B86 Rates of Loss and Replacement of Very Small Particles (VSP) on the Contact Surfaces of Footwear During Successive Exposures

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After attending this presentation, attendees will better understand the rate of loss and replacement of VSP from the contact surfaces of footwear, methods to measure this rate, and the potential contribution to the evaluation of trace evidence on footwear.

This presentation will impact the forensic scientific community by providing information necessary to properly appreciate and interpret VSP on the contact surfaces of footwear.

The separation of particle signals arising from different sources is one of the enabling operations for Particle Combination Analysis (PCA).[1] Although it is well-recognized that criminals track dust to and from every crime scene, dust particles on a suspect's shoes are very seldom used as evidence linking the accused to the crime. The major obstacle preventing the use of this type of evidence is that the shoes have mixtures of particles arising from activity before, during, and after the crime itself.[2] Methods separating the evidentiary particle "signal" from background noise would enable a powerful new and widely applicable forensic capability. This capability would augment traditional footwear pattern evidence with objective quantitative associations, addressing one of the specific issues raised in the 2009 National Academy of Sciences (NAS) Report. To help pursue this possibility, methods are being developed and tested that will lead to better understanding of the loss and replacement of VSP on the contact surfaces of footwear.

Prior work established that a 250m walk (approximately 175 steps per shoe) removes and replaces particles on the outermost contact surfaces of footwear.[3] It is important to achieve a better understanding about how quickly this replacement occurs. This understanding will: (1) help interpret the significance of the trace evidence found on the contact surfaces (representing the most recent environment(s) to which the footwear was exposed — how recent?); and, (2) provide a foundation for the differential analysis of these traces and those found on other areas of the footwear.

Two distinctly different and commonly encountered types of shoe soles were used in this study: athletic shoes (with flexible rubber soles) and work boots (with hard rubber soles). Three well-characterized environmental sites with characteristic VSP profiles (distinguishable by defined qualitative and quantitative particle characteristics) were used for footwear exposures under dry, dusty conditions.

Thirty-six pairs of shoes (18 pairs of each type) were exposed to a "loading site" by walking distances of 175 steps/shoe: six pairs (12 shoes) of each type in each of the test site environments. For each set of 12, two shoes (one pair) was set aside as a control (0 steps in the second environment). Each of the remaining 5 pairs of shoes were exposed for a different number of steps to a second of the three environmental sites: 5, 10, 25, 50, and 100 steps/shoe.

VSP were recovered from the contact surfaces of all shoes by swabbing, analyzed by polarized light microscopy, and interpreted using: (1) a chi-square measure of distance; and, (2) a Latent Dirichlet Allocation model developed at South Dakota State University.

Substantial loss and replacement of VSP occurs on contact surfaces of footwear in as little as five steps/shoe. By 25 steps/shoe, the replacement is substantially complete. Knowledge of the rapid loss and replacement on contact surfaces provides a basis to explore differential analysis of: (1) VSP signals from the contact areas of footwear; and, (2) those from more recessed areas of the footwear sole.

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Reference(s):

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Trace Evidence, Footwear, Particle Signals

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