

Identifying Consecutively Made Garbage Bags Through Manufactured Characteristics

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Abstract: The availability and durability of plastic garbage bags make them popular for use during the commission of a variety of crimes, and these types of bags are often submitted to a forensic laboratory for latent print examinations. However, an additional type of examination should be considered. By understanding the bag manufacturing process, a physical comparison between the questioned evidence bag and known standard bags can also be conducted.

Introduction

Plastic garbage bags are routinely submitted to forensic laboratories in connection with the investigation of various crimes. Generally, the examination of plastic bags has been limited to latent print analysis. In certain circumstances, however, the determination that the submitted evidence can or cannot be associated to a supply of similar garbage bags recovered from a suspect may be crucial to the investigation. In such cases, a physical comparison of the unknown sample to the seized property of the suspect is possible. This type of physical comparison requires an understanding of the manufacturing process used to produce plastic bags.

Manufacturing

Most plastic garbage bags are made from blown polyethylene film [1, 6]. The basic manufacturing process, depicted as a basic sketch in Figure 1, starts when reprocessed and/or virgin polyethylene pellets are

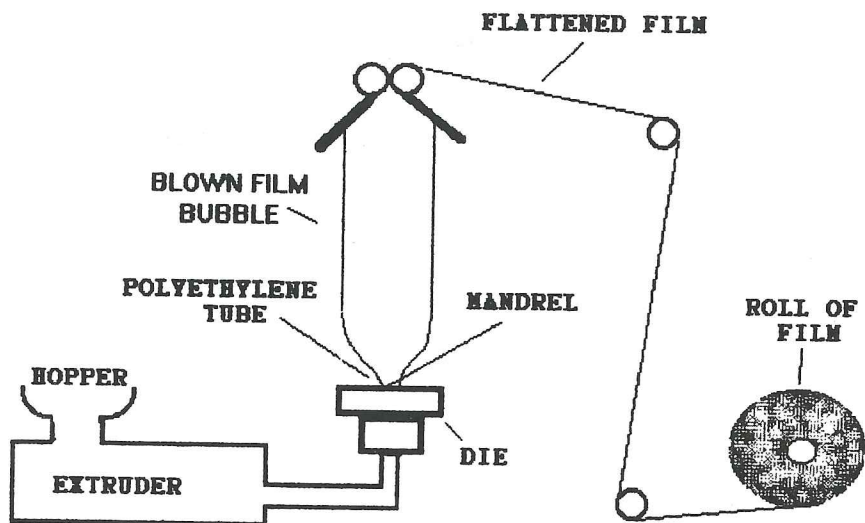


Figure 1

Basic sketch of initial manufacturing stages

melted (400°-500° F) and mixed with dye pigment to form a molten plastic. This molten plastic is forced through a screen filter to remove large impurities from the mixture.

Smaller impurities pass through the screen filter and are randomly arranged throughout the molten plastic. The amount of impurities in the blown film is usually related to the quality and quantity of reprocessed material used. After passing through the screen, the molten plastic is extruded between a ring shape die and mandrel to form a plastic tube. As the plastic is passing between the die and mandrel, striated toolmarks are impressed into the outer and inner surface of the plastic tube [5].

Often, especially for lengthy rolls of blown polyethylene film that could be ten miles long, the die and mandrel are slowly rotated as a unit so that the position of the striated toolmarks spiral slightly around the plastic tube. The spiraling die lines will help avoid a lumpy contour on large rolls of blown film.

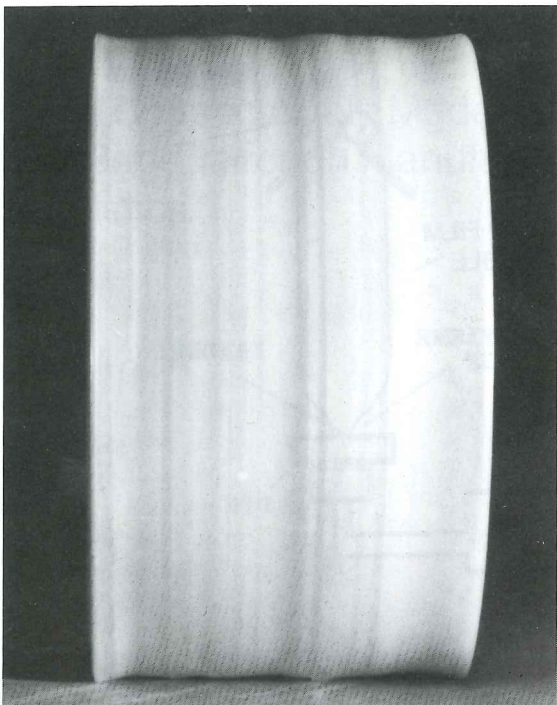


Figure 1A

*A seven inch diameter roll of clear blown polyethylene film.
The non-spiralling die lines are developing a lumpy contour
on this small roll of film.*

Figure 1A illustrates what happens when the die and mandrel are not slowly rotated. In addition, as the plastic is being extruded between the die and mandrel, residues might build up then wear away on the die and mandrel. This residue buildup might cause slight random streaks or slight random gauge variations in the plastic tube.

As the plastic tube is being extruded, pressurized air is blown through the mandrel to the inside of the plastic tube. The tube is inflated and stretched by the pressurized air to the desired size and gauge, earning its name of blown film. This blown film bubble tube is pulled upwards by other machinery and cooled. The chemical mixture of the polyethylene and pigments, its temperature, the diameter and gauge of the extruded plastic, the air pressure and the speed of the machinery all play a role in producing the desired size and gauge of the blown film bubble. At this time, somewhat horizontal (in relation to

the length of the blown film) streaks can be formed across the blown film by the vibrations of the pulling machinery and the pressurized air stretching the film.

The shapes and arrangements of these horizontal streaks are random. The label "tigerstripes" has been previously attached to these horizontal streaks in other literature [2]. As the film is being blown and stretched to size, the random impurities become visible as dark pigment spots with somewhat vertical (in relation to the length of the blown film) streaks radiating from the dark pigment spot. These randomly arranged dark pigment spots with vertical streaks have been labeled "fisheyes" and "arrowheads" in other literature [2, 3, 4].

Die lines also become visible as the film is blown and stretched to size. Some die and mandrel striations on the outer and inner side of the plastic tube will become visible as light or dark, somewhat vertical, die lines over the length of the blown film. The die line (die and mandrel striations) arrangement will be unique to the die and mandrel that produced it. The die line arrangement on the four surfaces of the flattened blown film can be viewed simultaneously with transmitted

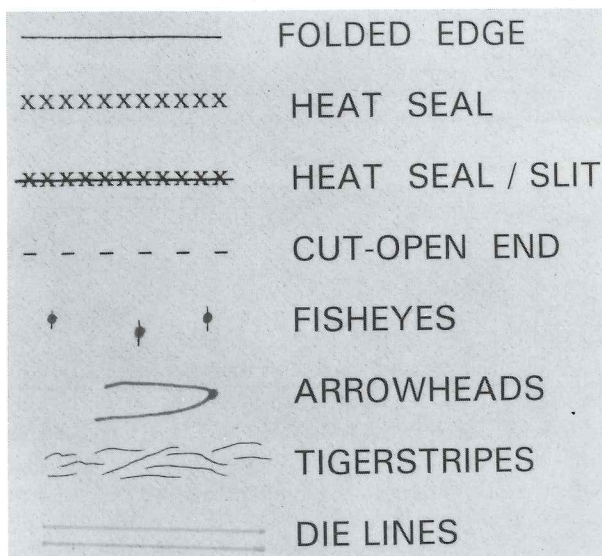


Figure 2

Key for the depictions in Figures 3-10

light through the film. The relative position of the die to the mandrel will play a key role in the arrangement of the visible die lines.

The non-uniform mixing of the polyethylene pellets and pigments, gauge variations caused by residue buildup on the die and mandrel, and random variations in stretching will visually appear as pigment variations as the film is blown and stretched to size. A random marbled appearance often occurs in the polyethylene film because of these variations.

Figures 3 - 6 depict some sealing and cutting arrangements used to manufacture bags from a flattened tube of blown polyethylene film.

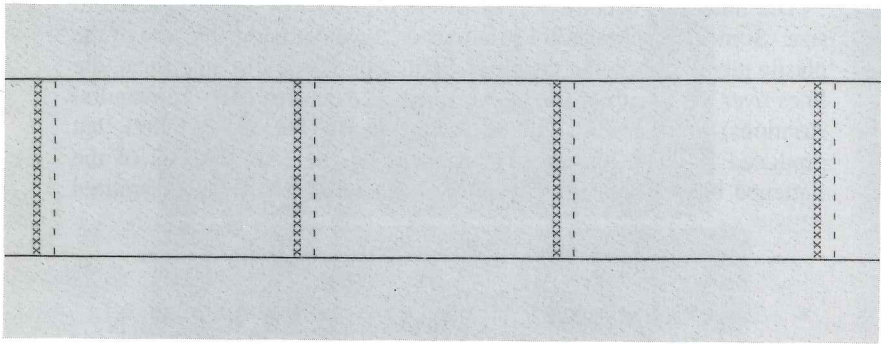


Figure 3

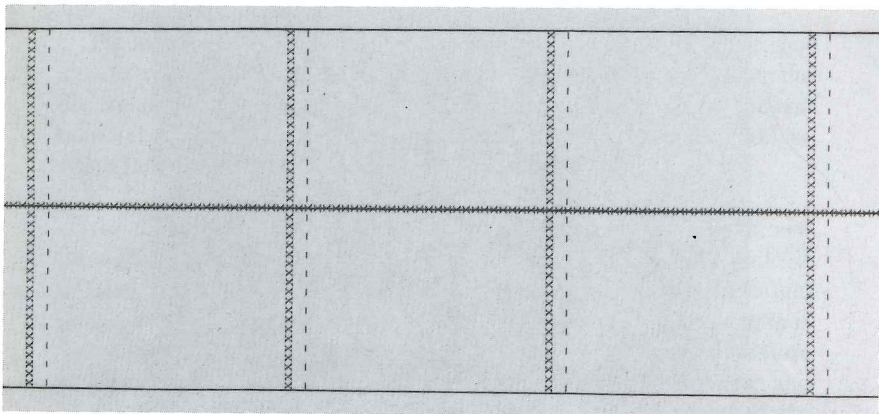


Figure 4

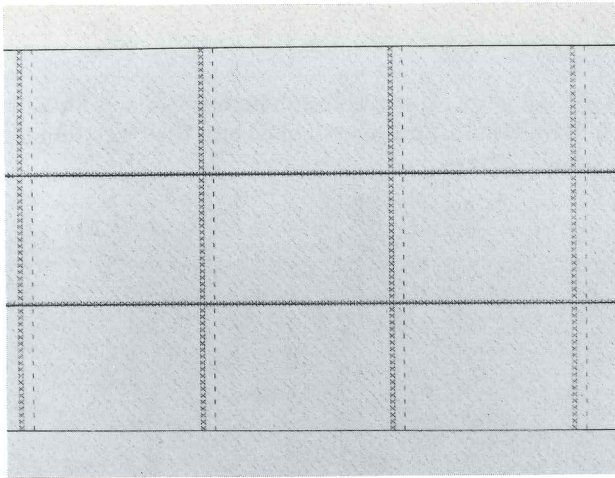


Figure 5

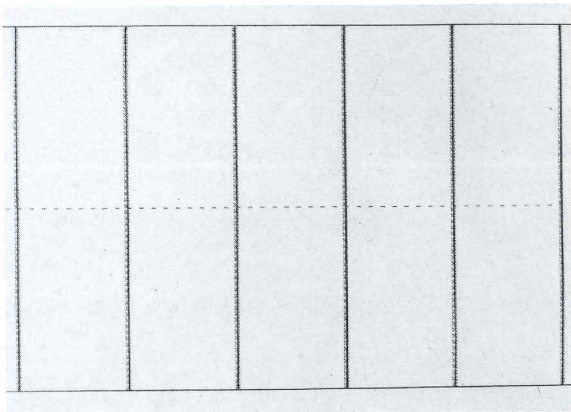


Figure 6

As the blown film bubble is pulled upward, it is air cooled, then flattened. Often, the flattened film is rolled onto a spool, then later is unrolled, heat sealed and cut to desired dimensions. Another option is to immediately heat seal and cut the film without rolling it up. Some different arrangements of sealing and cutting the flattened blown film are depicted in Figures 3-6. These arrangements of bags with die lines, fisheyes, arrowheads and tigerstripes are illustrated in Figures 7-10.

Packaging of the bags can be either by machine or hand. Investigators should be aware that bags that had been directly connected to each

Figures 7 - 10 show exaggerated depictions of die lines, fisheyes, arrowheads, and tigerstripes, and their relationships to adjacent bags.

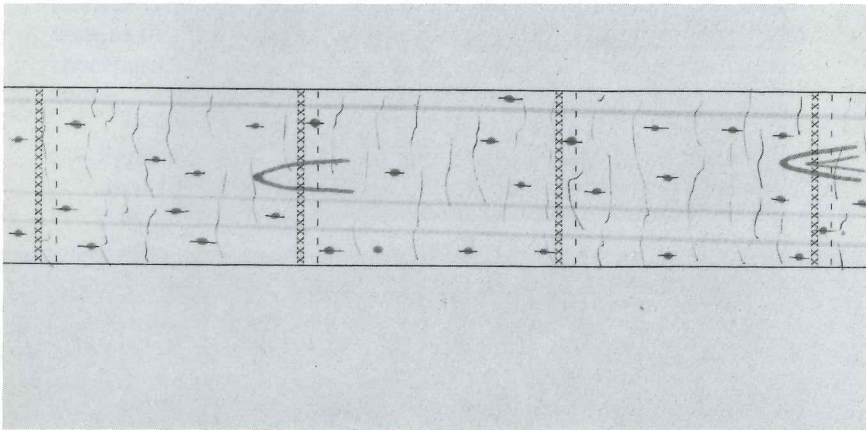


Figure 7

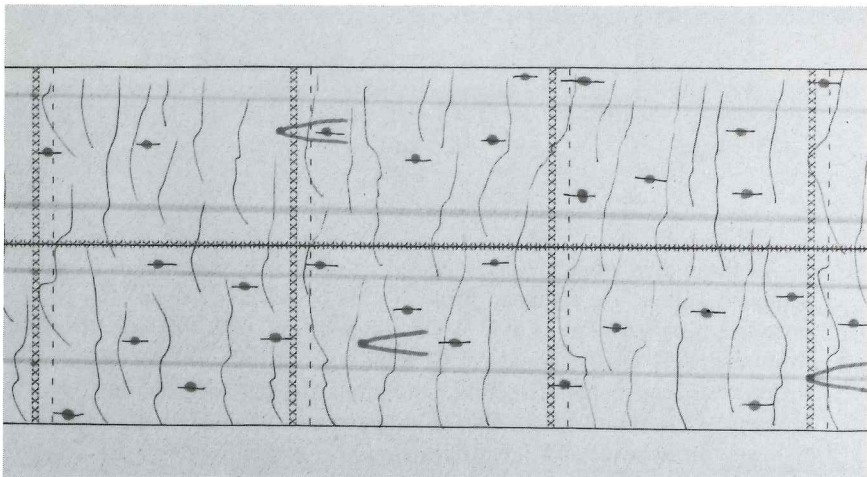


Figure 8

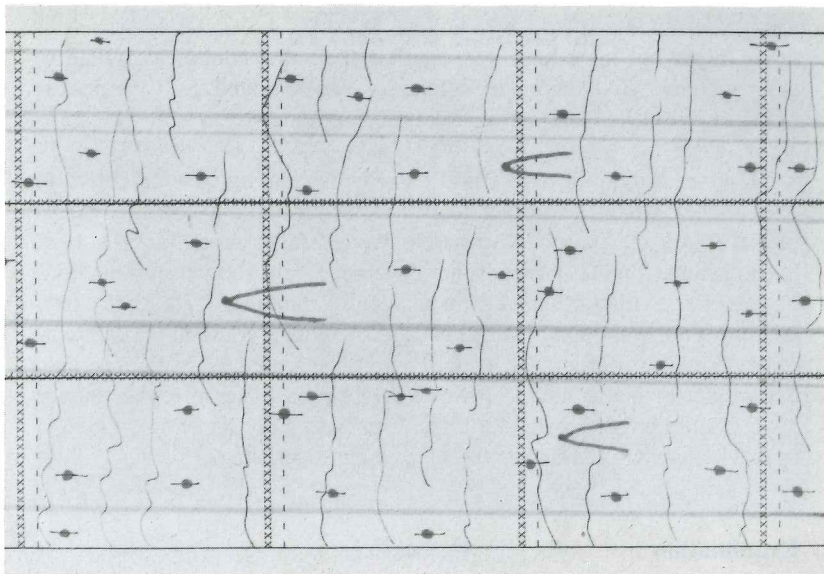


Figure 9

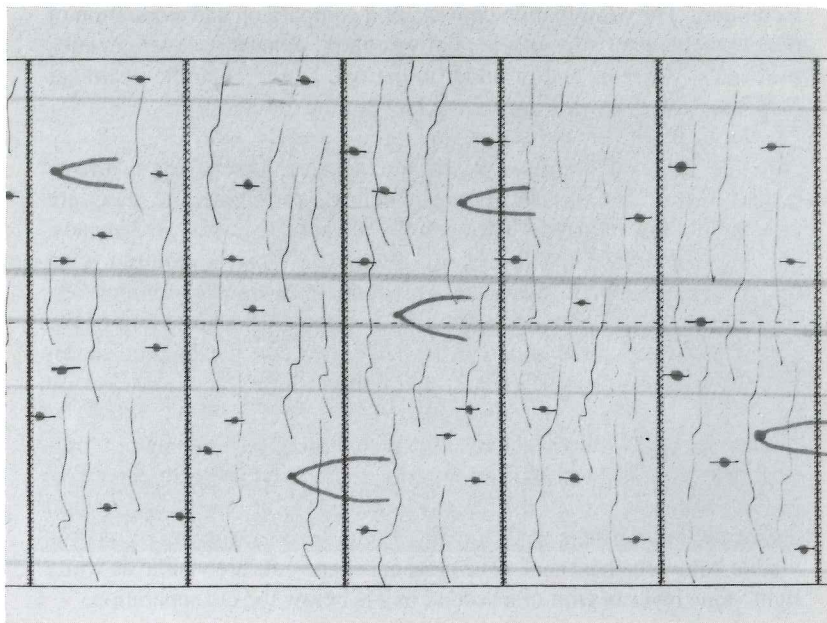


Figure 10

other might not have been packaged in the same container. Quality control checks could be made with bags being removed from a series of bags, with replacement bags added to the package.

Hand packaging of bags could vary the packaging of consecutively manufactured bags. Another bag in a package might not have been directly connected to any other bag in that package. Also, bags that had been produced in the same production series might show different class characteristics than other bags in that same container. The upper left bag in Figure 9 and the lower right bag in Figure 9 could have different dimensions, a different heat sealer could have sealed the bags, a different slit-sealer could have separated the bags, a different cutter could have cut the bags apart and a different class of die line arrangements would be present; yet they could be packaged together.

Examination

During the examination, a large lightbox can be used to transmit light through the bags. Most bags are transparent enough to use this technique. The examination consists of a comparison and evaluation of the class characteristics of the relative colors, dimensions, gauge, cuts, heat seals, slit-seals and printing on the two bags. Then the examiner compares and evaluates the arrangement of the die lines.

After this step, the random arrangements of the fisheyes, arrowheads, tigerstripes, streaks, pigment density variations and tears are compared and evaluated. The specific labels of fisheyes, arrowheads, and tigerstripes are not necessarily required. What is required is an understanding of what causes these random arrangements of impurities, stretch marks, and pigment variations to occur. The stretching of the plastic at the separated bonds of the perforated cuts needs to be examined, as well as any surface marks and wrinkles.

Figures 11-14 illustrate a visual explanation of the examination process using transmitted light photographs of blown polyethylene film bags. The black areas at the top of Figures 11-13 are two layers of film above the bottom heat seal of a bag. One layer of that bag's skirt is visible below the heat seal. The crescent shape cuts are visible as white light. One layer of film of a second bag is below the cut separation.

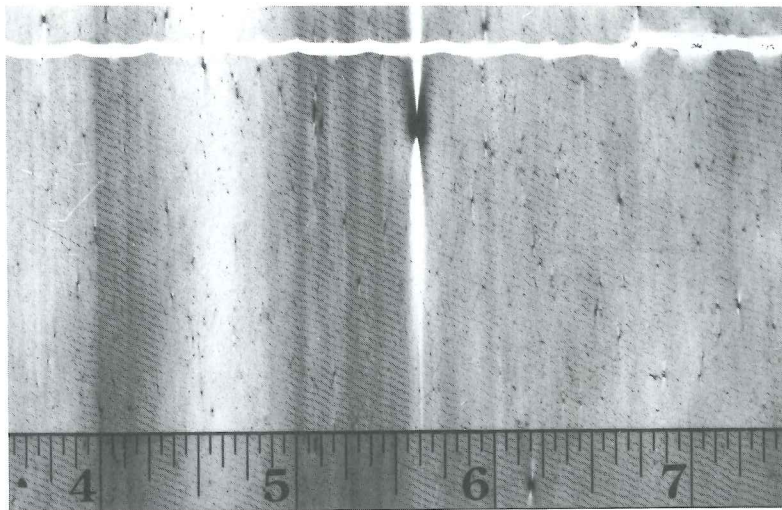


Figure 11

An agreement of class and random blown polyethylene film characteristics

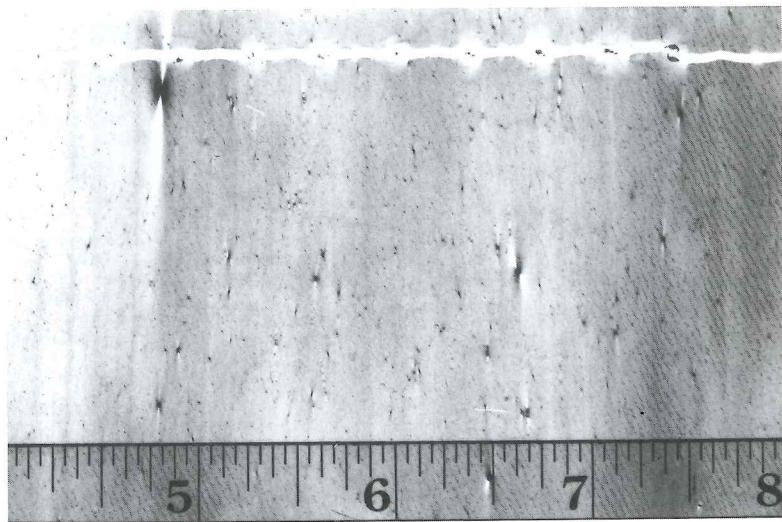


Figure 12

An agreement of class and random blown polyethylene film characteristics

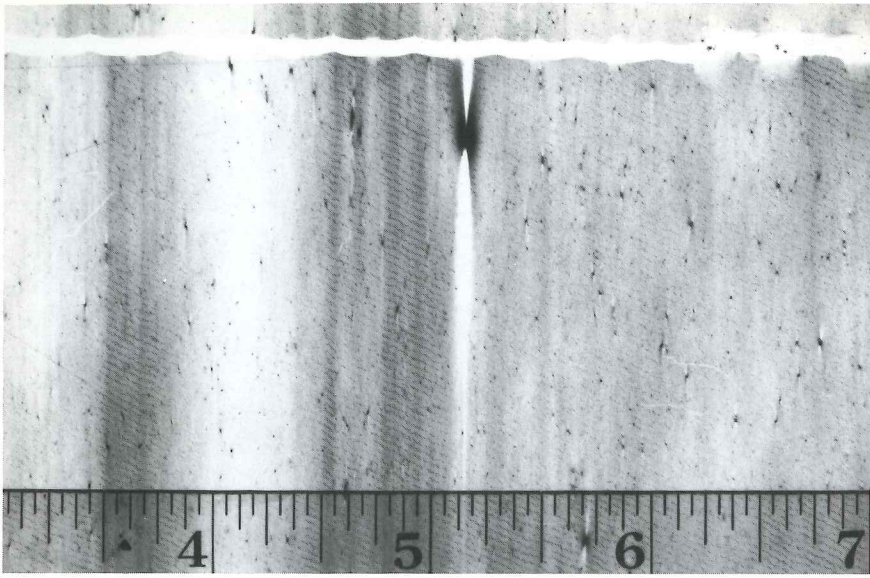


Figure 13

Some agreement of class characteristics that are not in complete alignment, with no agreement of random characteristics

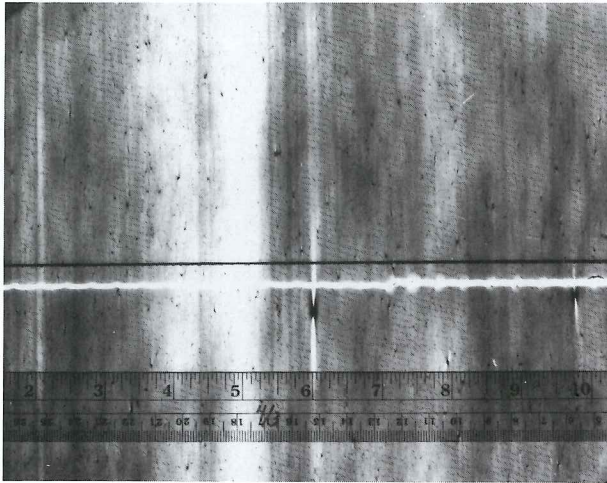


Figure 14

A significant agreement of class characteristics and random characteristics indicating these two bags had once been directly connected to each other

Results of Examination

A variety of conclusions can be reached after examining two garbage bags. Some conclusions could be:

1. The bag in item 1 and the bag in item 2 show no common origin.
2. The bag in item 1 had not once been directly connected to the bag in item 2. Similar characteristics indicate they could have been produced on the same machinery.
3. The bag in item 1 had not once been directly connected to the bag in item 2. Similar characteristics indicate they had been produced on the same machinery.
4. The bag in item 1 was not identified as having once been directly connected to the bag in item 2; however, similar characteristics indicate they could have once been directly connected to each other.
5. The bag in item 1 was identified as having once been directly connected to the bag in item 2.

The significance of the quality and quantity of the repeatable class characteristics and the quality and quantity of the non-repeatable random arrangements of characteristics are all compared and evaluated to reach the conclusion. Realizing what arrangement of characteristics are or can be repeated and what arrangements of characteristics cannot be repeated is essential for all comparisons.

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