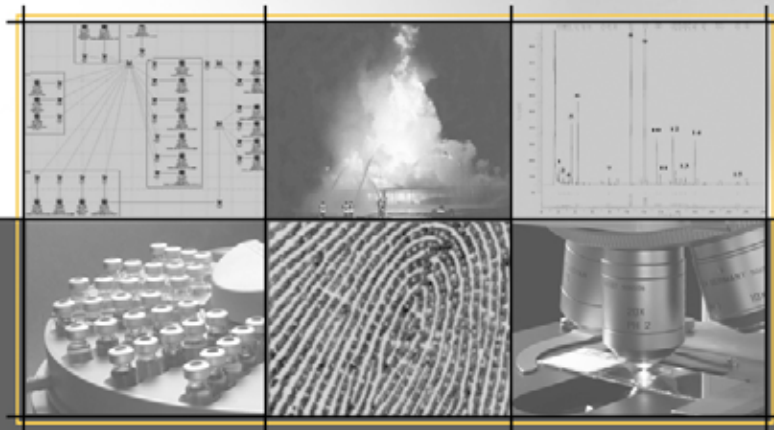


Household Red Paint: A Case Example and evidence interpretation

G. Massonnet



Introduction

- > 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.

Mission

- > 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 ?

Building 1

- > 5th of June 07, red paint on a broken bottle and other debris found close to public building 1.



Building 2

- > 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

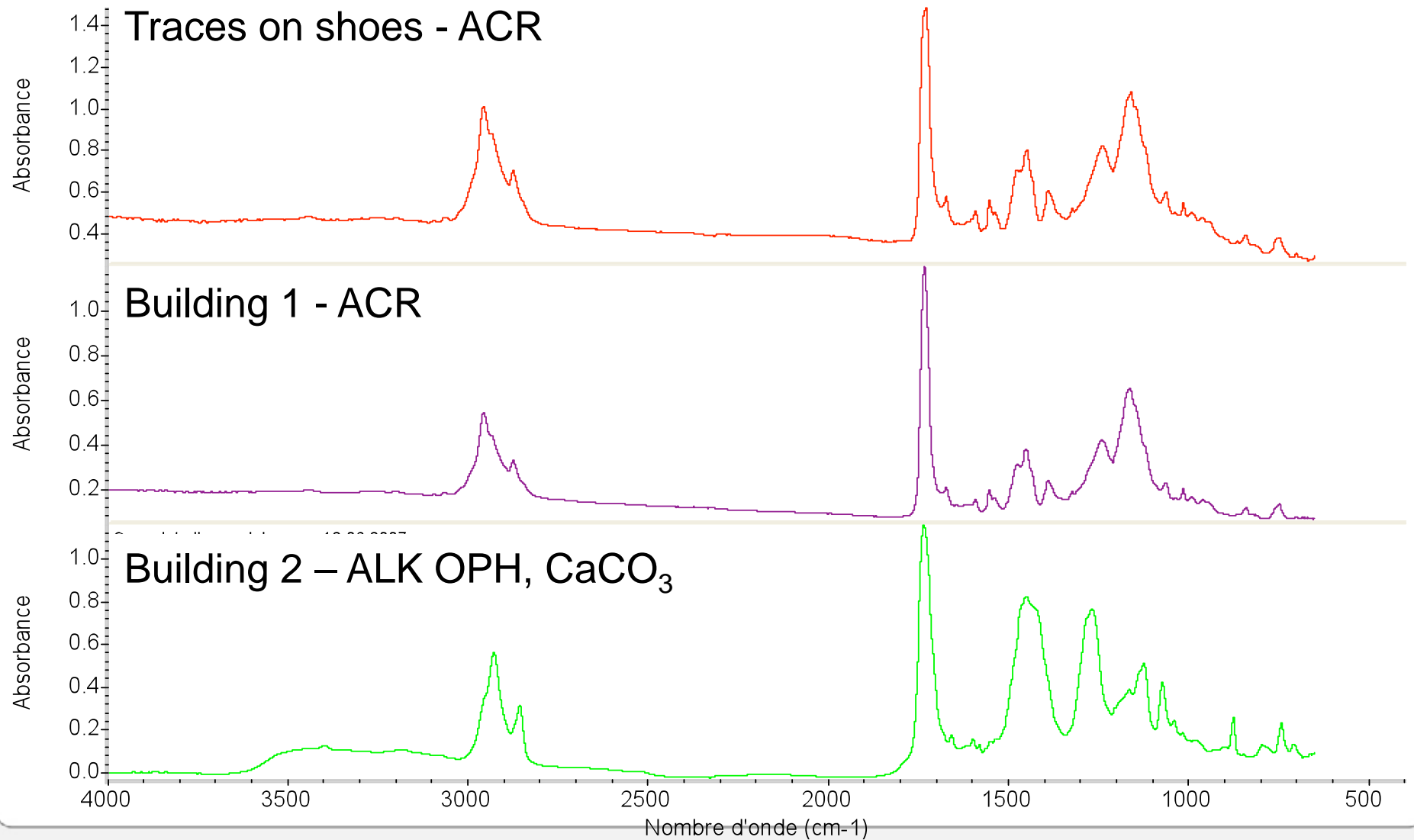


Several red traces

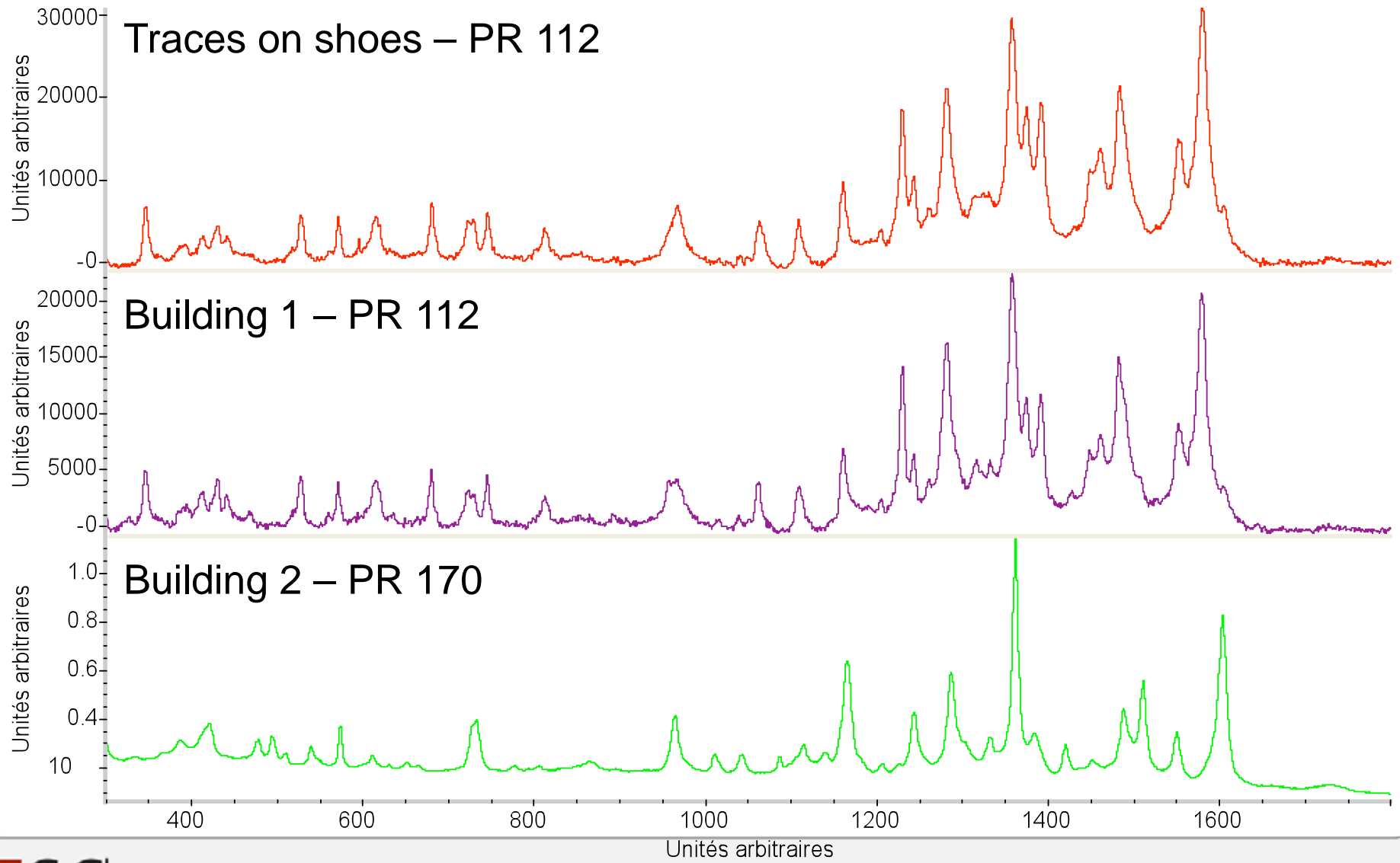
Analytical results : FTIR + RAMAN

- > 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.
 - > Orthophtalic alkyd + CaCO_3 (FTIR)
 - > C.I. pigment red 170 (Raman, 785 nm)

FTIR spectra

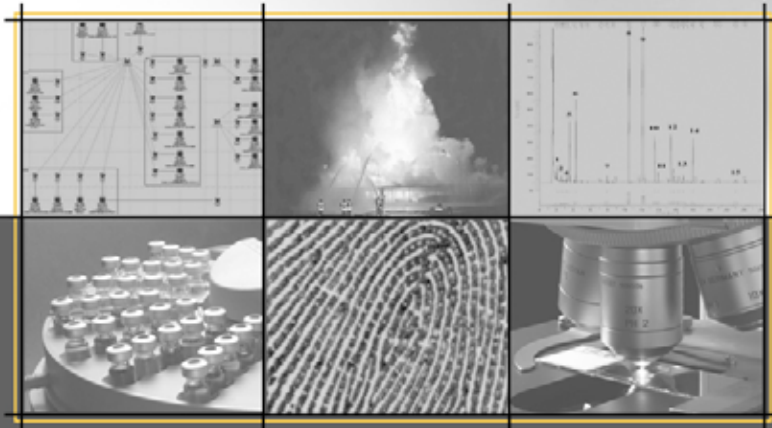


Raman spectra



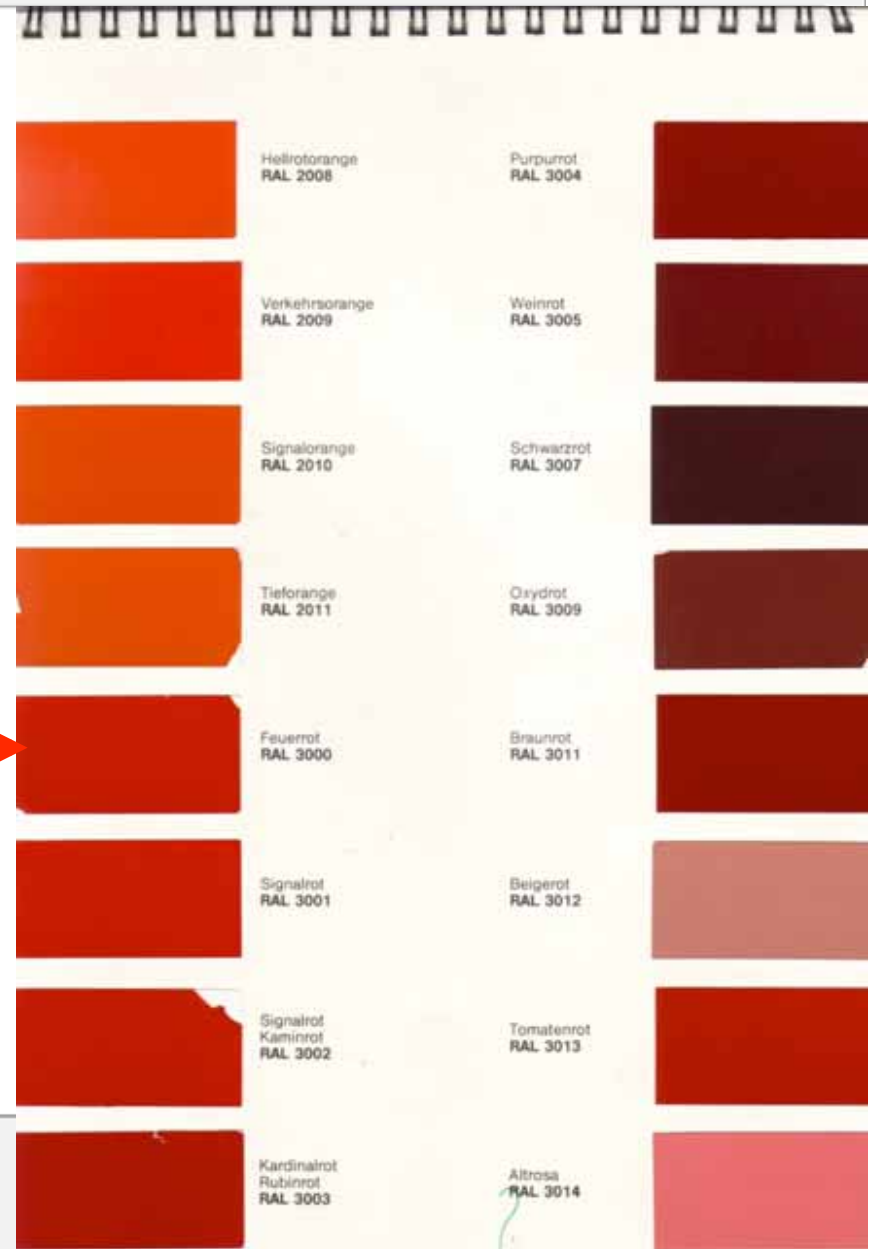
Evidential value

- > Frequency distributions of the measured characteristics (market study, database)
- > Literature
- > Bayesian framework



Market study, color determination

Both traces and comparison paints correspond to a RAL code 3000
« Feuerrot »



Market study, samples



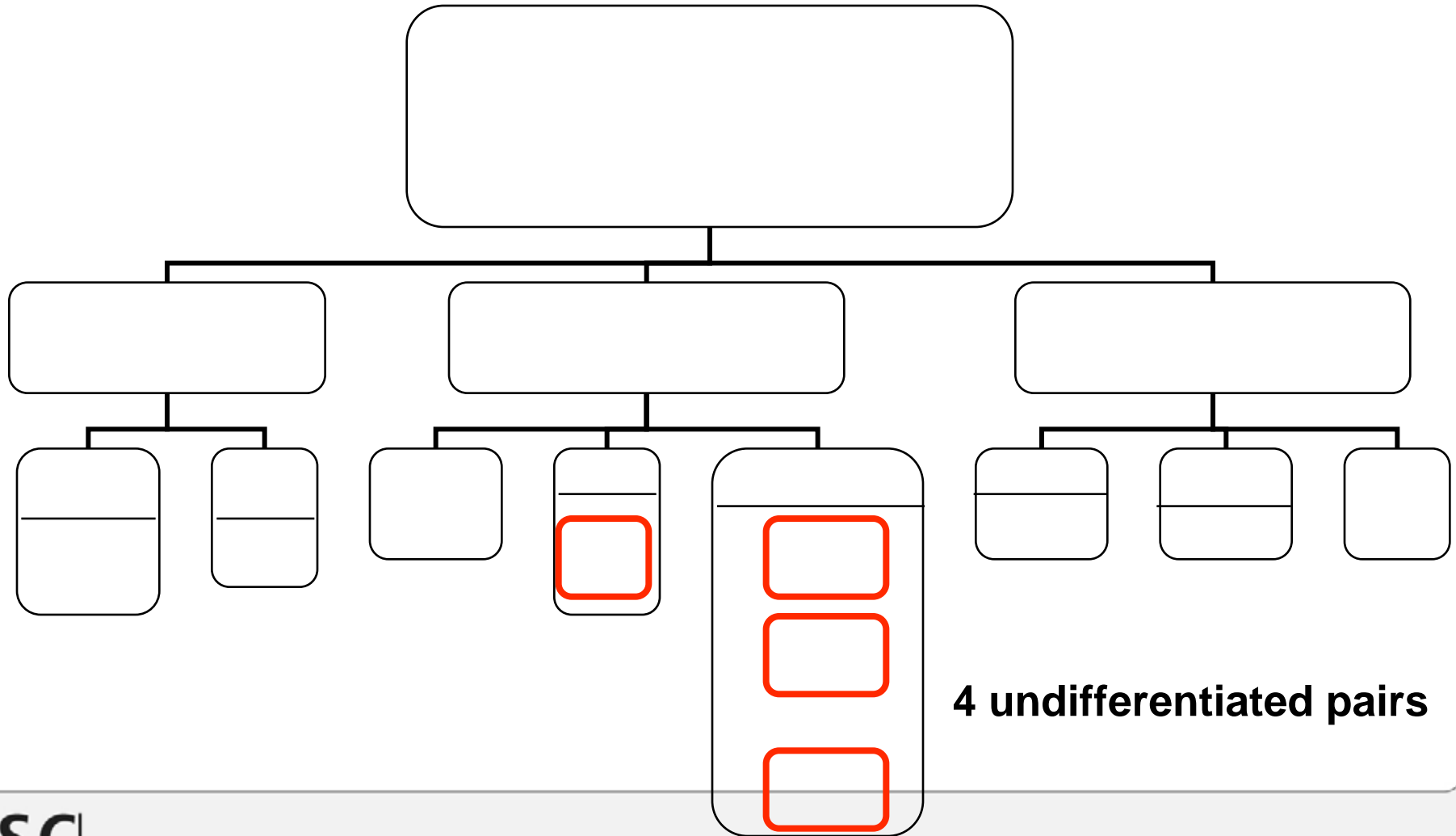
28 domestic red paints corresponding to the RAL code 3000

Market study, sample preparation



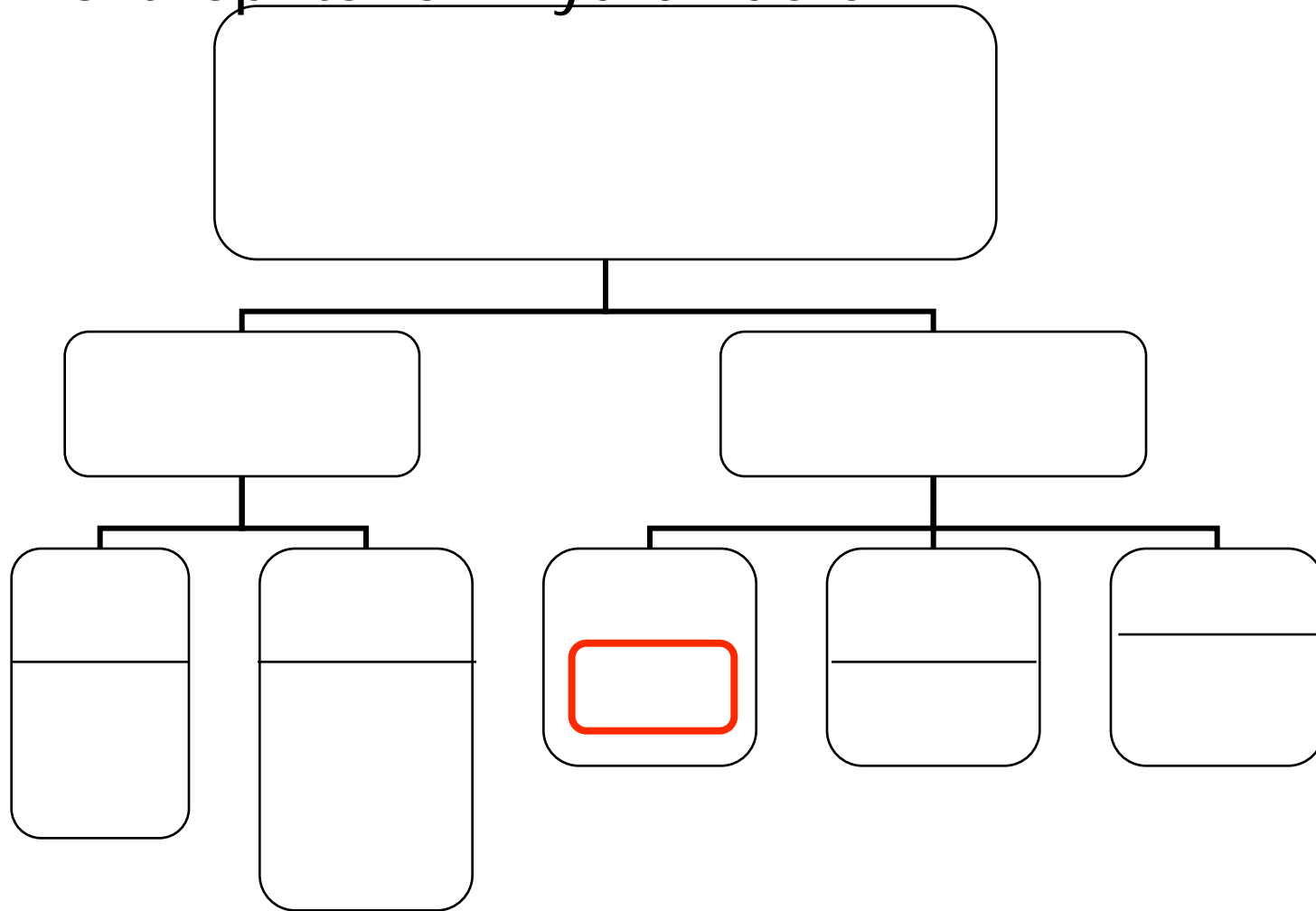
Market study, FTIR results

> 16 Acrylic binders

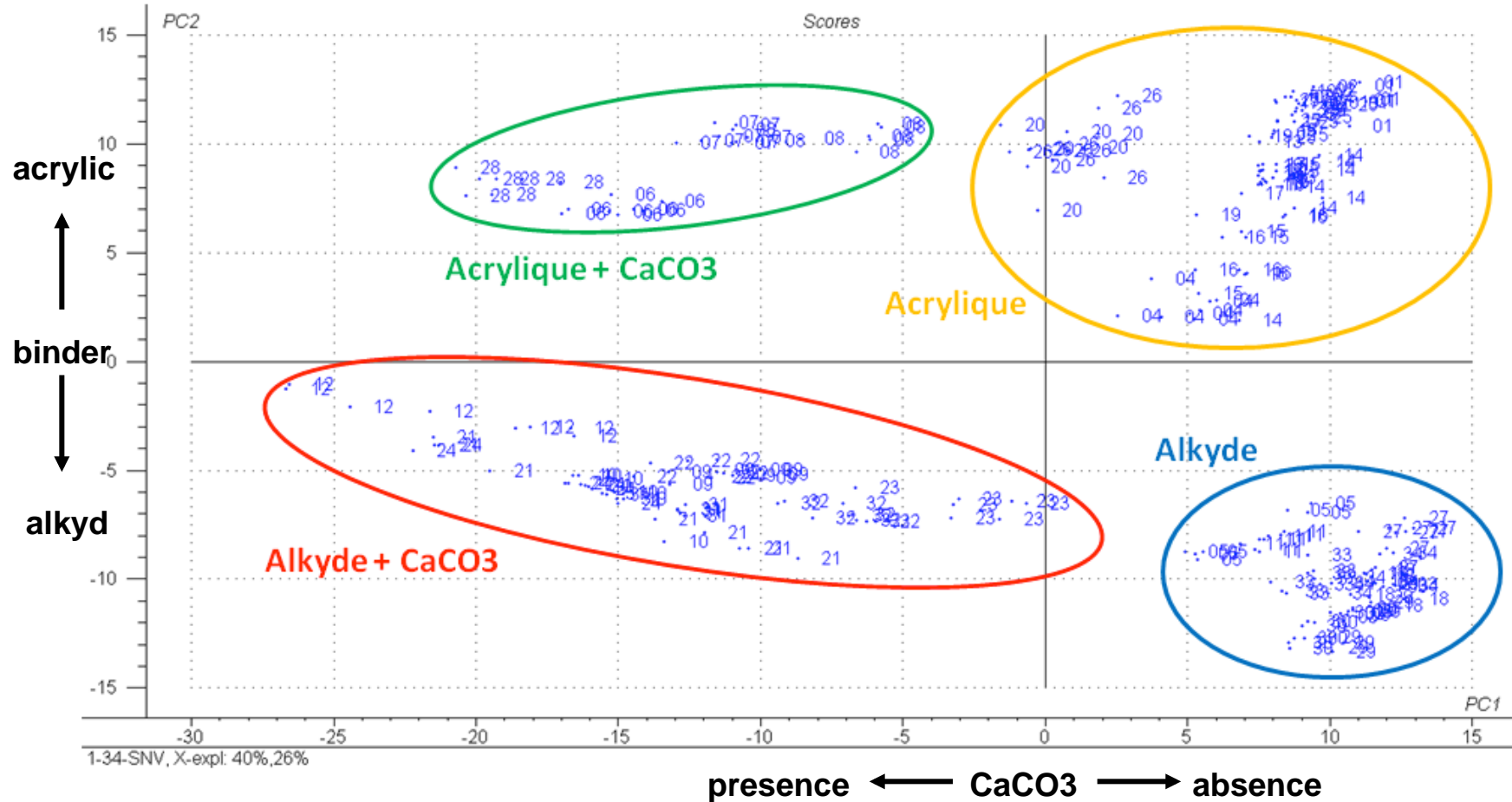


FTIR results

> 12 Orthophtalic Alkyd binders

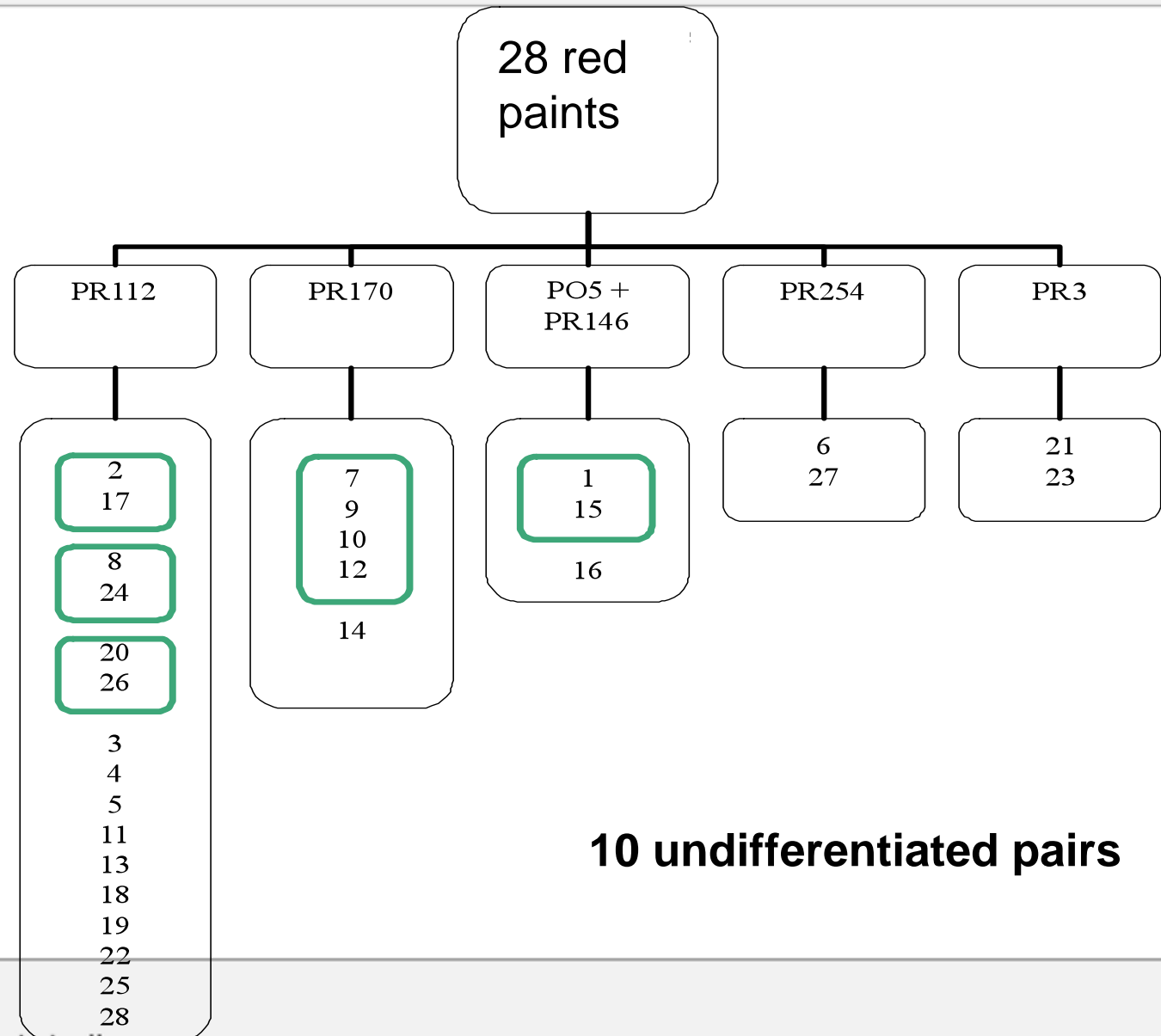


FTIR results - PCA (chemometrics)

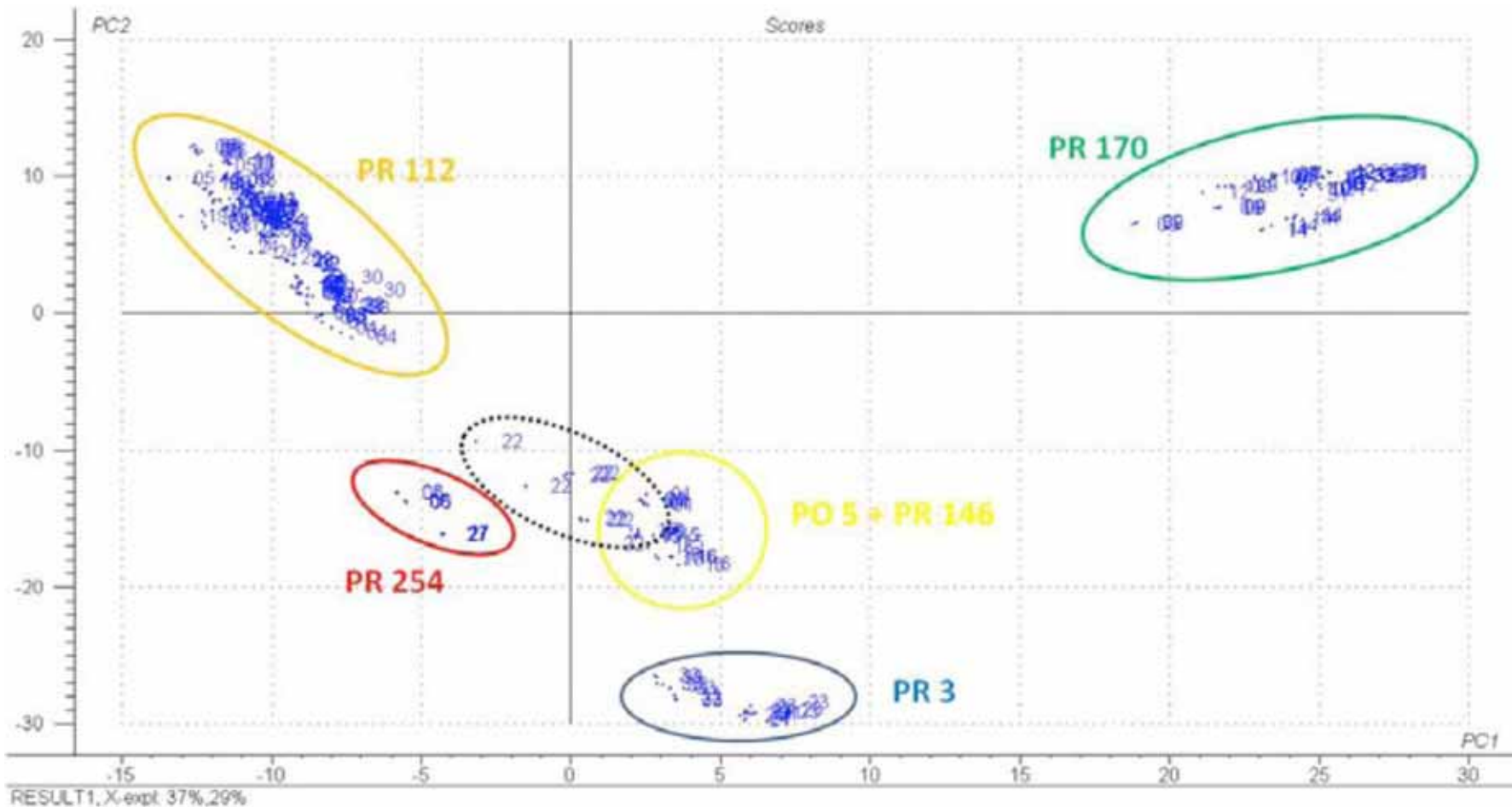


Cyril Muehlethaler, 2009 « The application of chemometrics to infrared and Raman spectra », Master project ESC, Switzerland

Raman results, 785 nm laser



Raman results - PCA (chemometrics)



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.

Samples

N°échantillon	Magasin	Marque	Importateur	Pays de production	code RAL	Résine	brillant/satiné	Prix
001	Coop	Colodur	J.W. Ostendorf, 6300 ZUG	Allemagne	3000	ACR	Satiné	5.90
002	Coop	Colodur	J.W. Ostendorf, 6300 ZUG	Allemagne	3000	ACR	Brillant	5.90
003	Coop	Colodur	J.W. Ostendorf, 6300 ZUG	Allemagne	3000	ALK	Ultra-Brillant	5.90
004	Coop	Colodur	J.W. Ostendorf, 6300 ZUG	Allemagne	3000	ACR	Satiné	12.40
005	Coop	Secrets de 3V3 couleurs	V33 SA, 1541 BUSSY	France	(coquelicot)	-	Brillant	18.90
006	Coop	Talens	Royal Talens, Amsterdam	Hollande	(rouge pyrrole)	ACR	-	7.50
007	Migros	Mcolor	Migros Suisse, 8031 Zurich	Suisse, France, Allemagne	3000	ACR	Brillant	4.00
008	Migros	Mcolor	Migros Suisse, 8031 Zurich	Suisse, France, Allemagne	3000	ACR	Satiné	4.00
009	Migros	Mcolor	Migros Suisse, 8031 Zurich	Suisse, France, Allemagne	3000	ALK	Satiné	4.00
010	Migros	Micolor	Migros Suisse, 8031 Zurich	Suisse, France, Allemagne	3000	ALK	Brillant	4.00
011	Migros	ICI, Dulux Valentine	ICI, Paint deco France, 92607 Asnières	France	(Rouge Madras) 90	-	Brillant	9.00
012	Migros	Mcolor	Migros Suisse, 8031 Zurich	Suisse, France, Allemagne	3000	ALK	Satiné	14.80
013	Migros	Pébéo	Pebeo, 13881 Gémenos	France	(Rouge Vermillon)	ACR	Brillant	7.80
014	Migros	M-creativ	Migros Suisse, 8031 Zurich	Suisse, France, Allemagne	(Rouge Cerise)	ACR	-	22.50
015	Jumbo	Architect	J.W. Ostendorf, 6300 ZUG	Allemagne	(feuerrot)	ACR	-	8.95
016	Jumbo	Architect	J.W. Ostendorf, 6300 ZUG	Allemagne	(rot)	ACR	-	12.50
017	Jumbo	Architect	J.W. Ostendorf, 6300 ZUG	Allemagne	(feuerrot)	ACR	Brillant	5.75
018	Jumbo	Architect	J.W. Ostendorf, 6300 ZUG	Allemagne	(feuerrot)	ALK	Brillant	4.90
019	OBI	Classic	Ernit AG, 8953 Dietikon	Suisse	3000	ACR	Brillant	4.95
020	OBI	Classic	Ernit AG, 8953 Dietikon	Suisse	3000	ACR	Satiné	4.95
021	OBI	Classic	Ernit AG, 8953 Dietikon	Suisse	3000	ALK	Brillant	6.90
022	OBI	Classic	Ernit AG, 8953 Dietikon	Suisse	3000	ALK	satiné	6.90
023	Hornbach	Hornbach	Hornbach AG, 6210 Sursee	Allemagne, Suisse	3000	ALK	Satiné	5.10
024	Hornbach	Hornbach	Hornbach AG, 6210 Sursee	Allemagne, Suisse	3000	ALK	Brillant	4.90
025	Hornbach	Hornbach	Hornbach AG, 6210 Sursee	Allemagne, Suisse	3000	ACR	Brillant	4.80
026	Hornbach	Hornbach	Hornbach AG, 6210 Sursee	Allemagne, Suisse	3000	ACR	Satiné	4.80
027	Hornbach	Glasurit	Akzo Nobel Deco, 50827 Köln	Allemagne	3000	ALK	Brillant	11.50
028	Hornbach	Glasurit	Akzo Nobel Deco, 50827 Köln	Allemagne	3000	ALK	Satiné	12.50

Chemical link, information for the police

> 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)*

H1

- > 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.

H2

- > 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%).

H2

- > 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)*:
- > $7\% \times 1\% = \mathbf{0.07\%}$ (LR=1429)

* Aitken, Taroni, *Statistics and the Evaluation of Evidence for Forensic Scientists*; Wiley, 2004. p. 389

Conclusion

- *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 ?