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A Study of Quality Differences between Waterless and Conventional Litho Printing

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Abstract

This paper discusses the differences in print quality of graphic communications products that are produced by waterless and conventional lithography (litho). A comparison between waterless and conventional litho products was performed on seven print quality characteristics. These characteristics were color consistency, ink density, dot gain, print contrast, and ink gloss. The research study was based on Lamparter's (1994) and other studies. A cross-sectional research was conducted. Questionnaires were sent to participants to collect data. A seven-point Likert scale was used to obtain data responses regarding print quality characteristics. Descriptive data analysis was performed to answer research questions. It was found that waterless litho provides better image quality than conventional litho.

Introduction

Waterless lithography (litho) or dry offset printing (driography) has been in existence for several years, but few research studies have been in the field of waterless lithography. As a result, many graphic communications professionals jumped into installing waterless litho presses without extensive knowledge about the waterless litho process. Eventually, most of them became dissatisfied with waterless litho or confronted unanticipated problems with waterless litho.

William C. Lamparter, President of PrintCom Consulting, performed an interview survey for the American Printer magazine in mid 1994. Lamparter (1994) found that waterless lithographers produce higher image quality than that of conventional lithographers. Two experimental studies were conducted at R. R. Donnelley & Sons Company by Ben Wong, David Strong, Rick Stone, and Zhenhua Xie to measure the print characteristics of waterless litho. They measured different print characteristics, such as, color consistency, ink density, dot gain, ink gloss, and print contrast. Wong concluded "we have had good results but there are extra plate and ink costs" (Vruno, 1997, p. 65).

Quality of the printed products plays an important role in increasing market share and raising profits. Ruggles (1996) listed quality of the product as one of the factors when determining pricing. He stated “typically, higher quality products justify higher selling price” (p. 193). An empirical study was conducted to determine quality of printed products produced by waterless or dry lithography (litho) and conventional or wet lithography. This paper investigates the quality differences between waterless and conventional litho products.

Purpose

The purpose of the research was to determine quality rankings of waterless and conventional litho products. Five quality aspects were used to determine quality of printed products: (1) color consistency, (2) ink density, (3) dot gain, (4) print contrast, and (5) ink gloss.

Problem

The problem of the research was to compare quality of printed products of waterless litho with that of traditional litho. It was found from the review of

literature that waterless lithographers and conventional lithographers had disagreements on the quality issue.

Research Question

The following research questions were prepared for this study:

1. Do waterless lithographers perceive that they achieve higher printed quality in comparison with that of conventional lithographers?
2. Are waterless lithographers satisfied with quality of printed products?

Review of Literature

This research study was based on relevant information gathered through both primary and secondary sources. The findings related to quality associated with waterless litho are discussed in the following paragraph.

The concept of waterless lithography or driography was first developed by 3M Company in late 1960s (Cross, 1993, April). The concept was to modify lithography so that there was no need to use dampening solution. After several years of research and development and many millions of dollars invested to solve the technical problems associated with ink consistency and plate durability, 3M sold the concept to Toray Industries, Inc., a Japanese chemical company (What it is, 1997a).

Waterless lithography was different from conventional lithography in that the dampening system was eliminated. Because of this change, waterless lithography requires a special type of plate, specially formulated high viscosity ink, and a press outfitted with a temperature control system.

A Toray Positive-Acting (TAP) waterless litho plate was first introduced at DRUPA, a graphic arts exposition that was held in Germany in 1977. Whereas, a Toray Positive-Acting (TAN) waterless litho plate was introduced at the Print graphic arts show in the United States in 1980 (What it is, 1997a). The waterless litho plate consists of five layers: (1) an unanodized aluminum base, (2) a primer to bind the photopolymer layer to the base, (3) a light sensitive photopolymer layer, (4) an ink repellent silicone layer, and (5) a protective cover film at the top. It was stated in "What it is" (1997b) that waterless litho inks have higher viscosities than traditional litho inks. The temperature of the waterless litho ink increases rapidly because of removal of the dampening system. As temperature increases, the ink loses viscosity. To maintain the temperature of ink, a temperature control system is required.

Since the dampening system was eliminated in waterless lithography, all other problems associated with the dampening system were eliminated, too. Waterless litho press operators stated that the process offers better print contrast, less dot gain, higher gloss value, higher ink density, and the ability to print up to 900 lpi (lines per inch) screens (Cross, 1993, December). KBA, a press manufacturing company, argued that by printing waterless, the problems of fan in and out were eliminated (Hayes, 2001a). Macintosh, Sun Chemicals' coldset chemist mentioned that waterless litho reduces the problems of tinting and ink misting (Hayes, 2001b). Alan Dungar, manufacturing director at the Cambridge University Press, said the move to waterless litho is bringing quality improvements (Larkin, 2003). On the contrary, conventional litho press operators argued that high quality could be achieved through the utilization of stochastic screening without running waterless (Lamparter, 1994). Thus, there were contradicting arguments regarding the quality issue of waterless litho products.

Methodology

A survey instrument, questionnaire, was prepared for collecting data. Gay (1996) stated that usually descriptive data were gathered through a questionnaire survey, an interview, or an observation. The questionnaire contained questions regarding perceived opinions for waterless litho as compared to conventional litho on various aspects of quality, such as, color consistency, ink density, dot gain, print contrast, and ink gloss.

The questionnaire was pre-tested for its validity and reliability. A pilot test was conducted to check the validity of the questionnaire, eliminate any ambiguity, and make appropriate changes according to respondents' suggestions. A targeted sampling technique was applied to select the final subjects. Printing companies of the United States who had experience with both waterless litho and conventional litho were selected. Questionnaires were mailed to middle-level to top-level management personnel of those companies. Bailey (1967), Balian (1982), Balsley and Clover (1988) stated that mail questionnaires had advantages of standardized wording, no interview bias, respondent privacy, cost and time saving, and convenience, but usually the response rate was low. Waterless lithographers' perceived opinions about quality of printed products were measured in comparison with those of conventional litho products. A seven-point Likert scale was used to measure participants' opinions. The seven-point Likert scale was designed as: (1) very satisfied, (2) satisfied, (3) somewhat satisfied, (4) no difference, (5) somewhat dissatisfied, (6) dissatisfied, and (7) very dissatisfied. Participants' opinions about quality satisfaction related to color consistency, ink density, dot gain, print contrast, and ink gloss were grouped to form a quality-satisfaction index. The frequency of responses for each question was calculated. Means, medians, and standard deviations were executed for the data analysis.

Findings

A total of 27 questionnaires (32.53%) were received out of 83 subjects from 28 states of the United States. Twenty-three valid questionnaires were used for the data analysis. Original ordinal data were converted to ratio data as 1 = very satisfied, 2 = satisfied, 3 = somewhat satisfied, 4 = no difference, 5 = somewhat dissatisfied, 6 = dissatisfied, and 7 = very dissatisfied. Table 1 shows that satisfaction range of each valid participant regarding the quality satisfaction index. It is observed from the table that participants' responses for measuring the quality satisfaction index

were between 1 = very satisfied to 3 = somewhat satisfied on the seven-point Likert scale.

The mean received for the quality satisfaction index was 1.67 (see Table 2) on the seven-point Likert scale which placed their opinions between "very satisfied" and "satisfied." This indicates that most of the respondents were more satisfied with the quality of waterless litho products as compared to that of the conventional litho products.

Conclusions

The results of the empirical study showed that lithographers who had experience with both printing processes, conventional and waterless litho, believed that they obtained higher print quality using waterless litho compared to conventional litho. In addition, the participants were more satisfied with the print quality of waterless litho products in comparison to that of conventional litho products. Most of the lithographers were satisfied with waterless litho on all five aspects of quality, color consistency, ink density, dot gain, print contrast, and ink gloss. Their satisfaction levels of quality aspects of waterless litho printed products were as follows in the descending order: color consistency, dot gain, ink density, print contrast, and ink gloss.

Quality of printed products is not the only factor for deciding whether one should implement waterless litho or not. Other factors to be considered, costs for producing printed products and environmental friendliness of the process, for implementing the desired process (Lamparter, 1994). The results of this study provide important data for one who wants to know about the quality of printed products that is achieved using waterless litho.

Recommendations for Future Research Studies

Recommendations are made based on research methodology and findings. The following recommendations are made for future research studies.

1. An experimental study should be conducted to print jobs using both waterless litho and traditional litho under the same settings to measure the quality of printed materials.
2. A research study should be performed with a larger sample size of printing companies that operate both waterless litho and traditional litho to verify the results, and generalize findings for the larger population.
3. Research should be performed to compare other factors, such as, costs of the printed images, environmental friendliness of the process, and overall satisfaction with the process between waterless litho and conventional litho.

Table 1. Frequency of Quality Satisfaction Index

Satisfaction Index	Frequency	Percent	Cumulative Percent
1.0	4	17.4	17.4
1.2	2	8.7	26.1
1.4	5	21.7	47.8
1.6	1	4.3	52.2
1.8	2	8.7	60.9
2.0	5	21.7	82.6
2.2	1	4.3	87.0
2.4	2	8.7	95.7
2.8	1	4.3	100.0
Total	23	100.0	
Total	23	100.0	

Note. The satisfaction ranges of color consistency, ink density, dot gain, print contrast, and ink gloss are grouped together. The satisfaction range shows the value on the seven-point Likert scale.

Table 2. Statistics for Quality Comparison

	N				Standard
	Valid	Missing	Mean	Median	Deviation
Quality Satisfaction Index	23	0	1.6696	1.6	0.5138

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