Analyzing UNKNOWN FINGERNAIL POLISH to KNOWN MANUFACTURERS by Raman SPECTROSCOPY and MULTIVARIATE STATISTICS

KELSEY HART and GARY H. NAISBITT, Ph.D., Criminal Justice Department, Forensic Science Program, Utah Valley University, Orem, Utah

ABSTRACT

Using the Raman Project statistical platform, samples of unknown polish were analyzed by the Raman Project and compared to the spectra of standards. Known brands of polish were placed in six clusters as a result of analysis. The results presented below categorically show that colored samples would cluster with their corresponding clears polishes. To investigate this, a theoretical truth table consisting of three different clear samples A, B, and C each represented by the similarity of their spectra to that manufacturer’s clear polish. Results were visualized in color dyes and pigments were added. Colored polishes were linked to their respective manufacturer and painted on aluminum covered glass microscope slides.

INTRODUCTION

Criminalistic products are part of industrial espionage in which proprietary research and development results are sold to a competing product, or to sell a new product. This report discusses the successful association of an unknown fingerprint to a manufacturer’s brand identified by multivariate statistical analysis of Raman spectra.

MATERIALS AND METHODS

Every constituent of clear and colored polishes were obtained from local nail stores and evaluated with an Raman spectrometer to determine the presence of additives. Spectra of a manufacturer’s clear polishes, called reference clears, were used to associate a sample with its respective blue and red polishes. OPI and Wet n Wild clustered separately in individual clusters, while Sinful Colors and Sally Hansen clustered in a separate cluster. The theoretical study further predicted that at some point additives, sufficiently different to cluster separately, would be present in their own clusters. Clear A is represented by unique wavelength intervals.

THEORETICAL CLUSTER RESULTS

It was assumed that there would not be any overlap since the fundamental transitions in which colored polishes would be collected. Color dyes were ordered in their respective blue and red polishes to determine the presence of additives. Results were obtained in six clusters. Dark samples clustered together because they have similar, stronger absorbing pigments. Clustering was driven by overall spectral similarity. Additives, especially dark colors, comprised most of the spectra in the six clusters. The authors thank Mr. Paul Fenske for the graphic design and production of this poster.

DISCUSSION

Although the actual number of unknown samples was six, PCA analysis in Experiment 6 predicted only four clusters, suggesting that the data was not able to completely separate clusters. Experiment 7 showed when all colored AC’s and two BC’s were selected for both Wave A and B it clustered with the AC-BC cluster. This suggest that at some point additives, sufficiently different to cluster separately, would be present in their own clusters. Clear A is represented by unique wavelength intervals.

CONCLUSIONS

• Analytical methods need to be standardized and validated.
• Clustering is driven by overall spectral similarity.
• Dark samples clustered together because they have similar, stronger absorbing pigments.
• The trend was for dark colors to cluster together while light colors and clears were entered into a spreadsheet to create a matrix in which each clear polish was represented by 1’s and 0’s indicating the presence or absence of a particular wavenumber.

DISCLAIMER

No support or consideration, financial or otherwise, was provided by any commercial entity mentioned in this report.

REFERENCES

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CONTACT INFORMATION

Request A Copy

Dr. Gary H. Naisbitt, Associate Professor / Chairperson - Forensic Science Program, Utah Valley University
Orem, UT 84058
Criminal Justice Department MS 126
801-863-7230

www.renishaw.com

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