IDENTIFICATION
NOTES

# Latent Fingerprint Development on a Cement Matrix

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On May 20, 1990, a woman was killed in Winnipeg. The victim had been struck with a piece of concrete from a parking lot abutment. The assailant had carried and handled the concrete leaving fingerprints.

The concrete was tested for hair, fibre, serology and chemistry at the RCMP Forensic Laboratory in Winnipeg. Because of abutment surface characteristics, the potential of latent fingerprint development was assumed to be high.

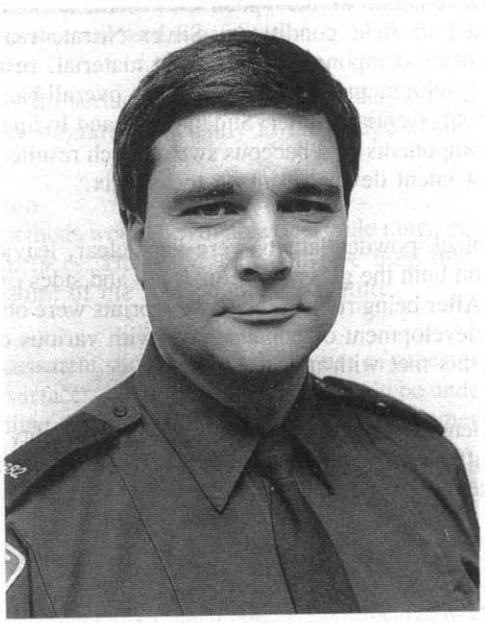
Concrete is made of graded mineral products in a cement matrix. When mixed with water, a blend of sand, gravel and cement forms a solid product. After concrete has set and hardened, it cannot be ''duplicated''. Gross characteristics such as mix designs and petrographic nature are consistent with other mixtures but never exactly the same.

The matrix bears microscopic differences known as reaction haloes around each particle. There are also variations in spacing factors between paste, aggregates and air voids. A further concern is the fineness composition in the cement.

Essentially, cement is described as Calcium Magnesium Aluminum Oxide Silicate with varying amounts of Tricalcium Silicate (Alite) and Bicalcium Silicate (Belite). The Belite and Alite crystals take on many different forms depending on kiln treatment (overburning, fineness, variation, etc.) which affect the concrete surface characteristics. These crystals can be plates, tubes, radiating fibres, clustered nests or ragged particles. Surface characteristics vary depending on the matrix paste. These variations affect the degree of concrete porosity and permeability. For example, on smooth concrete, these factors will affect surface latent retention suitability and development.

Latent development attempted on porous mediums proved unsuccessful. Although unable to supply original concrete molds similar to the one used in the crime, the concrete company supplied a similar design using the same process and mix. The concrete used in the murder was made of normal Portland cement and batched into a mold coated with an unknown release agent and was between five and ten years old.

As a result of contact with the mold, the mold batch process leaves the top and sides of the abutment with a mat surface. The base of the abutment displays a glossy surface affected by bleed water as this constitutes the top of the pour. All surfaces have a high cement matrix percentage and the base of the abutment is nearly 100% cement paste.



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A test section was cut into one inch slabs and latent impressions were placed on the surfaces. The test impressions were subjected to a variety of chemical enhancement treatments as well as powders. The range of tests were:

*Black Powder
Grey Powder
Silver Powder
Gold Powder
White Powder
Black Magna Brush
Grey Magna Brush
Ninhydrin
Ninhydrin with zinc toning
Rhodamine 6G
Ninhydrin with nickel toning
Amido Black
*Gentian Violet
Physical Developer
*Sudan Black
*Cyanoacrylate w/ Gentian Violet
*Cyanoacrylate w/ Sudan Black
*Iodine
Laser w/ and without Redwop Powder

*Denotes where identifiable impressions developed in tests.

All other treatments resulted in unidentifiable smears or no development. Silver Nitrate was not tested due to expected chloride content in the specimen's cement matrix once subjected to field conditions. Silver Nitrate reacts with the chloride component of the latent material, resulting in latent development being masked by an overall background darkening. Gentian Violet, Sudan Black and Iodine react to fatty components of sebaceous sweat which resulted in high contrast latent development on the matrix.

The black powder latents were very clear, leaving fresh prints on both the glossy base, mat top and sides of the test slabs. After being rubbed lightly, the prints were obliterated and redevelopment or enhancement with various chemical treatments met with negative results.

The Gentian Violet latents were of excellent quality immediately after treatment but quickly diminished as the slab dried leaving prints of poor quality or none at all.

Sudan Black latents were faint but clear after the two-minute immersion time. Once washed, these latents became faint. Several tests were done using extended development times of up to six minutes and no washing after treatment. The optimum time frame was four minutes at 68–72 degrees Fahrenheit with no washing of the slab after treatment and air-drying.

For the Iodine treatment, a Sirchie Disposable Iodine Fuming Gun (CA# DF201A) was used. The results were very clear but faint (tan) brown latent impressions were developed. Enhancement techniques were not performed on the iodine latents at the time but should have resulted in high quality prints. The iodine-treated latent also rapidly diminished within hours without fixing and enhancement.

A slab was treated for two hours with Cyanoacrylate and then immersed in Gentian Violet. A clear print resulted and faded slightly as the slab dried. The Cyanoacrylate appeared to assist in fixing the latent material as the print remained faint but visible.

The process was repeated but this time the slab was immersed in Sudan Black. A very clear permanent print resulted. The Cyanoacrylate tends to fix and preserve the latent on the concrete to some degree.

After testing various methods, the Cyanoacrylate-fixed Sudan Black procedure was preferred. This conclusion was based on latent development quality, high contrast and print longevity. The degree of absorption into Sudan Black matrix is much less than the Amido Black. In addition, the Sudan Black solution contains a certain degree of particulate matter which appears to adhere to the latent to some degree, resulting in enhanced development.

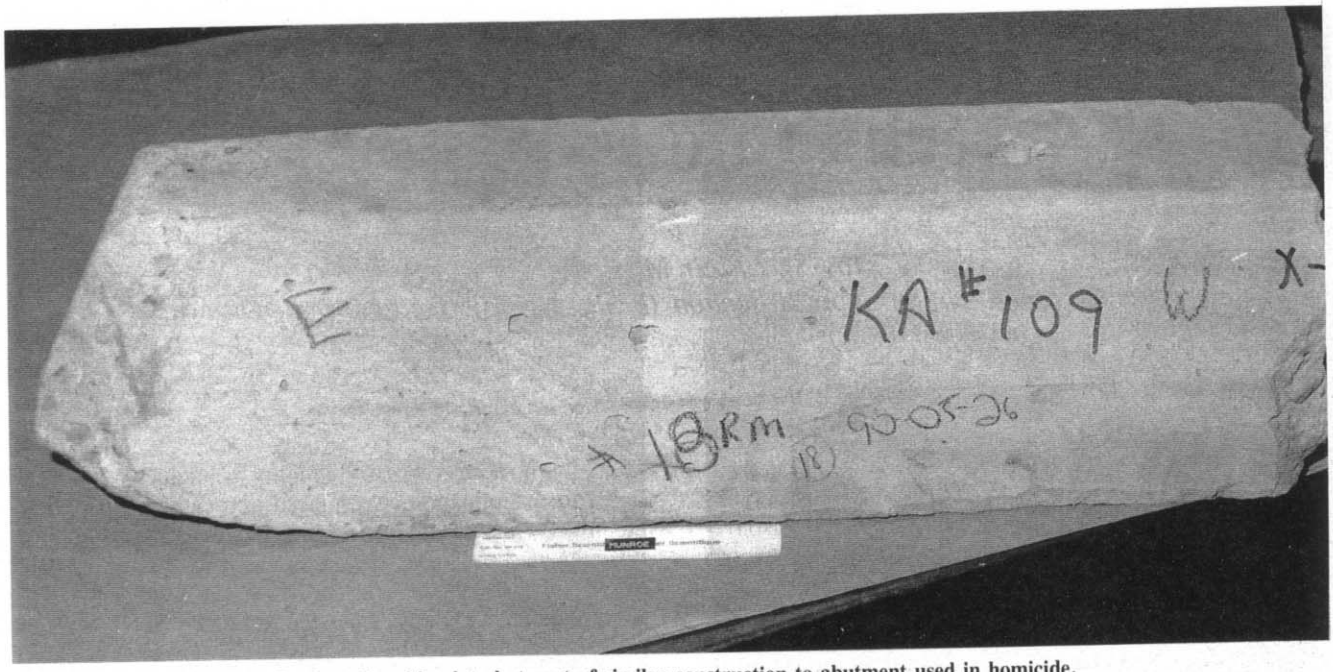
In all of the tests, the resultant latents were developed on the mat top and sides of the slab. Latents were developed on the rough sawn slab faces using Sudan Black on both the cement and aggregates, specifically on carbonates and granites. Latent development occurred on the glossy base only with black powder and to some extent with Cyanoacrylate and Sudan Black.

The RCMP Forensic Identification Support Section in Ottawa verified, critiqued and suggested enchancements to these preliminary results. The new vacuum Cyanoacrylate chamber was suggested along with Sudan Black treatment to ensure even application — yet this is not mandatory.

Applying a fine water spray on the treated surface results in latents becoming visible against the dampened background because of different permeability levels between the Cyanoacrylate-treated latent and cement matrix. Though water treatment will not work in all cases, it allows technicians to see if any latents have been developed prior to treatment with Sudan Black. Spraying Rhodamine 6G which leaves a fluorescent background against a black latent was also suggested. A laser or luma-light would enhance the prints. Even though a percentage of the cement matrix had weathered off during the five to ten years, the Rhodamine 6G helped. Therefore, a reduced matrix cover is not a problem.

Treated with Cyanoacrylate and Sudan Black, the abutment showed several smudges that approximated fingerprints and palm outlines caused by the assailant's sweat during the crime. This would be caused by the quantity of sweat produced by the assailant during the incident. The block weighed about 55 lbs. and a certain degree of friction ridge slippage was expected, leaving smudges.

A further factor would have been the time between the incident and the actual treatment of the block. The time frame and fluctuating humidity levels during three months could only have been detrimental to the retention of the latent and loss of clarity due to oil migration into the matrix. It would have been necessary to treat the block with Cyanoacrylate immediately after the incident in an attempt to fix the latent. The latent may also be fixed with Methanol, heated and then treated with Cyanoacrylate.




**Section of parking lot abutment of similar construction to abutment used in homicide.**

## Case Study

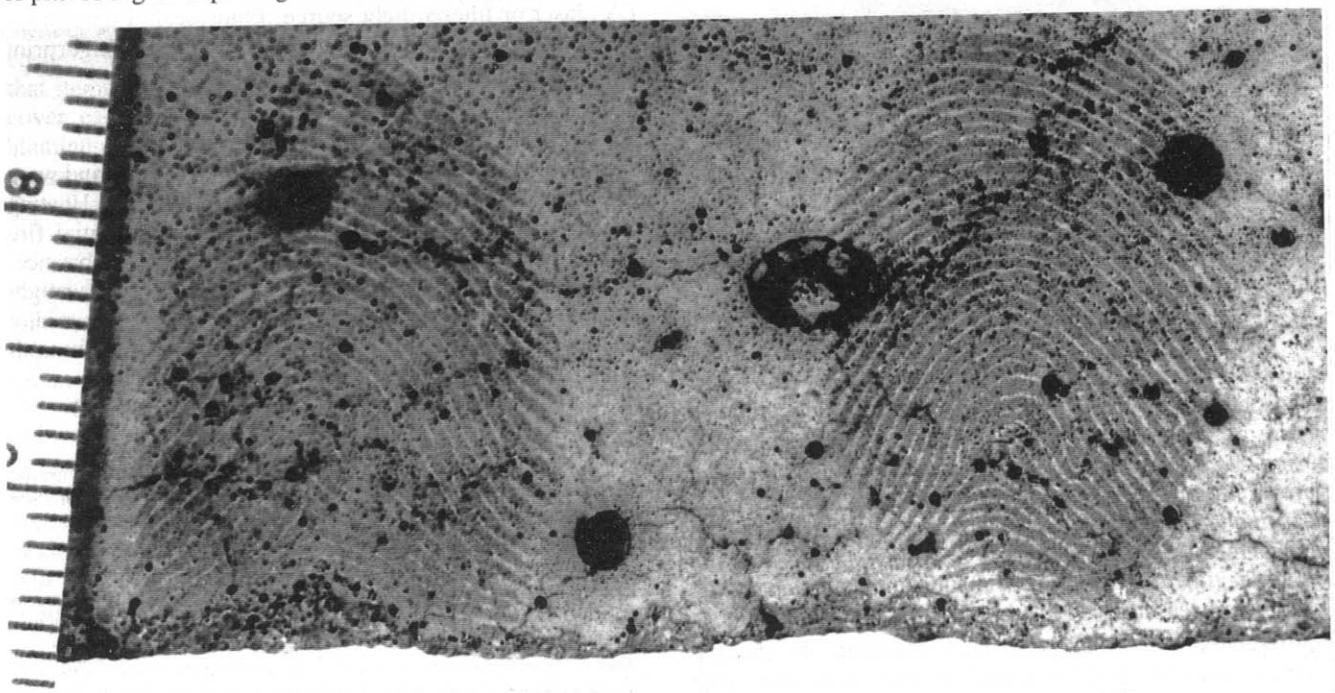
A crypt in Selkirk, Manitoba was broken into and the grave desecrated. I assisted the RCMP members in the use of this method. The crypt, nearly 30 years old, was made of polished dolomitic marble and had become rough and pitted to a fine sandpaper texture.

The treatment worked well on the test sections with the latent materials being very clearly depicted on the white background. Microscopic examination of pitted surfaces revealed that the latent materials had filled in the void spaces or pits. A degree of pooling of sweat was evident in the lower portions of the surface. Without the Cyanoacrylate treatment sweat may migrate sufficiently to blur ridge detail.

## Conclusion

These methods would be suitable on a wide range of rough, porous surfaces. However, care must be used due to the fragile nature of the surface/latent structure.

This assessment should not limit the use of other methods on other surfaces. Analysis and testing should be undertaken to determine the best method for latent development.



**Test section of mat side of abutment after treatment with Sudan Black using the preferred method.**