Household Red Paint: A Case Example and evidence interpretation

G. Massonnet
>At two different times and locations, beer bottles filled with red paints were thrown on public buildings.

>Four month later, a suspect was apprehended and shoes with red traces were found in his apartment.
Comparative analysis between the paint found at the two building locations and the red traces on the suspect shoes.

Methods:
- Optical examinations
- Infrared spectroscopy FTIR
- RAMAN spectroscopy

Interpretation, evidential value?
5th of June 07, red paint on a broken bottle and other debris found close to public building 1.
12th of June 07, red paint on a broken bottle and other debris found close to public building 2.
Trace, sport shoes of a suspect.

October 2007

Several red traces
The paint at building 1 and the traces on the suspect shoes (13) are undifferentiated.

- Acrylic (FTIR)
- C.I. Pigment Red 112 (Raman, 785 nm)

The paint at building 2 is clearly different.

- Orthophthalic alkyd + CaCO₃ (FTIR)
- C.I. pigment red 170 (Raman, 785 nm)
FTIR spectra

Traces on shoes - ACR

Building 1 - ACR

Building 2 – ALK OPH, CaCO₃
Raman spectra

Traces on shoes – PR 112

Building 1 – PR 112

Building 2 – PR 170
Evidential value

- Frequency distributions of the measured characteristics (market study, database)
- Literature
- Bayesian framework
Both traces and comparison paints correspond to a RAL code 3000 « Feuerrot »
Market study, samples

28 domestic red paints corresponding to the RAL code 3000
Market study, sample preparation
Market study, FTIR results

> 16 Acrylic binders

4 undifferentiated pairs
FTIR results

> 12 Orthophtalic Alkyd binders

1 undifferentiated pair
FTIR results - PCA (chemometrics)

Cyril Muehlethaler, 2009 « The application of chemometrics to infrared and Raman spectra », Master project ESC, Switzerland
Raman results, 785 nm laser

28 red paints

- PR112
  - 2
  - 17
  - 8
  - 24
  - 20
  - 26
  - 3
  - 4
  - 5
  - 11
  - 13
  - 18
  - 19
  - 22
  - 25
  - 28

- PR170
  - 7
  - 9
  - 10
  - 12
  - 14

- PO5 + PR146
  - 1
  - 15
  - 16

- PR254
  - 6
  - 27

- PR3
  - 21
  - 23

10 undifferentiated pairs
Cyril Muehlethaler, 2009 « The application of chemometrics to infrared and Raman spectra », Master project ESC, Switzerland
Summary

>FTIR:

PD=0.99 (5 pairs)

>Raman:

PD=0.97 (10 pairs)

>FTIR + Raman:

3 undifferentiated pairs.

Samples: 1/15, 2/17 et 20/26.
<table>
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<tr>
<th>N°échantillon</th>
<th>Magasin</th>
<th>Marque</th>
<th>Importateur</th>
<th>Pays de production</th>
<th>code RAL</th>
<th>Résine</th>
<th>brillant/satiné</th>
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Building 1 and traces

Sample 2 - Colodur, acrylic, RAL 3000, shop: COOP, importer: J.W. Ostendorf, 6300 ZUG

Sample 17 - Architect, acrylic, feuerrot, shop: Jumbo, importer: J.W. Ostendorf, 6300 ZUG

Building 2

Sample 10 - Miocolor, alkyd, RAL3000, shop: Migros, importer: Migros Switzerland.
Interpretation - set of hypothesis

> The shoes of the suspect have been in contact with the paint used against building 1 (H1)

> Versus:

> There was no contact between the shoes of the suspect and the paint used against building 1 (H2)
It must be verified that the traces recovered on the shoes are compatible with the action of manipulating wet paint.

The aspect of the traces and their adherence to the shoes indicates that the transfer occurred when the paint was wet. A dry paint transfer can be excluded.

The expert considers that the number, size and configuration of the paint traces are consistent with the action of manipulating wet paint.
If we consider that no contact occur, and that the suspect has no explanation concerning the presence of paint on his shoes, the background probability of finding red paint traces on shoes must be assessed.

Literature: few surveys (smears, not wet paint).

- Lau et al. (1997)*: Paint on 164 pairs of shoes from students. 15 red fragments in total, size: less than 1 mm². Only 2 pairs with more than 12 fragments.
- Pearson et al. (1971)**: 100 man suits. 26% of red paints. Probability to find fragment bigger than 2 mm is less than 1%.

Considering both surveys, the probability to find about 50 red paint traces on shoes can be considered as rare (less than 1%).

Frequency distribution of this specific red paint (combining IR and Raman spectra): 7% (2/28) in our database containing 28 red paints of the same colour code.

Background probability and frequency distribution can be multiplied (given that the trace is present by chance and that we consider a global population)*:

$7\% \times 1\% = 0.07\%$ (LR=1429)

Considering both the analytical results and the discussion, the expert’s opinion is that all the observed and measured characteristics strongly support* the hypothesis that the suspect shoes were in contact with the paint used against building 1 (versus the hypothesis that there was no contact between the shoes of the suspect and the paint used against building 1).

No link was found between the suspect shoe and the paint used against building 2.

Questions ?