2-1-1995

A Study of the epic delta dampening system's ability to eliminate plate-caused hickeys

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A Study of the Epic Delta Dampening System's Ability to Eliminate Plate-Caused Hickeys

by

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A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in the
School of Printing Management and Sciences in the College
of Imaging Arts and Sciences of the
Rochester Institute of Technology

February 1995

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Certificate of Approval

Master's Thesis

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With a major in Printing Technology
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Title of thesis: A Study of the Epic Delta Dampening System's Ability to Eliminate Plate Caused Hickeys

Acknowledgements

I would like to thank the following people for their assistance, advice, and support during the preparation of this thesis:

Cliff Frazier for serving as my thesis advisor and sharing his vast knowledge of lithography.

Dr. Charles Layne for serving as my research advisor and sharing his knowledge of research methods and statistical analysis.

Tyler Dahlgren and Dan Dalton of Epic Productions International Corporation, for their support of the study and permission to use the Epic Delta name in the study.

John MacPhee and Wendell Smith of Baldwin Technology Company, Inc. for their support and for providing information related to the study.

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Abstract

The purpose of this study was to determine if the Epic Delta dampening system removed and eliminated 98% of the plate-caused hickeys that occurred on press runs with a continuous plate-feed dampening system. This was accomplished by comparing the proportion of hickeys per 10,000 cartons that occurred with a continuous plate-feed dampening system, to the proportion of hickeys per 10,000 cartons that occurred with the Epic Delta dampening system.

The data were obtained from carton quality audits of jobs run on a press with a continuous plate-feed dampener and carton quality audits of the same jobs run on the same press with a Delta dampener. A 55" six-color sheetfed press with a coater/perfector was used.

Each week jobs were randomly selected by the quality control auditor to be audited and visually inspected for defects such as poor register, picking and hickeys. The number of serious and major hickeys that occurred and the number of cartons inspected each week, were recorded from these audits over a twelve week period for both dampening systems. The printing jobs were grouped according to ink coverage and ink sequence into categories A, B, C, and D.

The chi-square test of homogeneity was used to test if the Delta dampening system significantly reduced the proportion of hickeys that occurred with the continuous plate-feed dampening system. No hickeys were recorded for cartons in categories B and D so the data recorded in categories B and D were not analyzed. The calculated chi-square value for cartons in category A was 25.30. The chi-square table value for five degrees of freedom at the alpha level of .05 was 11.07. The null hypothesis was rejected for

category A. The Delta dampening system did significantly reduce the proportion of hickeys that had occurred on press runs with the continuous plate-feed dampening system.

The data recorded for cartons in category C could not be analyzed using the chi-square test of homogeneity because no hickeys were recorded for the cartons run on the press with the Delta dampener. The t' test was used to determine whether there was a significant difference between the average proportion of hickeys per 10,000 cartons that occurred on press runs with the continuous plate-feed dampening system, and the average proportion of hickeys per 10,000 cartons that occurred on press runs with the Delta dampening system. The null hypothesis was rejected because the absolute value of the calculated t' value of -1.94 was greater than the table value of 1.812. In category C the Delta dampening system did significantly reduce the proportion of hickeys that had occurred on press runs with the continuous plate-feed dampening system.

The data from categories A and C were combined to calculate the average proportion of hickeys per 10,000 cartons that occurred on press runs with the two dampening systems, in order to test if the Delta dampener reduced 98% of the hickeys that occurred on press runs with the continuous plate-feed dampener. The quality carton audits took place after the press operators had performed a visual quality inspection during the press runs. The press operators removed defective press sheets, which altered the data. Therefore, this hypothesis could not be tested. However, the Epic Delta dampening system did reduce 88% ±.3% of the hickeys that occurred on press runs with the continuous plate-feed dampening system using the data recorded in the study.

Chapter 1

Introduction

The purpose of this study was to determine if the Delta dampening system when compared to a continuous plate-feed dampening system eliminated 98% of the plate-caused hickeys.

Definition of Hickeys

Hickeys are a problem inherent to the lithographic printing process. Printers use the term hickey to describe both the doughnut-shaped spot in the image area on the printed substrate, and to describe the foreign particle in the system that has caused the spot. Plate-caused hickeys are caused from a foreign particle that is on the plate and blanket-caused hickeys are caused from a foreign particle that is on the blanket. Plate-caused hickeys are more common than blanket-caused hickeys, however blanket-caused hickeys do occur. Hickeys are also classified as either ink hickeys or paper hickeys according to the means by which the hickey travels in the press.

An ink hickey usually appears as a doughnut-shaped white area or hard centered spot that is completely surrounded by a tiny circle of color on the printed sheet.[1] The ink hickey is caused by a particle that enters the inking system through the ink fountain pan or through the inking rollers. If the particle lodges onto the plate, the ink receptive particle may pick up ink but prevents the area around it from coming into full contact with the blanket. Thus, creating the doughnut like appearance.

A paper hickey usually produces elongated thread-like patterns of white on the printed sheet.[2] A paper hickey is typically the result of a paper particle that is lodged onto the

blanket. The water receptive particle prevents the plate from coming into direct contact with the blanket and rejects ink, so no ink is applied to the blanket and a void results on the printed sheet.

There are many sources that can cause hickeys. Ink skin, the dried ink film layer that forms on top of the ink in its container, dirt or dried ink chips that fall from the ceiling or light fixtures, dust from the slitter, loose paper fibers, pieces of rubber from deteriorating inking rollers, or paper fibers pulled from the sheet by a tacky blanket may all get into the press and become hickeys.

Printers want to be able to prevent hickeys. Eliminating surface debris on the substrate is one way to eliminate hickeys. Methods such as using sheet cleaners, trimming the stock, and vacuuming the edges of the stock before loading it into the press, all reduce surface debris.

To prevent debris from falling into the press, the area around the press must be kept clean. It is very important to keep the blanket and the ink rollers clean as well. A thorough cleaning of the ends of the ink rollers will eliminate dry ink from building up on the ends of the rollers, breaking off, and entering the inking system. Deep cleaning the blanket will prevent the blanket from pulling paper fibers from the sheet.

Significance of the Study

Preventing hickeys improves the quality of reproductions, promotes high levels of productivity, reduces spoilage, helps keep downtime to a minimum and increases job satisfaction for the offset press operator.[3] Eliminating or preventing hickeys would save printers money and time, and increase customer satisfaction.

Downtime on the press costs the printer money because no product is being produced. An operator must remove the hickey from the plate or blanket in order to eliminate the spot on the printed substrate. This means that the operator tries to remove the hickey from the plate or blanket with a hickey-picking device while the press is running or with

their thumb or fingernail while the press is stopped. As a last resort the plate or blanket is washed to remove the hickey.

Paper is the most expensive material used in the printing process. Printed sheets that contain hickeys may have to be discarded depending on the customer's specifications. The number of sheets used for makeready also increases with hickeys because the press is being stopped and started again. These factors increase waste and cost the printer money.

Another cost that results from hickeys is the manhours spent on visually inspecting every sheet of a job and sorting out the sheets that are not acceptable. In the packaging printing segment, hickeys are more noticeable because of the heavy ink coverage and large solid image areas. An important function of the package is to sell the product to the consumer. Often times the customer does not even differentiate between the package and the product. If the appearance of the package is excellent, the customer feels the product inside the package is a higher quality product than a product in an average looking package.

Hickeys cause many problems for packaging printers that print on recycled board. The board has more paper fibers because it is thicker than paper and is composed of mainly post-consumer waste. Because of these factors, more dust is caused when the boards are slit, sheeted, scored, or die cut. According to a recent survey of folding carton plants, 84% of the respondents reported that hickeys are a major concern when printing on recycled board.[4] With the public's awareness of environmental concerns increasing, it is reasonable to state that the demand for recycled substrates will also increase in the future.

This study addressed if the Epic Delta dampening system effectively removes hickeys from the plate and keeps them from relodging onto the plate. The substrate that was used in the study was recycled board so this study may be especially useful to the carton printer that is presently printing on or will be printing on recycled board in the near future.

Endnotes for Chapter 1

1. "Pinpoint Origin of Hickeys Before Trouble Shooting," American Printer, (Volume 201, Number 2), November 1988, p 128.

2. "Proper Cleaning Rids Press of Potential Print Hickeys," American Printer, (Volume 202, Number 4), January 1989, p 68.

3. "Hickey Prevention in Offset Printing Offers Significant Benefits, But Course of Action Varies With the Type of Hickey," American Printer, (Volume 201, Number 3), December 1988, p 88.

4. Huck, C., "Inks and Plates for Recycled Boxboard," Boxboard Containers, (Volume 99, Number 7), February 1992, p 32.

Chapter 2

A Review of the Literature

The functions of a dampening system are to supply a thin uniform film of fountain solution to the non-image areas of the plate, prevent the feedback of ink into the dampening system, and minimize paper waste by quickly achieving the correct ink-water balance. When ink is applied to the plate, the fountain solution repels the ink in the non-image areas and keeps the areas free of ink. Lithographic printing is made possible because of this phenomenon.

Conventional Dampening Systems

Conventional dampening systems consist of a fountain pan, fountain pan roller, ductor roller, oscillating roller and a dampening form roller. The fountain pan contains the fountain solution. The fountain roller, a chrome-plated or treated aluminum roller, rotates in the pan and transfers a film of dampening solution onto the ductor roller. The fountain roller is not operated at press speed like the other rollers in the system. It is powered by its own motor so solution will not fling off the roller at high press speeds and so that the amount of solution metered to the plate can be varied.

The ductor roller intermittently contacts the fountain roller and the oscillator roller so the supply of fountain solution to the plate is not constant. The length of time the ductor roller is in contact with the fountain roller also meters the amount of solution fed to the plate. The oscillator roller oscillates across the press to provide an even fountain solution film thickness and drives the form roller. The dampening form roller transfers this fountain solution film to the printing plate. Both the ductor roller and the dampening form roller are composed of rubber while the oscillator is chrome-plated or treated aluminum.

Continuous Dampening Systems

Continuous dampening systems are more popular than conventional dampening systems because conventional dampening systems are difficult to control. There are very few conventional dampening systems used on large format presses today. The popularity of the continuous dampening system has almost made it an industry standard.

Continuous dampening systems are sub-divided into plate-feed and inker-feed systems. The dampening solution is applied to the plate by the dampening form roller with plate-feed systems. Both the fountain solution and the ink are applied to the plate by the first ink form roller with inker-feed systems.

There are several similarities between plate-feed and inker-feed systems. A ductor roller is not used in the design of either the plate-feed or inker-feed continuous dampening systems. All continuous dampening systems use a flooded metering nip formed by the contact of a rubber metering roller with a chrome roller to control the dampening film thickness. The film thickness at the exit of the metering nip is determined by the the speed of the rollers, the hardness or durometer of the rubber roller, the amount of pressure between the rubber and chrome rollers, and the viscosity of the dampening solution.[1] The dampening solution film is split into a thin, even film in the metering nip. The metering and chrome rollers are geared together and are driven by a variable speed motor. Their surface speed is different than the speed of the plate and the other rollers in the system.

The relationship of the surface speed of the metering and chrome roller, to the speed of the other rollers in the dampening system that are running at the same speed as the press, creates a slip nip. A slip nip is a nip point in which one roller, usually the transfer roller, is running at a different speed relative to another roller, usually the form roller.[2]

Some dampeners utilize a reverse slip nip. A reverse slip nip is a slip nip created by the two rollers rotating in counter directions. The reverse slip nip reduces the interaction of the fountain solution fed to the plate and the solution returned from the plate, minimizing

contamination of the solution. The reverse rotation prevents the solution from going through the nip. It is all either carried to the plate or back to the fountain pan.

Inker-Feed Continuous Dampening Systems

Inker-feed systems consist of a chrome plated transfer roller and a rubber metering roller. Either roller can be the fountain roller. The metering nip between the two rollers controls the fountain solution film thickness. A slip nip is formed between the transfer roller and the first ink form roller. The first ink form roller then applies the dampening solution and the ink to the plate. A reverse slip nip may also be utilized.

Plate-Feed Continuous Dampening Systems

Plate-feed dampening systems use a separate dampening form roller to apply the dampening solution to the plate. A rubber metering roller and a chrome roller form a metering nip in the plate-feed system and either a slip nip or a reverse slip nip exists in the dampening system.

Combination Continuous Dampening Systems

A combination continuous system is a combination of the inker and plate-feed systems. It contains an oscillating or vibrating bridge roller that contacts the dampening form roller and the ink form roller. The system improves makeready time because the water and ink balance is better. The system reduces ghosting and runs less solution.

Epic Delta Dampening System

The Delta dampening system evolved from the Delta Effect that was created by Julius Domotor, a printer. The Delta Effect was based on the idea that hickeys stuck on the plate, could be continuously dislodged by a wiping action on the plate. When the ink form roller was run at the same speed as the press, a contact point on the form roller had a path normal to the surface of the plate. When the ink form roller speed was increased or decreased, the contact point on the roller had a path parallel to the surface of the plate, at the time of contact, creating the wiping action.[3] The Delta Inking System was

designed so that the ink form roller was driven at a speed differential of at least 3%, and generally 15-20% slower than the plate.[4]

Julius Domotor commercialized and patented the Delta System in 1969, and with his partner, Larry Lester, established a business selling the systems.

In 1973, Julius sold the patent rights to Baldwin. Baldwin conducted a study to evaluate the system's ability to remove hickeys. Artificial hickeys were seeded into 3 different presses. The number of sheets the hickeys appeared on when the Delta System was not activated was compared to the number of sheets the hickeys appeared on when the Delta System was activated. Under normal running conditions the hickeys persisted for more than 100 impressions when the Delta system was not activated, compared to 20 impressions or less with the Delta System activated.

Baldwin found disadvantages to using the first ink form roller as the Delta roller. Therefore, the Delta Inking System was replaced by the Delta Dampening System which uses the dampening form roller as the Delta roller. A leader in the development of the dampening system was Larry Lester. The dampening system was patented by Baldwin and commercially developed by Epic Products International Corporation of Dallas. Epic was licensed to manufacture and sell the system in 1983.

The Delta dampening system is a combination continuous dampening system that includes the Delta dampening form roller and a contacting ink receptive oscillating bridge roller, that are driven at a slower speed than the plate. The bridge roller may also be engaged to contact the first ink form roller and form a bridge across the inking and dampening systems. The system's ability to remove hickeys is not effected by whether the oscillating bridge roller is disengaged or engaged.

The purpose of the ink receptive oscillating bridge roller is to reduce ghosting and control emulsification. If the bridge roller was driven at the same speed as the press, a slip nip would exist between the bridge roller and the Delta roller, and would increase

emulsification significantly. When the bridge roller is in contact with the first ink form roller, a slip nip occurs between the first ink form roller and the oscillating bridge roller and actually reduces emulsification.

Many advantages resulted from placing the Delta roller in the position of the dampening form roller. The power required to drive the Delta dampener is less than the power needed to drive the Delta inker. A clutch is not necessary with the Delta dampener and is necessary with the Delta inker to allow the ink form roller to run at press speed during washup. The Delta dampening system reduces mechanical ghosting which was not observed with the Delta inking system. The roller setting of the dampening form roller is less critical than the setting of the ink form roller. The Delta dampener uses less water.

Both systems run cleaner screens, but the screens are cleaner with the Delta dampener. The Delta systems both remove hickeys from the plate equally well, eliminate the need to run less ink to reduce hickeys, and result in smoother ink laydown on large solid image areas.

In order to understand why the Delta dampening system removes hickeys from the plate, the behavior of hickeys must first be understood. Hickeys usually adhere to the plate and not to the blanket. A possible explanation for this phenomenon is that the blanket is pushed away from the hickey because the blanket is softer than the plate, so the area of contact between the hickey and the plate is greater than the area of contact between the hickey and the blanket. Hickeys also stick to the plate and do not stick to the inking rollers. The pressure in the blanket and plate nip is typically 100 times more than the pressure in the roller nips[5] which may explain this occurrence.

A theory to explain why the Delta dampening system works was proposed by John MacPhee based on the behavior of hickeys. It can be reasoned that ink receptive foreign particles are always circulating throughout the inking system on the press. When a foreign particle passes through the plate/blanket nip it usually sticks to the plate. When a

particle sticks to the plate, it takes several revolutions of the plate cylinder before the initial supply of ink on the blanket is depleted and a spot is printed in the image area. The wiping action of the Delta roller dislodges the hickey before the plate cylinder turns one revolution. The wiping action is continuous, so even though hickeys are constantly circulating through the inking system, they do not cause hickeys to occur on the printed substrate.

Endnotes for Chapter 2

1. MacPhee, John, "Trends in Litho Dampening Systems Show Vast Improvements in Designs," Graphic Arts Monthly, (Volume 53, Number 4), April 1981, p 35.

2. "Dampeners Diversify," Graphic Arts Monthly, (Volume 63, Number 10), October 1991, p 35.

3. MacPhee, John and Wirth, David M., "Design and Test of an Inking System Modification for Reducing Foreign Particle Accumulation on Lithographic Printing Plates," 1975 TAGA Proceedings, p. 88.

4. Ibid., 86.

5. "New Insights into the Behavior and Elimination of Hickeys," American Ink Maker, (Volume 72, Number 5), May 1994, p 36.

Chapter 3

Hypotheses

The purpose of this study was to determine if the Delta dampening system when compared to a continuous plate-feed dampening system eliminated 98% of the plate-caused hickeys. Hickeys are common defects that plague lithographic printers and cause them to lose money.

Hypotheses

The study tested the following two hypotheses.

1.0 The proportion of hickeys that occur during a sheetfed press run, using the Delta dampening system, is less than the proportion of hickeys that occur during a similar sheetfed press run on the same press, using a continuous plate-feed dampening system.

2.0 The proportion of hickeys that occur during a sheetfed press run, using the Delta dampening system, is 98% less than the proportion of hickeys that occur during a similar sheetfed press run on the same press, using a continuous plate-feed dampening system.

Limitations

The following variables existed in the study. The formulation of the dampening solution used with the Delta dampening system was different than the formulation of the fountain solution used with the continuous plate-feed dampening system. The dampening system on the press was changed from the continuous plate-feed dampener to the Delta dampener. The press operating conditions such as, the environment of the pressroom, press operator error, equipment error, and inspection error in the audit were not controllable.

Delimitations

The scope of the study was limited to the following conditions. The study compared the Delta dampening system with a continuous plate-feed dampening system. The study used the press conditions stated. The composition of the substrate was not considered but it did not change during the period of the study. The study compared the number of hickeys that occurred with the Delta dampener and the continuous plate-feed dampener on jobs run on the same sheetfed press in one plant. The study did not compare attributes other than hickeys. The study analyzed data recorded over the same twelve week period of time during two consecutive years.

Chapter 4

Methodology

The purpose of this study was to determine if the Epic Delta dampening system reduced the proportion of hickeys by 98% that occurred with a continuous plate-feed dampening system. This was accomplished by comparing the proportion of hickeys that occurred when running the same jobs on the same press equipped with the different dampening systems. The press that was used in the study was originally equipped with a continuous plate-feed dampening system. This press was retrofitted with the Epic Delta dampening system units on all six of its printing units. Data from weekly carton quality audits before and after the change were analyzed. The data were supplied by the folding carton printing division of a large corporation.

Quality Alert System

A visual quality alert system was used during all press runs. The press operators worked in teams. One press operator pulled press sheets approximately every 200 sheets and placed flags between the press sheets being loaded onto a pallet in the delivery when printing defects were detected, while the other press operator made adjustments to the press to eliminate the defects. The press continued to run and the flagged portions of the pallet loads were later removed and recycled after the sheets were dry. The pallet loads were then jogged in a jogger aerator, hot foiled stamped, die cut, and glued. The finished cartons were then packed in shipping cases and loaded onto pallets.

The quality alert system detected problems such as scumming, poor register, hickeys or spots, and picking while the cartons were printed. If more than half of the cartons on a press sheet were unacceptable, the entire sheet was recycled. Otherwise, the cartons were separated and salvaged.

Carton Quality Audit

Carton quality audits were conducted each week by the quality control auditor and the data used in the study were received from the auditor. The audits recorded any printing or gluing defects that occurred during the manufacture of the folding cartons. The print shop contained a 40" six-color, a 49" four-color, and a 55" six-color sheetfed press. The samples used in this study were only printed on the 55" six-color press that was retrofitted with the Delta dampener.

The jobs were logged in the carton quality audits according to the gluing line the cartons were finished on. During each shift, one job from each operating gluing line was randomly selected to be inspected. There were six gluing lines in the printing department and the department ran three shifts a day and six days a week. Therefore, if all six gluing lines were operating during all three shifts, 18 jobs would be inspected for that day. From each job one case was removed from a pallet and one hundred cartons were pulled from this case. Any gluing or printing defects found during the audits were recorded. The production cycle curve for the department was basically flat throughout the year with a slower period from November through December.

The number of serious and major hickeys and the number of cartons inspected each week, for twelve weeks from mid-May to mid-August of 1993, were recorded from jobs run on the 55" six-color press with the continuous plate-feed dampening system. The number of serious and major hickeys and the number of cartons inspected during the same period in 1994 were recorded from jobs run on the same press with the Epic Delta dampening system (See Appendix A).

Hickeys were classified as either minor, major, or serious defects based on their location on the carton and on their size (see Table 1). A minor defect was within manufacturing conformance limits and was considered acceptable. A major defect approached manufacturing conformance limits but was considered passable. A serious defect did not meet manufacturing conformance limits so the carton was entered into the recycled waste stream. Any hickeys that appeared in the company name, trademark names, logo on any of the carton panels, or in the white reverse print area were serious defects.

A maximum of six hickeys per folding carton were allowed before the carton was rejected and recycled. However, any hickeys located on the major or minor flaps of the carton were not counted. In addition, if a hickey caused one or more printed characters to be illegible the carton was unacceptable and was entered into the recycled waste stream.

Table 1. Carton Hickey Classification and Number of Hickeys Allowed

		Size of Hickeys (inches)					
Carton Location	**Ink**	**< .04**	**< .05**	**< .06**	**< .07**	**< .08**	**< .09**
Front Panel	Red	0 Serious	0 Serious	0 Serious	0 Serious	0 Serious	
	Yellow	3 Minor	3 Minor	2 Major	1 Major	0 Serious	
	Black	2 Major	1 Major	0 Serious	0 Serious	0 Serious	
	Accent (each color)	2 Minor	1 Major	0 Serious	0 Serious	0 Serious	
Top or Side Panels	Red	1 Major	0 Serious	0 Serious	0 Serious	0 Serious	
	Yellow	3 Minor	3 Minor	2 Major	1 Major	0 Serious	
	Black	2 Minor	1 Major	0 Serious	0 Serious	0 Serious	
	Accent (each color)	2 Minor	1 Major	0 Serious	0 Serious	0 Serious	
Bottom Panel	Red	2 Major	1 Major	0 Serious	0 Serious	0 Serious	
	Yellow	3 Minor	3 Minor	2 Major	1 Major	1 Major	
	Accent (each color)	3 Minor	2 Major	1 Major	0 Serious	0 Serious	
Barcode	Black	2 Major	1 Major	1 Major	1 Major	1 Major	0 Serious

Job Specifications

The typical number of jobs run on the press was 30-33 per week. Eighty percent of the work was six-color front and one-color back. The average run lengths were short to medium (20,000-40,000 sheets per job).

The jobs run on the press were grouped in four categories (A,B,C,D) according to the ink sequence and the ink coverage percent of the image area versus the non-image area. The categories are listed below:

A: Print Sequence PMS 300, Black, Cyan, Magenta, PMS 151, and Corporate Yellow
   Ink Coverage 80%

B: Print Sequence Red, Black, Green, Corporate Yellow
   Ink Coverage 95%-98%

C: Print Sequence Special Color, Black, Cyan, Magenta, Yellow, Corporate Yellow
   Ink Coverage 80%

D: Print Sequence Black, Red, PMS Yellow
   Ink Coverage 90%

Press Conditions

The press used in the study was a 55" six-color press with a coater/perfecter. The running speed of the press was 8000 impressions/hour. The substrate used was 16 point recycled paper board, gray back, coated on one side. The fountain solution used was an acidic fountain solution with a 8-10% alcohol content. The other materials used on the press were vegetable-based inks, aqueous plates and compressible blankets.

Chapter 5

Results

The number of hickeys that occurred during press runs and the number of cartons inspected for the continuous plate-feed dampener and the Delta dampener, are recorded in Appendix A.

Data Analysis

The weekly proportions of hickeys per 10,000 cartons were calculated from the data obtained from press runs with the continuous plate-feed dampening system and with the Epic Delta dampening system.

The weekly proportions of hickeys were indexed per 10,000 cartons for two reasons. The number of cartons sampled differed from week to week and from dampening system to dampening system. By indexing the proportions of hickeys it was possible to compare equal sample sizes. The chi-square test of homogeneity[1] was used to test if the proportions of hickeys that occurred during press runs with the Delta dampener, were significantly less than the proportions of hickeys that occurred during press runs with the continuous plate-feed dampener. In order for the chi-square test of homogeneity to work well, the expected values in the contingency table should not be less than one, and not more than 20% of the expected values should be less than five[2].

The chi-square test of homogeneity was used to determine if the frequency of occurrence of hickeys produced during twelve weeks was the same for the continuous plate-feed dampening system and the Delta dampening system. Contingency tables were setup in order to analyze the data recorded in categories A, B, C, and D. No hickeys were recorded for cartons in categories B and D so the data recorded in categories B and D

were not analyzed. The contingency table for cartons in category A is shown below.

Table 2 Contingency Table for Category A

Observed Frequencies of Hickeys/10,000 Cartons

Weeks	Continuous Dampener	Delta Dampener	Total
1	27.78	5.00	**32.78**
2	42.85	0	**42.85**
3	17.65	10.00	**27.65**
4	0	0	**0**
5	29.63	5.26	**34.89**
6	28.57	0	**28.57**
7	33.33	10.00	**43.33**
8	16.67	0	**16.67**
9	20.00	0	**20.00**
10	21.43	6.67	**28.10**
11	77.78	4.55	**82.33**
12	58.82	0	**58.82**
Total	**374.51**	**41.48**	**415.99**

Expected Frequencies of Hickeys/10,000 Cartons

Weeks	Continuous Dampener	Delta Dampener
1	29.51	3.27
2	38.58	4.27
3	24.89	2.76
4	0	0
5	31.41	3.48
6	25.72	2.85
7	39.01	4.32
8	15.01	1.66
9	18.01	1.99
10	25.30	2.80
11	74.12	8.21
12	52.95	5.87

In category A, many of the expected frequencies of hickeys per 10,000 cartons with the Epic dampener were less than five. In order to calculate the chi-square value the expected frequencies were combined for the following weeks: 1 and 2; 3, 4 and 5; 6 and

7; and 8, 9, and 10. The calculated chi-square value for cartons in category A was 25.30. The table value for chi-square at the alpha level of .05, and 5 degrees of freedom was 11.07. The null hypothesis (the proportion of hickeys that occur on press runs with the continuous plate-feed dampener is the same as the proportion of hickeys that occur on press runs with the Delta dampener) was rejected because the calculated value was greater than the table value for cartons in category A. The proportion of hickeys per 10,000 cartons that occurred with the Delta dampener was significantly less than the proportion of hickeys per 10,000 cartons that occurred with the continuous plate-feed dampener for cartons in category A.

The data recorded for cartons in category C could not be analyzed using the chi-square test of homogeneity because no hickeys were recorded for cartons run on the press with the Delta dampener. All of the expected frequencies of cartons run with the Delta dampener were zero.

The average proportion of hickeys per 10,000 cartons was calculated for cartons in category C run on the press with the continuous plate-feed dampener and with the Delta dampener. The F-test[3] was used to determine if the variance of the continuous plate-feed dampener population was the same as the variance of the Delta dampener population. The calculated F value was zero. The table value for F at the alpha level of .10 and 8 and 10 degrees of freedom was 3.072. The table value for F at the alpha level of .10 and 10 and 8 degrees of freedom was .30. The null hypothesis (the variances of the two populations are the same) was rejected because the calculated F value of zero did not fall between the F table values of .30 and 3.072.

The t' test[4] was used to test whether there was a significant difference between the average proportion of hickeys per 10,000 cartons in category C that occurred on press runs with the continuous plate-feed dampening system, and the average proportion of hickeys per 10,000 cartons that occurred on press runs with the Delta dampening system. The calculated value of t' was -1.94. The table value of t' at the alpha level of .05 and 10

degrees of freedom was 1.812. The null hypothesis (the average proportion of hickeys that occur on press runs with the continuous plate-feed dampener is the same as the average proportion of hickeys that occur on press runs with the Delta dampener) was rejected because the absolute value of the calculated t' value of -1.94 was greater than the table value of 1.812. The average proportion of hickeys per 10,000 cartons in category C that occurred with the Delta dampener was significantly less than the average proportion of hickeys per 10,000 cartons that occurred with the continuous plate-feed dampener.

The data in categories A and C when tested supported hypothesis 1.0. The data recorded in categories A and C for both dampening systems were combined and the average proportion of hickeys per 10,000 cartons was determined. The average proportion of hickeys per 10,000 cartons that occurred with the continuous plate-feed dampening system was multiplied by .02, in order to calculate if the average proportion of hickeys that occurred with the Delta dampening system was 98% less than the average proportion of hickeys that occurred with the continuous plate-feed dampening system. The calculated average proportion of hickeys was then compared to the actual average proportion of hickeys that occurred with the Delta dampening system.

Hypothesis 2.0 would be accepted if the average proportion of hickeys per 10,000 cartons that occurred with the Delta dampening system was less than or equal to the average proportion of hickeys per 10,000 cartons calculated from the data recorded with the continuous plate-feed dampening system.

The study could not test hypothesis 2.0 which stated that the proportion of hickeys that occur during a sheetfed press run, using the Delta dampening system was 98% less than the proportion of hickeys that occur during a similar sheetfed press run on the same press using a continuous plate-feed dampening system. The number of hickeys that were recorded in the quality carton audits was not the actual number of hickeys that occurred on the printed jobs. The press operators performed a visual quality inspection while the jobs were printing on the press. Any press sheets that were defective were flagged and

the press operators made adjustments to the press to eliminate the printing defects. The defective press sheets were removed from the pallet loads before the cartons were finished and audited in the carton quality audits. In order to determine if the Delta dampening system eliminated 98% of the hickeys the data needed to be unaltered.

The number of flags per job with the Delta dampener was significantly less than the number of flags per job with the continuous plate-feed dampener. When the continuous plate-feed dampening system was installed on the press the average number of flags per pallet load was two or three. An average pallet load consisted of 2400 sheets. The number of pallet loads per job was ten to twelve, therefore, the average number of flags per job when the continuous plate-feed dampener was operating was between twenty and thirty-six. The average number of flags per job when the Delta dampening system was operating was one or two. Even though the press operators throughout the press runs removed press sheets that contained printing defects, a significant number of printing defects were not detected on press.

The average proportion of hickeys that were eliminated by the Delta dampening system, was calculated using the altered data to be 88% with a confidence interval[5] of .3 % at the alpha level of .10. It appears that the Epic Delta dampening system has the ability to eliminate 98% of plate-caused hickeys that occur during press runs with a plate-feed continuous dampening system. This statement is based on the large reduction of the number of flags per job, and the elimination of 88% ± .3 % of the hickeys that occurred on press runs with the continuous plate-feed dampening system calculated from the altered data. However, the results of this study could not confirm this claim.

There are several factors that could have effected the results of the study. Press maintenance is critical in order to prevent hickeys. The press shop in the study completed regular press maintenance. The press was completely taken apart when the Delta dampening system was installed on the printing units and due to time constraints the press was not thoroughly cleaned when it was dissembled. When a press is restarted

after being mechanically dissembled and reassembled, debris that was loosened inside of the press during the process could dislodge and increase the number of hickeys that would ordinarily occur during press runs.

The formula of the dampening solution changed when the Delta dampener was installed. The new dampening solution formula could cause the wettability of the solution to change. The change in wettability of the solution could cause the fibers in the paper to break loose more readily and increase the number of hickeys that ordinarily would occur during press runs.

The Delta dampening system was installed in March of 1994 and the data for the study were recorded from jobs run on the press between mid-May and mid-August of 1994. The press operators had only worked with the Delta dampening system for a month and a half before the first data were collected and they were not as experienced operating the Delta dampening system as they were operating the continuous plate-feed dampening system. Operator error may have effected the results with the Epic Delta dampening system.

Endnotes for Chapter 5

1. Dowdy, Shirley and Wearden, Stanley, Statistics for Research, (New York, New York: John Wiley and Sons, Inc., 1991), p. 125.

2. Ibid., p. 110.

3. Ibid., p. 213.

4. Ibid., p. 215.

5. Ibid., p. 181.

Chapter 6

Summary and Conclusions

The purpose of this study was to determine if the Epic Delta dampening system eliminated 98% of the plate-caused hickeys that occurred during press runs with the continuous plate-feed dampening system. The hypotheses that were tested are listed below.

1.0 The proportion of hickeys that occur during a sheetfed press run, using the Delta dampening system, is less than the proportion of hickeys that occur during a similar sheetfed press run on the same press, using a continuous plate-feed dampening system.

Hypothesis 1.0 was accepted.

2.0 The proportion of hickeys that occur during a sheetfed press run, using the Delta dampening system, is 98% less than the proportion of hickeys that occur during a similar sheetfed press run on the same press, using a continuous plate-feed dampening system.

The data collected in the study could not be used to test hypothesis 2.0. The null hypothesis was neither accepted nor rejected.

To determine if the Delta dampening system eliminated 98% of the hickeys produced with the continuous plate-feed dampening system, the data collected needed to be unaltered. The carton quality audit was completed after the press sheets with defects that were flagged by the press operator, had been removed.

Recommendations for Further Study

The study was limited to comparing the proportion of hickeys that occurred on press runs with Epic Delta dampening system to the proportion of hickeys that occurred on press runs with the continuous plate-feed dampening system. There are many dampening systems that are used by printers in the industry. To increase the scope of the study the proportion of hickeys that occurred with the Delta dampening system could be compared to the proportion of hickeys that occur on press runs of the same jobs on the same press with several different plate-feed, inker-feed and combination continuous dampening systems installed on the press.

The period of time in which the study was conducted was limited to twelve weeks. The jobs in categories B, C, and D in the study were run on the press less frequently than the jobs in category A. In order to have sufficient data to analyze that represents the population, the study should compare data collected for one year. Also, the number of cartons inspected each week should be the same for press runs with the Delta dampening system and with the continuous plate-feed dampening system.

The issue of paper waste is very important to printing companies. Paper is the most expensive material used in the printing process. A study that compared the paper waste that occurred with jobs run on a press with a continuous dampening system to the paper waste that occurred with the same jobs run with the Delta dampening system installed on the same press would be very informative for printing companies.

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Appendix A

Data

Appendix A

Data

		Continuous Plate-Feed Dampener		Epic Dampener	
Product Category	Week	Number of Cartons	Number of Hickeys	Number of Cartons	Number of Hickeys
A	1	1800	5 major	2000	1 major
	2	2100	9 major	2500	0
	3	1700	3 major	2000	2 major
	4	700	0	2000	0
	5	2700	8 major	1900	1 major
	6	1400	4 major	1400	0
	7	1500	5 major	2000	2 major
	8	1200	2 major	1900	0
	9	1500	3 major	1000	0
	10	1400	3 major	1500	1 major
	11	900	7 major	2200	1 major
	12	1700	10 major	1800	0
B	1	0	0	0	0
	2	0	0	0	0
	3	0	0	100	0
	4	0	0	0	0
	5	0	0	0	0
	6	0	0	0	0
	7	0	0	0	0
	8	0	0	0	0
	9	0	0	0	0
	10	200	0	0	0
	11	0	0	0	0
	12	0	0	100	0

Appendix A (continued)

		Continuous Plate-Feed Dampener		Epic Dampener	
Product Category	Week	Number of Cartons	Number of Hickeys	Number of Cartons	Number of Hickeys
C	1	200	0	400	0
	2	400	0	0	0
	3	700	1 major	200	0
	4	200	0	200	0
	5	0	0	500	0
	6	700	0	200	0
	7	200	1 major	200	0
	8	600	0	400	0
	9	300	1 major	0	0
	10	300	0	300	0
	11	400	1 major	200	0
	12	100	0	0	0
D	1	0	0	0	0
	2	0	0	0	0
	3	0	0	100	0
	4	300	0	0	0
	5	100	0	100	0
	6	0	0	500	0
	7	500	0	100	0
	8	0	0	0	0
	9	0	0	0	0
	10	0	0	100	0
	11	300	0	0	0
	12	200	0	300	0

Note: 100 Cartons were inspected per press run