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	Document Manager: Tracee McIntosh	Approved By: Jeffrey Nye

3.15 Physical Developer

3.15.1 Introduction

Physical Developer is a silver-based liquid reagent, which reacts with lipids, fats, oils and waxes present in fingerprint residue. Physical Developer is a productive means of developing latent prints on porous objects; however, it is the last of the processes in the regular chemical sequence. Paper items are generally treated with DFO first if a Forensic Light Source is available, then with Ninhydrin. The items are processed with Physical Developer last. After each step, the developed latent prints should be evaluated and photographed, as the next step may obliterate the prints developed from the previous step.

Physical developer on an account book



Physical Developer has been found to work well on numerous items, including:

- dry paper items
- clay fire bricks
- concrete/gesso statuary
- latex or rubber gloves
- both sides of adhesive tape
- wet/previously wet paper
- rayon or nylon clothing
- unfinished porcelain
- unfinished wood
- wooden knife handles
- items which have not been touched in years

Physical developer is a product of British Home Office research devised specifically for the examination of wetted or water soaked porous items. This technique is a method, which utilizes silver nitrate in an unstable ferrous/ferric redox solution in combination with a detergent solution. Unlike the conventional silver nitrate procedure which reacts with the chlorides of palmer sweat, physical developer deposits freed

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silver from the solution on any non-water soluble sebaceous material that may be present in a latent print residue. Although this technique was developed for water soaked items it should be used on any porous item, whether water soaked or not. If used sequentially, in conjunction with ninhydrin and zinc chloride, the full evidence potential of each item can be realized as these techniques work on different types of residue.

Water soaked or wetted papers rarely contain sufficient amounts of amino acids or salts for effective examination with normal porous surface processes. Components in sweat are either completely removed or diffused throughout the surface. Previous attempts to visualize latent prints on wetted porous items involved air drying and magnetic powder. Under optimum conditions when greasy or oily impressions remain on the surface and fiber swell does not create traps for overall painting, magnetic powder will adhere to the residue.

Since physical developer is an immersion process of high sensitivity, the reagent penetrates the porous material to detect any lipids, which may be present. This reaction with residue other than palmer sweat increases the usefulness of physical developer as a post-treatment to items processed with ninhydrin and zinc chloride. However, physical developer cannot be used after the conventional silver nitrate procedure. Physical developer is a somewhat complicated procedure when initially attempted, but can be efficiently incorporated as an examination technique by batch processing eligible items. Physical developer requires special care and exact adherence to procedures.

Some glassware and utensils must be dedicated to the technique and reagent contamination must be avoided. Several chemicals must be purchased from sole source vendors due to required purity. In spite of these obstacles, the results often obtained from physical developer can be so productive that it must be included when full evidence exploration of porous items is desired.

3.15.2 Other Related Procedures

Ninhydrin

3.15.3 Safety Considerations

- Chlorine Bleach, Household
- Citric Acid
- Ferric Nitrate
- Ferrous Ammonium Sulfate
- Maleic Acid
- n-Dodecylamine Acetate*
- Photofix ie. Polymax Fixer
- Silver Nitrate
- Synperonic N*

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution should be exercised and the use of personal protective equipment should be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

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Warning! Toxic! n-Dodecylamine Acetate is possibly toxic via oral, inhalation or absorption. Consider a severe hazard.

3.15.4 Preparations

3.15.4.1 Stock Detergent Solution

- Pour one liter of distilled water into a 1500-milliliter beaker containing a large magnetic stir bar previously rinsed with distilled water.
- Add 2.7 grams of n-Dodecylamine Acetate and stir with a magnetic stirrer. If some of the detergent sticks to the weigh boat the weigh boat can be immersed in the solution.
- Add 4 grams of Synperonic N. Place the weigh boat in the solution as the Synperonic N will adhere to the weigh boat.
- Stir for thirty minutes.
- Remove the weigh boats.
- Pour the solution into a one-liter glass bottle, transferring any material not yet dissolved. This solution must not be used for at least 24 hours. At this time there should be no visible solids.
- One liter of the stock detergent solution is sufficient to make 25 liters of Physical Developer working solution. The detergent stock has an indefinite shelf life.

Maleic Acid Pre-wash

- Pour one liter of distilled water in a 1500-milliliter beaker.
- Add 25 grams of Maleic Acid and a large magnetic stir bar rinsed with distilled water.
- Stir with a magnetic stirrer until all solids are dissolved.

Silver Nitrate Solution

- Pour 50 milliliter of distilled water into a 100-milliliter beaker.
- Add 10 grams of silver nitrate and stir for one minute. If using a magnetic stir bar you must rinse with distilled water. The chlorine in tap water would combine with the silver nitrate and form a milky colored solution (silver chloride), rendering the solution unusable. Never use tap water for any of the working solutions.

Buffered Ferrous/Ferric Redox Solutions

- Pour 900 milliliters of distilled water in a 1500-milliliter beaker.
- Rinse a large magnetic stir bar with distilled water and place in the beaker and stir.
- Add the following chemicals in the order given making sure the chemicals are dissolved before adding the next chemical
 - 30 grams of Ferric Nitrate
 - 80 grams of Ferrous Ammonium Sulfate
 - 20 grams of Citric Acid
- Stir until all chemicals are dissolved and then stir an additional five minutes.

Combining the Component Solutions for Physical Developer

- To the Redox Solution add 40 milliliters of the Stock Detergent Solution and stir.

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- Examine the Silver Nitrate Solution to ensure that all solid material has dissolved. Stir again if needed. Add the entire Silver Nitrate solution to the redox/detergent solution and stir for two minutes.

*These two steps must be performed in this order, otherwise the silver will fall out of suspension.

The Physical Developer is now ready for use. This prepares approximately one liter and should be sufficient to process about one hundred checks. The combined working solution is unstable and cannot be stored and should therefore be prepared on an as needed basis.

3.15.4.2 Alternative Method

Purchase stock solutions A & B pre-mixed following manufacture's directions for application.
Polymax Fixer Rinses

Rinse 1:

Four or five drops of fixer per liter of tap water in a glass or plastic tray.

Rinse 2:

Is made by preparing a normal Photofix solution with tap water in a glass or plastic tray (one part photographic fixer to nine parts tap water).

3.15.5 Instrumentation

See General Instrumentation

3.15.6 Minimum Standards And Controls

The Standards and Controls for the Physical Developer Procedure consists of placing test impressions on porous items to make test strips. The test strips are then immersed in the working solution. If the test impressions are visualized the working solution can be used to process evidence. This testing procedure must be done for each working solution at the time the solution is made. Since the depletion of the working solution is unpredictable test impressions should be used frequently to insure the working solution is working properly. Documentation of this process must be done in the form of a reagent log for each working solution and in the case record worksheet.

3.15.7 Procedure or Analysis

The procedure for Physical Developer involves three stages; a prewash, reagent development and rinse. Since the working reagent is unstable a pre-treatment wash is necessary, unless the items to be processed are too fragile, to avoid the introduction of contaminants to the reagent. The rinse stage essentially removes contaminants and stabilizes the reaction.

All equipment associated with the pre-wash and reagent must be dedicated. Trays must be of glass and must be scrupulously clean. Beakers for mixing solutions should be labeled according to the type of solution and should not be used for any other purpose. Plastic or bamboo tongs without serrated edges should be employed for item handling. Rinse trays can be the plastic photographic type, but must be

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clean. Physical Developer reacts with even trace amounts of various rubber products so that rubber tipped tongs cannot be used. Similarly, certain gloves will leave marks upon the evidence, which will attract silver deposits. After the pre-wash any contact of glove to surface must be avoided.

Step 1: Maleic Acid Prewash:

- Pour enough Maleic acid prewash solution in a glass tray to cover the item to be processed.
- Immerse the items in the solution for five to ten minutes or until bubbles are no longer given off.

Step 2: Physical Developer Solution:

- Pour enough physical developer solution in a glass tray to cover the items to be processed.
- Drain the items of excess prewash.
- Immerse the items in the working solution and gently rock the tray.
- Keep the items separated and be careful not to crease or handle the items extensively.
- The processing time will vary and can be as little as one minute or up to twenty minutes. Therefore the examiner should monitor the development very closely to avoid over processing and obliteration of weaker impressions. Remove the item when optimum contrast is observed.

Step 3: Rinse:

Two types of rinses are available. The items can be rinsed in a tray of tap water with a constant gentle flow of water into the tray or a two-step Photofix rinse can be employed.

Photofix Rinse:

After sufficient development in the physical developer solution the item is placed in the first Photofix rinse for 30 seconds.

Transfer the item into the second Photofix rinse (standard Photofix solution)for three minutes.

Wash the items in running water for three to five minutes.

Step 4: Drying:

- Allow the items to dry while lying flat. The items can be blotted carefully to speed the drying process if the item is not fragile.
- Impressions developed with physical developer are relatively stable. However in most instances all developed impressions should be photographed.

Step 5: Bleach Solution (optional: to be used only when trying to improve the contrast of darker impressions).

Only proceed with this step after all impressions developed previously have been photographically preserved.

- Place the item in the bleach solution for two to three minutes.
- Rinse the item in running tap water for two to three minutes.
- Photograph any improved impressions.

3.15.8 Regenerating Physical Developer

Processing large amounts of evidence may eventually exhaust the silver content in the solution. It will then be necessary to mix a new kit of Physical Developer or to regenerate the solution. Regenerate by adding an entire new bottle of Solution A, the silver concentrate. This regeneration process may only be done during a short time period. In other words, if you are processing many pieces of paper and suddenly no latent prints are developing, add a new bottle of Solution A, stir completely and continue processing.

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Do not save the solution and wait until the next day to do this regeneration process. It is recommended that the regeneration process is performed within a few hours of the original process.

3.15.9 Interpretation of Results

Processing of the porous items with physical developer is similar to photographic development. Latents appear as dark gray images, which increase in contrast. The depletion of the working solution is unpredictable due to the inherent instability of the reagent. The failure to produce an image may be due to insufficient reactive material present in the item or exhaustion of the chemicals necessary to cause the reaction. Frequent use of test impressions is essential to insure proper reagent reactivity. Weaker impressions may benefit from additional processing with the physical developer solution. The item to be retreated should not be subjected to fixing with photographic fixer and/or bleaching as these treatments will affect the success of the re-treatment.

Articles, which appear too fragile for the Maleic acid pre-wash, such as charred papers or extremely water soaked items, may be introduced directly into the physical developer working solution. Such evidence should be treated one item at a time and the solution must be checked carefully for the effects of contamination. The use of plastic canvas as described by Clarence Philips, et al may help when the items are too fragile to manipulate by other means. Usually contamination will precipitate the silver from the working solution in the form of dark reddish brown particles resembling curds. Contaminated solutions must be discarded and the evidence cannot be processed using contaminated solutions.

3.15.10 Minimum Quality Standards And Controls

See Standards

3.15.11 Additional Readings

- Advances in Fingerprint Technology edited by Dr. Henry Lee and Dr. R. E. Gaensslen
- Manual of Fingerprint Development Techniques by the British Home Office, second edition

3.15.12 References

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