ingredients[7]. Vegetable oil inks contain vegetable oils as a replacement for some or all of the petroleum oil in lithographic inks[8].

Many printers claim that soy inks are more forgiving and thus they make it easier to run a high quality job on older equipment. It is sometimes easier and faster to change from a dark to a light colour ink with soy than with petroleum-based inks.

Vegetable oil-based printing ink vehicles did not require any petroleum components, which meet or exceed industry standards for rub-off resistance, viscosity and tackiness for a variety of printing applications[9,10].

This may be a guide to how much vegetable oil can be used to replace the solvent component of a sheet-fed lithographic ink without detracting ham the setting speed of the print on coated papers[11].

The word "oil" is used for triglycerides that are liquid at ordinary temperatures. They are water insoluble products of plants[12].

Soy oil printing inks are used by more than 90 % daily newspapers in the US, a quarter of the 50,000-plus US commercial printers and are widely used globally. These inks contain unmodified oils and a variety of specialized pigments and resins, depending on the printing application. The amount of soybean oil in the ink also depends on the application, for example, newspaper inks contain 50-75 % soybean oil, while sheet-fed printing, heat-set and cold-set printing inks contain 20-30 % soybean oil. One of the major advantages of soy inks is that volatile organic compounds (VOCs) are not released into the air when it dries. Instead of drying by losing solvents, the oil polymerizes, usually catalyzed by heat, pressure and metallic catalysts[10-13].

Gloss is an indispensable measure in the printing industry. Packaging and magazine covers are regularly UV varnished for a quality glossy appeal to consumers and company brochures are given that professional edge with lamination and varnish to give contrasting matt and gloss effects[14]. The quality of an ink film can be described by optical properties such as gloss and optical colour density[15].

EXPERIMENTAL

In the experimental section, the test printings were performed with the help of an offset printing machine having 4 units, size of 35 cm × 40 cm, Heidelberg Speedmaster infrared dryer, automatic table remote.

A special scale was established for the test printing, by means of the Adobe Illustrator program. IT8.7/3 colour scale, a picture of ISO 300 standard and CMYK solid colours were used on the scale. IT8.7/3 colour scale on the test scale is used for constructing colour profiles as a result of the printings performed and making comparisons, the picture of ISO 300 standard is used for the visual control and solid CMYK colours are used for measuring the L*a*b* values.

Printing plates were prepared by using computer to plate exposure device of Fuji Violet type, Fuji Violet printing plates and again, plate processing machine of the Luxel series. The details about the plate processing machine, being used, are given in Table-1 and details about the plate are given in Table-2.

TABLE-1
TECHNICAL SPECIFICATIONS OF FUJI LUXEL Vx-6000 CtP SEMI-AUTOMATIC PLATE PROCESSING MACHINE

Max. plate size	762 mm × 675 mm
Min. plate size	340 mm × 317 mm
Plate thickness	0.15-0.30
Exposure speed	2438 dpi
With 1 laser	22 pieces 50 × 70 plate
With 2 lasers	37 pieces of 50 × 70 plate

TABLE-2
TECHNICAL SPECIFICATIONS OF FUJI BRILLIA LP-NV PHOTOPOLYMER COMPUTER TO PLATE

Type	Negative, high speed photopolymer
Light source	30 mw violet laser diot
Chemicals	LP-D3W Developer LP-D3WR Replenisher FN-6 Finishing gum
Solubility	200 lpi 2-98 %

Printed and non-printed paper was measured by Novo Gloss NG 75 glossmeter, which is the most appropriate model for measuring board and printing surfaces, according to Tappi T 480.

Mineral and vegetable oil-based inks, whose formulations are given in Table-3 below, were prepared for the test printing. Technical properties of coated matt paper and coated glossy paper used in test printings are given in Table-4.

TABLE-3
FORMULATIONS OF MINERAL AND VEGETABLE OIL-BASED TEST PRINTING INKS

	Mineral oil-based ink (%)	Vegetable oil-based ink (%)
Organic pigments	12-19	13-20
Modified phenolic resin	18-27.5	20-30
Vegetable-based oils	5-10	25-46
Mineral oils	22-30	0
Dryers	1.5-3.5	2-4

TABLE-4
TECHNICAL PARAMETERS OF PAPERS USED IN THE TEST PRINTING

Parameter	Unit	170 g/m^2 coated glossy paper	170 g/m^2 coated matt paper
Basis weight	g/m^2	170	170
Thickness	µm	124	158
Ash	%	40.9	42.8
Porosity	mL/d	140	160
Surface smoothness (PPS) front	µm	1.03	2.03
Surface smoothness (PPS) back	µm	1.12	2.12
Whiteness with f (front)	%	82.16	83.81
Whiteness without f (front)	%	93.06	94.24
Whiteness with f (back)	%	81.88	83.58
Whiteness without f (back)	%	92.7	94.02
Cobb-60 (front face)	g/m^2-1 mn	25	38
Cobb-60 (Reverse side)	g/m^2-1 mn	31	56

RESULTS AND DISCUSSION

As a result of the brightness measurements of mineral and vegetable oil-based inks by means of glossmeter, it was determined that vegetable oil-based ink is 8.3 % (Table-5) more glossy on glossy paper compared to the mineral oil-based ink and it is 8 % (Table-6) more glossy on the matt paper.

TABLE-5
MEASURED BRIGHTNESS VALUES OF THE GLOSSY PAPER USED ON THE TEST PRINTING

Glossy paper	Brightness	
	Non-printed	Printed
Mineral oil	39	50
Vegetable oil	39	60

L*a*b* values of CMYK colours were measured on the test printings performed with the help of mineral and vegetable oil-based inks by Gretag Macbeth Spectrophotometer from the related areas. Additionally, the maximum colour gamuts

TABLE-6
MEASURED BRIGHTNESS VALUES OF THE MATT PAPER USED ON THE TEST PRINTING

Matt paper	Brightness	
	Printless	Printed
Mineral oil	32	40
Vegetable oil	32	50

they could give were determined by scanning the IT8.7/3 colour scale on the test scale with GretagMacbeth Eye1iO. Gamuts were compared through being clashed on a single diagram. It was determined that although the pigment rates of mineral and vegetable oil-based inks are the same, the colour gamut of the vegetable oil-based ink is broader (Figs. 1 and 2).

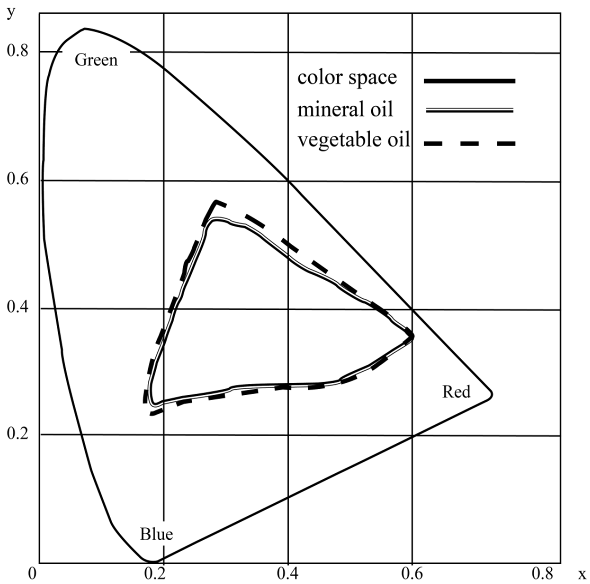

Fig. 1. Colour gamut of priting applied on coated glossy paper by mineral oil-based and vegetable oil-based ink, comprised after being scanned by Eye1iO device on the basis of IT8.7/3 colour scale

Other benefits of using vegetable oil in offset inks are mentioned below. Vegetable-based oils tend to be clearer than mineral oils, so the colours can be brighter. Vegetable oil-based inks has low levels of volatile organic compounds, which helps to reduce air pollution by minimizing toxic emissions. Mineral oil-free inks are not only environmentally friendly, but they also are rich in product quality. Vegetable oil-based inks are less inclined to form a scab on their packaging and ink reservoir. It is more stable on the offset printing plate and ink-water balance is much better. With less amount of ink on the unit area, sufficient densitometric value is obtained on the paper. Vegetable oil-based inks-printed products are easily deinkable by wastepaper processors. They provide better trapping for successive ink printing. Vegetable oil-based inks pickup and transfer is quicker, resulting in shorter startups and less waste. It is easy to print on recyclable papers by

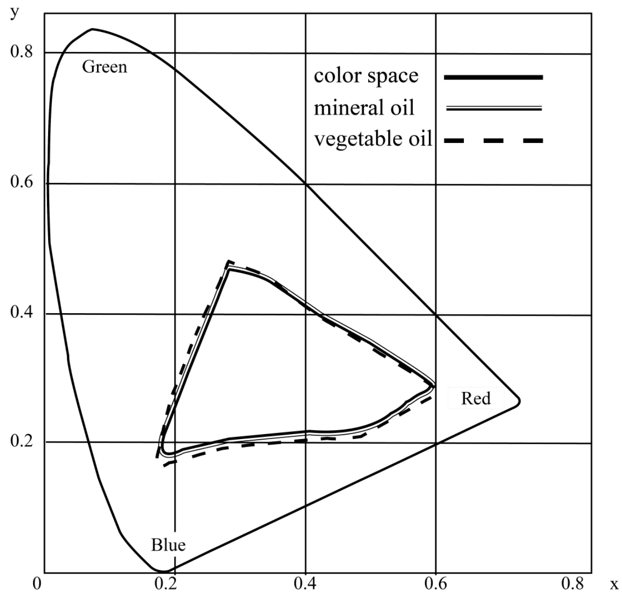

Fig. 2. Colour gamut of priting applied on coated matt paper by mineral oil-based and vegetable oil-based ink, comprised after being scanned by Eye1iO device on the basis of IT8.7/3 colour scale

vegetable oil-based inks. Because vegetable oil-based inks hold better on to paper fibers.

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