Choosing Cascading Beads for the Electrostatic Detection Apparatus

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The Electrostatic Detection Apparatus (ESDA) cascade developer beads become pitted or roughed up over time and lose the ability to attract toner, thereby lessening the effectiveness of the cascading beads. After viewing the Electrostatic Detection Apparatus beads under a microscope it was decided to replace them with newer beads. At this time an experiment was undertaken using two different size beads. Foster + Freeman beads and sandblasting beads were used, with the latter being the smaller of the two types of beads. The smaller sandblasting beads developed the indented images better.

Introduction

A recent article (Cavanaugh, Torres & Grose, 1999) indicated that the cascade developer beads used in the operation of the Electrostatic Detection Apparatus (ESDA) become pitted or roughed up over time and lose the ability to attract toner, thereby lessening the effectiveness of the cascading beads. (The ESDA is a device used to help visualize indented writing on documentary evidence without detrimental effects to the document.) This prompted a microscopic examination of this writer's cascading beads. These beads had a similar "old bead" appearance as that displayed in the recent article. It was then decided to buy more beads.

A few Forensic Document Examiners (FDEs) were contacted to determine the source of their beads. The four sources given were Foster + Freeman, Kinderprint®, Lightning Powder and a sandblasting business. At the time of this author's inquiry, Lightening Powder no longer sold the cascading beads.

A sandblasting business (Indianapolis Dry Stripping) was contacted but wanted to know what size beads were required. A sample of unused beads was provided to the business and after examining the beads the company reported that this size bead (0.45mm – 0.50mm) was not in stock. The company then offered to give a sample of smaller beads (0.177mm – 0.297mm) for testing with the ESDA. A test was conducted to distinguish which size beads would best visualize indented writing, the smaller or larger beads.

Methods and Materials

The items used in this experiment were:

A) Rachmayr weights: two ¼ pound (lb), one ½ lb, and one 1 lb

B) Paper Mate Rubberstik, medium ballpoint pen

C) Twenty-one sheets of recycled white, 8½" x 11", 20 lb paper

D) Electrostatic Detection Apparatus, Foster + Freeman, London, England

E) Glas-Shot glass beads, size: 0.0069" - 0.0116" or 0.177 mm – 0.297 mm

F) Glasperlen glass beads, size: 0.1772" - 0.1969" or 0.45 mm - 0.50 mm

The weights were obtained from the Firearms Unit and used to add pressure to the writing instrument. With the pen in a vertical position, the weight was placed on top of the pen. The pen was then used to write on the top of a 21-sheet stack of paper without applying additional pressure. The weight exerted was ¼ lb, ½ lb, ¾

lb, 1 lb, 1¼ lb, 1½ lb, 1¾ lb and 2 lb. The first, fifth and sixth pages under the top sheet were then chosen for developing.

The following procedure was conducted for the first, fifth and sixth sheets:

1) The sheet was placed in the humidifying chamber for five minutes.

2) The sheet was then placed on the sintered bronze plate.

3) The pump was turned on.

4) The sheet was covered with the plastic imaging film.

5) The corona wand was used for fifteen seconds.

6) The sheet was then processed with the smaller beads first, one pass.

7) The imaging film was then covered with a fixing film and removed from the ESDA (lifts).

Steps 4 through 7 were then repeated using the larger beads that were regularly used with the ESDA.

After the first three sheets chosen were processed, the beads were observed under a stereoscopic microscope. After the microscopic examination, the seventh sheet was chosen and processed by the above steps 1 through 7. The only difference from the above procedure was the larger beads were cascaded first using two cascading passes. This was to determine if there was any effect on which size beads were used first to develop the images. The smaller beads were then cascaded using two passes. After the seventh sheet was processed, the beads were examined again under the stereoscopic microscope.

Results

There was a noticeable difference between the ESDA lifts (see Appendix A). Overall, the smaller beads developed darker images than the larger beads. When the fifth, sixth and seventh sheets were examined, it was noted that the smaller beads developed the lesser weight indentations better than the larger beads. The 1¾-lb indentation was observable on the seventh sheet with the smaller beads, whereas, the larger bead's 1¾-lb developed impression would be considered indecipherable.

Discussion

Since the smaller beads were used first for the first, fifth and sixth sheet, the seventh sheet was chosen and steps 1 through 7 repeated using the larger beads first. This was to determine whether the beads being cascaded first or last made any significant difference on the developed impressions. It did not. On the seventh layer, one cascading pass with the larger beads developed very faint impressions so a second cascading pass was performed. Since two cascading passes were used for the larger beads, two cascading passes were used for the smaller beads as well. The same results were obtained for the seventh sheet as that of the first, fifth and sixth sheet: the smaller beads developed the impressions better than the larger beads even though less toner was apparent microscopically. The reader may note that the impressions are clearer on the sixth sheet when compared to the fifth sheet. This author has no explanation for this phenomenon.

Three hypotheses can be presented in an effort to explain the results. First, there are more beads per surface area with the smaller beads. Second, the smaller beads did not have the same tendency to bounce as the larger beads, thereby covering more surface area. And third, due to the smaller size of the beads they are more capable of "falling" into the indentations than the larger beads.

One drawback should be noted. The plate of the ESDA needs to be tilted slightly higher so the smaller beads will completely roll off. If the smaller beads roll too slowly they have a tendency to stick to the imaging film which becomes noticeable when the adhesive sheet is placed to preserve the impressions. After this experiment, the smaller beads were chosen to replace the larger beads normally used with the ESDA.

References

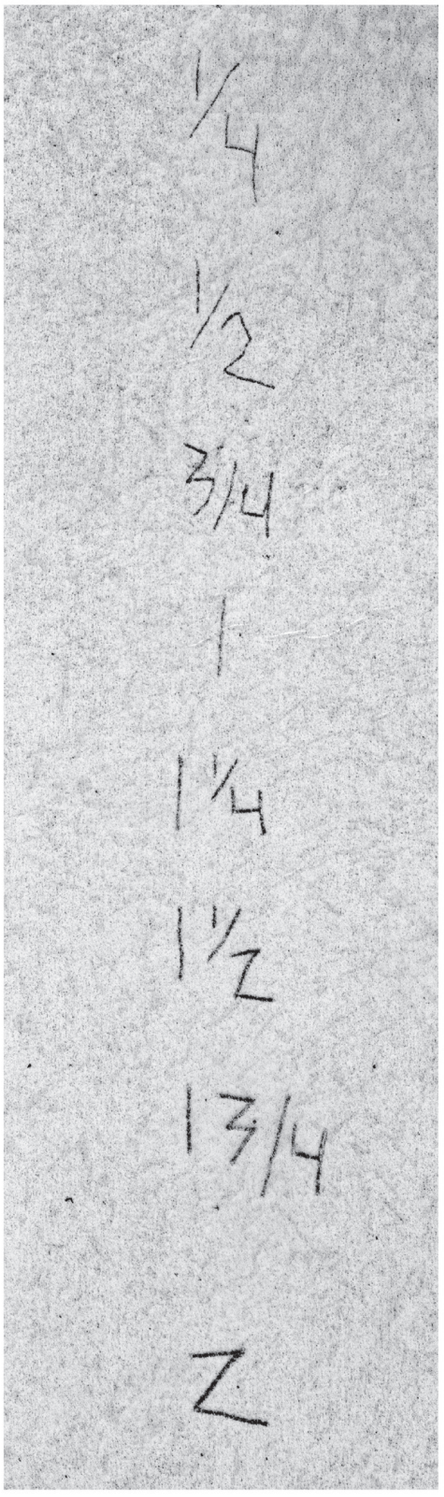
Cavanaugh, M.H., Torres, B.L., Grose, W.P. (1999). ESDA Cascade Developer Awareness, *Journal of the American Society of Questioned Document Examiners*, Vol. 2, No. 2, pp. 102-103.

Resources

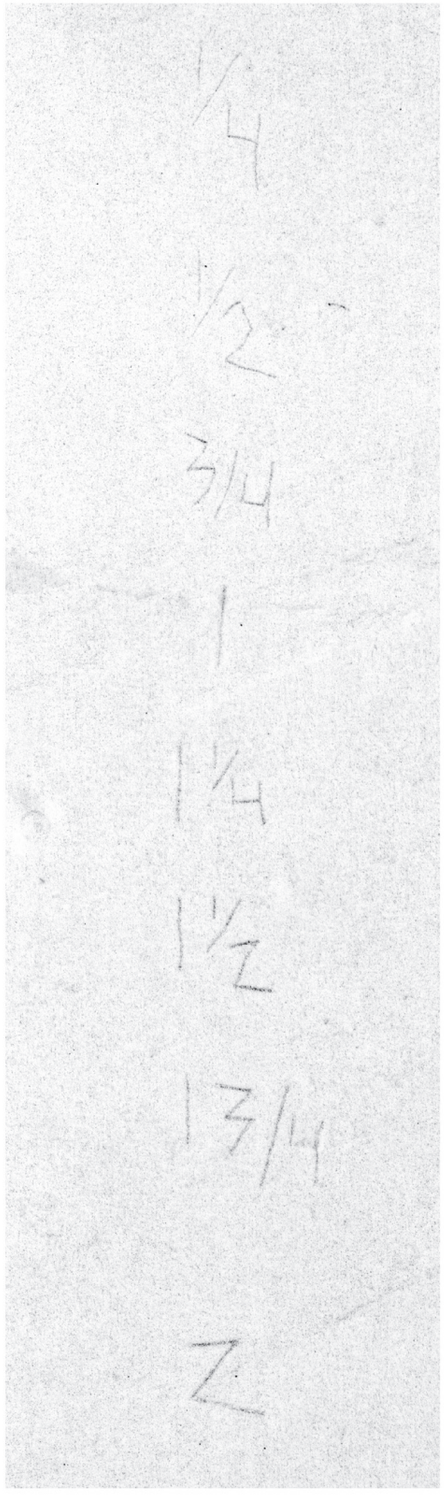
Indianapolis Dry Stripping, 6321 East 30th Street, Indianapolis, IN 46219. Contacts: Tom Ott and Derek Pawlivsk.

Appendix A
Developed Impressions

Small Beads, Layer 1 - Developed First
One Pass

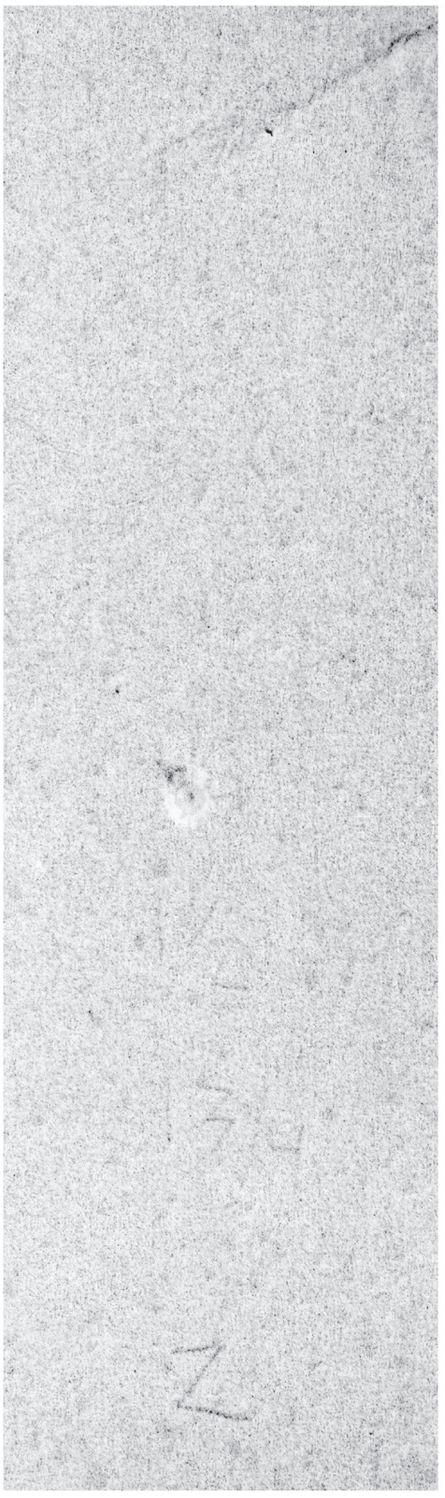


Large Beads, Layer 1 - Developed Second
One Pass



Developed Impressions

Small Beads, Layer 5 - Developed First
One Pass



Large Beads, Layer 5 - Developed Second
One Pass

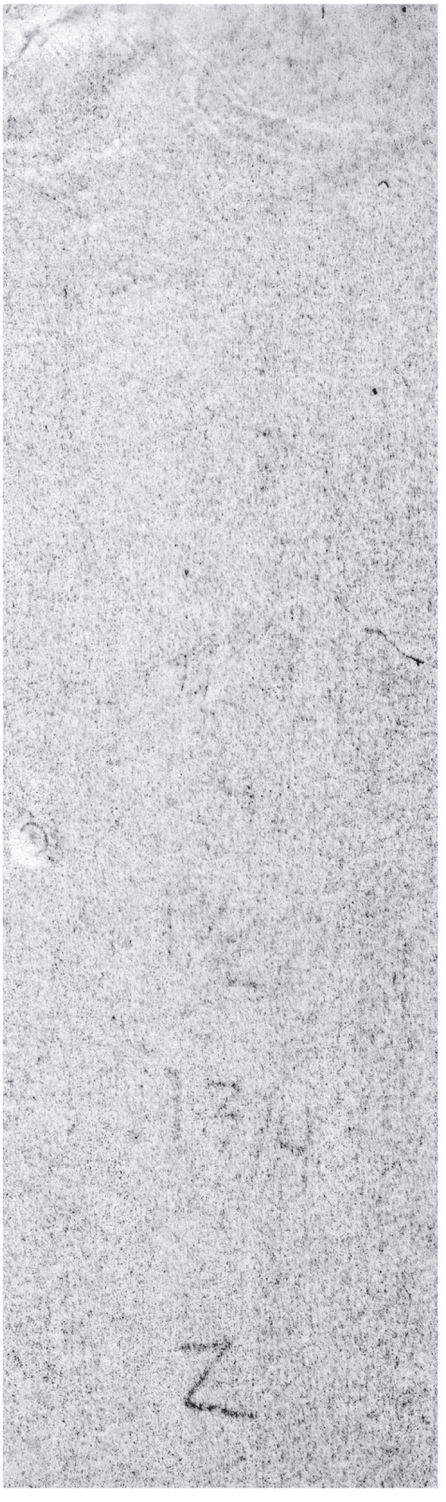
Developed Impressions

Small Beads, Layer 6 - Developed First
One Pass

Large Beads, Layer 6 - Developed Second
One Pass

Developed Impressions

Small Beads, Layer 7 - Developed First
One Pass



Large Beads, Layer 7 - Developed Second
One Pass