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Adhesive Tape Analysis: Establishing the Evidential Value of Specific Techniques

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ABSTRACT: This study investigated the evidential value of specific methods of analysis for packaging tapes and clear adhesive tapes available in Australia. Fifty-eight adhesive tapes were analyzed using a wide range of optical, physical, and chemical techniques. The results were collated for the purpose of creating an Australian database of adhesive tapes, which would be of assistance in criminal investigation. Each technique was evaluated for its discriminating power, both for comparative purposes and for the identification of adhesive tapes by comparing unknown samples with the database. The combined discriminating power of the techniques applied is very high. It is possible to individually identify the source of an unknown adhesive tape sample in many instances by searching the database. It is also possible to form an opinion on the significance of a failure-to-discriminate result in comparative casework. Further work is still needed to expand and update the database, as well as compiling data on the relative market share of various products.

KEYWORDS: forensic science, criminalistics, adhesive tape, class characteristics, identification, database, Australia

Adhesive tape is an example of physical evidence which may be associated with various types of criminal activity. While there are a wide range of adhesive tapes used in industry as well as available to the general public, recent figures suggest that the adhesive tapes most commonly encountered in investigations are packaging tapes and clear sticky tapes (Goulding J, Australian Federal Police, Personal Communication).

Packaging tapes are used for sealing boxes and cartons and therefore may be associated with unknown or suspicious parcels. Packaging tape may also be tied around plastic bags containing questionable objects. In other situations, this type of adhesive tape may be used to attach an explosive device. Due to its strength, packaging tape may also be used by criminals to restrain victims. Clear sticky tape is often a part of questioned document examination. Sticky tape may also be encountered in drug seizures as it is commonly used in drug packaging.

The main objective of the work reported here was to establish the evidential value of specific methods for the analysis of adhesive tapes commonly available in Australia. Although most techniques used in this study have been investigated previously, their relative value when applied in sequence to a large sample of tapes available at a given time and at a given location has not previously been studied and reported.

An additional objective of the work was to establish the foundation for a database of the adhesive tapes available to the general public in Australia. A database may provide information concerning the manufacture or common use of a particular adhesive tape, or may enable identification of the brand and type of tape. If the database is regularly updated, the age of the tape may also be estimated as some manufacturers regularly change their formulations.

A pressure sensitive tape consists of a backing material to which a pressure sensitive adhesive has been applied on one side (1). Materials used to form the backing of adhesive tapes include plastic, paper, and cloth. The two classes of adhesive tape considered in this work possess a plastic backing. One of the most important backing materials used in adhesive tapes is cellophane. Cellophane is a regenerated cellulose. It is a thermosetting, transparent film with excellent clarity and strength, but is susceptible to tearing. Cellophane is being replaced in many applications of adhesive tapes by cellulose acetate. Cellulose acetate is a transparent film with good resistance to ultraviolet light, moisture, oils, and greases. It has a high melting point and good toughness (resists abrasion). Polypropylene is used as the backing material in many adhesive tapes, particularly packaging tapes. It has greater strength and a higher softening temperature than polyethylene, and is stronger and more abrasion resistant than cellulose acetate.

Apart from polymers, the plastic backing of adhesive tapes may also contain plasticizers and other additives. Dialkylphthalates are the most commonly used plasticizers. They are used particularly in the cellulose and cellulose acetate products. Other materials which may be present in the backing material include stabilizers, pigments, extenders, etc. A release coating, usually a silicone, may be applied to the backing on the side opposite to the adhesive. This facilitates ease of unwind and prevents splitting of the adhesive layer.

There are a large number of adhesives available (2). Natural rubber-based adhesives were used in all of the early adhesive tapes. They are cheap and possess superior tack characteristics and good flexibility. However, the natural rubber-based adhesives suffer from poor aging characteristics and have largely been replaced by other classes of adhesive. Acrylic adhesives have excellent aging characteristics and strong tack, but are relatively expensive polymers to produce. Consequently, acrylics become the adhesive of choice only when high performance standards are required. Block copolymer-based adhesives are less expensive than acrylics and are commonly used in packaging tapes (2). Styrene-isoprene and styrene-butadiene are the most common examples of block copolymers. Less common than the acrylics or the block copolymers are the vinyl ether adhesives. These have some specialist uses.

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Due to the various components of adhesive tapes, a number of physical features and physical and chemical methods are available for identification and comparison. The physical dimensions of an adhesive tape provide many potential distinguishing features, such as width, thickness, density, etc. A physical examination of an adhesive tape may also include such properties as color, surface texture, fluorescence, and birefringence. A chemical analysis of an adhesive tape may be split into separate analyses of the adhesive and the backing. There are a wide range of spectroscopic techniques which may be applied to each.

There have been previous studies on the use of infrared spectroscopy in the analysis of adhesive tapes (3,4). These studies showed that infrared spectroscopy allowed discrimination of similar adhesives. A variety of sample preparation methods and analysis modes were attempted in these earlier works. The methods attempted for IR analysis of the adhesives include pelletization with KBr, cast films on the surface of KBr discs, and diffuse reflectance from KBr powder. None of these earlier techniques involved the use of the infrared microscope. Recent developments in spectrometer technology, such as the Attenuated Total Reflection accessory for infrared microscopes, have provided the opportunity for new methods of analysis with less sample preparation and rapid sample analysis (5).

Pyrolysis Gas Chromatography (PyGC) is a well-established technique for the analysis of microscopic samples encountered in forensic casework. The technique is used to characterize and compare evidential samples and can be applied to an entire adhesive tape or just to the backing or the adhesive. Studies indicate that PyGC enables adhesives to be assigned to a particular class (6). Different products in the same class of adhesives displayed pyrograms that were similar, although minor variations allowed all products to be discriminated. Different adhesive tape brands in the same class of product, including closely related adhesives, were distinguished by another study (7). PVC electrical tapes have been compared using PyGC (8). It was found that 26 of 30 tapes gave distinct pyrograms. The differences between the various tapes were thought to stem from differences in the adhesive rather than the backing, although the issue was not resolved.

The discriminating power of PyGC may be increased by interfacing the column to a mass-selective detector. Pyrolysis gas chromatography/mass spectrometry (PyGC/MS) allows the unambiguous assignment of peaks from the pyrogram. This is useful in the characterization of samples, allowing minor components of plastics to be identified.

The previous studies indicate that a number of physical and chemical methods are useful in the characterization and comparison of adhesive tapes. It is unlikely, however, that any one technique will lead to the identification of an adhesive tape with the exclusion of all others. For this reason a selection of physical and chemical techniques should be employed before either identification of an adhesive tape is achieved or a failure-to-exclude result for a comparative test is recorded. The physical techniques examined in this work include optical examination, thickness, weight/area, fluorescence, and birefringence, while instrumental chemical techniques include UV-visible spectrophotometry, microspectrophotometry, FT-IR spectrometry, and PyGC/MS.

Materials and Methods

Adhesive Tape Samples

As stated previously, the adhesive tapes most frequently encountered in forensic investigations are packaging tapes and clear sticky tapes. All available brands of packaging tape and sticky tape were purchased from major supermarkets, office supply stores, news agencies, and hardware stores. In total, 31 packaging tapes and 27 clear sticky tapes were purchased. Where the country of origin was specified on the packaging, this was recorded. The majority of the adhesive tapes purchased for the project were imported from a wide range of countries (Table 1).

Analytical Methods/Instrumentation

The tapes were submitted to a stepwise analysis including general and optical examination, visible microspectrophotometry, ultraviolet spectrometry, Fourier transform infrared spectrometry (FT-IR), and pyrolysis gas chromatography/mass spectrometry (PyGC/MS). Several measurements were taken from each sample (see below for the details), and average data and ranges were used to assess intrasample variations and compare different samples.

General and Optical Examination

Distinguishing features such as surface texture, color, and perforations were noted and photographed through a Leica MZ6 stereomicroscope.

The width of the tapes was measured to the nearest millimeter using a metal ruler. Thickness measurements were taken with a micrometer to the nearest micron. Five measurements of the width and thickness were taken for each tape and the average values and ranges reported.

The adhesive tapes were tested for fluorescence using a Rofin Polilight multiwavelength light source. Each sample was placed on a piece of black cardboard and illuminated using a range of excitation wavelengths. Interferential barrier filters (400 to 600 nm) were used to observe emission at six excitation wavelengths (350, 415, 450, 505, 530, and 555 nm). Samples which exhibited fluorescence were further examined to determine whether the adhesive or the plastic backing was the source.

The tapes were also tested for birefringence by placing them between crossed polarizing filters over a light box.

Visible Microspectrophotometry—A Micro-Colorite MCZ microspectrophotometer (Rofin, Australia) was used to record the visible spectrum of the colored packaging tape samples. Samples were prepared by placing a small piece of the adhesive tape onto a microscope slide. Spectra were collected in reflectance mode over the range of 380 to 750 nm. Three samples were run from different areas of each roll of adhesive tape. Fifty scans were collected and averaged for each sample.

Ultraviolet Spectroscopy—UV spectra were recorded for the backing material of all the adhesive tapes, using a Carey 3E double

TABLE 1—*Country of manufacture for adhesive tape samples.*

Country of Origin	Number of Packaging Tape Samples	Number of Sticky Tape Samples
Australia	4	7
China	2	3
Indonesia	1	1
Italy	1	…
Korea	3	…
Philippines	…	1
Switzerland	…	1
Taiwan	9	4
Thailand	…	1
US	1	7
Unknown	10	2

beam spectrophotometer. For each sample, a small piece of the backing was separated from the adhesive. Samples were collected in absorbance mode over the range of 190 to 350 nm. Two samples were tested from each roll of adhesive tape.

FT-IR—Infrared spectra were recorded for the backing material and for the adhesive in each sample. A Nicolet Magna-IR 760 spectrometer together with a Nic-Plan FT-IR microscope were used for the analysis. The backing materials were analyzed using the microscope, with a liquid nitrogen cooled MCT (mercury cadmium telluride) detector. Samples were prepared by placing a small piece of the adhesive tape onto a microscope slide. Spectra were recorded using an Attenuated Total Reflectance (ATR) objective with a ZnSe crystal. Spectra were collected using 256 scans over the range of 4000 to 650 cm^{-1}. Three samples were run for each roll of adhesive tape.

The adhesives were analyzed by Diffuse Reflectance IR, using a Spectra Tech Baseline DRIFTS accessory. The adhesive was removed from the backing and dissolved in chloroform. One drop of the solution was added to a bed of powdered KBr in a 3 mm DRIFTS sampling cup. The sample cup was then heated at 100°C for 15 min. Spectra were collected using 128 scans over the range of 4000 to 400 cm^{-1}. Two samples were run for each roll of adhesive tape.

PyGC/MS—A Hewlett-Packard HP5890 GC interfaced to a Jeol JMS DX-303 mass spectrometer was used to record PyGC/MS spectra. Pyrolysis was performed using an SGE Pyrojecter II furnace. The samples were pyrolyzed for 2 min at a constant temperature of 600°C before being swept onto the column (J&W DB-5MS, 30 m by 0.25 mm ID, 0.25 μm) with helium as the carrier gas. The temperature program for the column was 40 minus 290°C @ 5°/min and the sample was ionized using EI at 70 eV. Samples were prepared by folding a small piece of adhesive tape over itself repeatedly to form a sandwich, eight layers thick. This was then bored with a solids injector syringe and the contents of the syringe injected directly into the Pyrojector. Each sample was run in duplicate.

Construction of the Database

The database was compiled using File Maker Pro 3.0 for Windows 95. Spectra from various instruments were imported into a Microsoft Excel 97 spreadsheet and converted into a form compatible with the database software. Photographs of the adhesive tapes were scanned using MGI Photosuite SE software before being imported in JPEG format into the database.

The database was designed to be searchable using a large number of fields, corresponding to all of the analyses carried out on the adhesive tapes as well as general information such as brand name, country of origin, etc. A search may be carried out using any or all fields. The database may be readily updated and expanded as required. The completed database was stored on a writeable compact disc.

Results and Discussion

Results

Physical Examination—Ten of the packaging tapes were colorless. The remaining 21 samples could be sorted into five groups by color, as well as one unique sample. The sticky tapes were either colorless and transparent (21 samples) or frosted (6 samples).

The tapes were examined for distinctive physical features under the stereomicroscope. The results are summarized in Table 2. The packaging tapes that displayed a textured surface pattern were readily distinguishable from each other, while the packaging tapes with striations formed a group. The sticky tapes with striations could be distinguished from each other, as well as from the remaining tapes.

One of the packaging tapes displayed a textured pattern which appeared to be from a manufacturing defect. This pattern was not present on a second roll of the tape which was purchased for comparison purposes. The sample was not listed as textured in the database, but this would have been a strong piece of evidence in comparison casework. Two of the packaging tape samples and one of the sticky tape samples could be uniquely identified by measuring the width of the sample.

The thickness measurement of the tapes was originally conducted on the entire tape—backing plus adhesive. This was found to be impractical for two reasons. First, the adhesive was too soft to accurately measure because the sample deformed when the micrometer was used. Second, the samples were found to be easily contaminated, with strong effects on the thickness measurement. To overcome these problems, the thickness of the plastic backing alone was measured. The greatest variation for any particular tape was 0.003 mm. Two of the packaging tape samples and eight of the sticky tape samples were uniquely identified using this technique.

The average weight per square centimeter of the tape samples ranged from 3.54 to 7.38 mg/cm^2. While there was a large variation in the measured values, this was not an independent measure, being a function of the polymer composition and of the recorded value for tape thickness. For this reason, the weight per square centimeter is of limited value in an analytical scheme.

Sixteen of the sticky tape samples and twelve of the packaging tape samples were fluorescent under ultraviolet light (350 nm). For each of the fluorescent samples, the emission was found to be principally from the adhesive, with little or no fluorescence exhibited by the backing. The intensity of the fluorescence was found to vary between different samples, providing further discrimination.

Two of the packaging tape samples and one of the sticky tape samples were found to be fluorescent under visible light. Each of these samples could be uniquely identified by their response to excitation with visible light at various wavelengths. One of the packaging tapes was fluorescent when illuminated by light with a wavelength of 450 nm, while the other packaging tape and the sticky tape were fluorescent when illuminated at 450, 505, 530, and 555 nm.

Most of the samples exhibited weak birefringence when viewed between crossed polarizing filters. However, three of the packaging tape samples were uniquely identified by the color of their birefringence patterns. These are the three thickest packaging tapes, by a fair margin. However, six of the sticky tapes are as thick, without showing any special birefringence. This shows that birefringence is

TABLE 2—*Visible distinguishing features on adhesive tapes.*

Distinguishing Feature	Packaging Tapes	Sticky Tapes
Textured pattern	3	1
Striations	3	4
Both	5	0
Perforations	0	2
No features	20	20
Total	31	27

not an independent measurement. It is well established that the birefringence pattern depends upon both the thickness and the polymer composition of the sample.

Spectroscopic Examination—The UV-visible spectra of the backing of the tapes could be divided into six groups. One of the packaging tape samples was uniquely identified by its ultraviolet spectrum. In addition, it was not possible to obtain a UV-visible spectrum for seven of the sticky tape samples. The absorbance was off-scale at all wavelengths for these samples, which therefore comprised a seventh group.

The polymer forming the backing of the adhesive tapes was identified by FT-IR. All of the packaging tape samples were identified as polypropylene. The results for the sticky tape samples are shown in Table 3. In addition to the three main polymers, one sticky tape sample produced a unique spectrum containing polypropylene plus acrylate ester peaks. The backing from one of the sticky tape samples was unable to be identified.

There were two main types of polymer identified by FT-IR in the adhesive of the tape samples. These were acrylic-based adhesives and block copolymer-based adhesives. Each class of adhesive was able to be subdivided into smaller groups due to minor differences in the infrared spectra. These results are summarized in Table 4. The subdivisions within the acrylic-based adhesives are due to various acrylic and vinyl copolymers being incorporated into the basic acrylate polymer. These may be identified by FT-IR (9). Acrylic subgroups A and C were methylacrylate polymers, while acrylic subgroup B contained vinyl acetate as a significant component (Fig. 1). The block copolymers all contained styrene, but the copolymer varied (Fig. 2). Three of the packaging tapes and one of the sticky tapes could be uniquely identified by the infrared spectrum of their adhesive.

A group of six brown packaging tape samples which were indistinguishable by FT-IR were analyzed and compared by Pyrolysis GC/MS (PyGC/MS). For each sample, the duplicate runs produced the same component peaks. However, there was some variation in the ratios of certain components. The six packaging tapes were subdivided into one group of four samples and one group of two samples (Figs. 3 and 4). There was an additional peak present in the pyrogram of the second group which was identified as 2-propenoic acid.

TABLE 3—*Polymer type of sticky tapes (backing).*

Polymer Type	No. of Tapes
Polypropylene	18
Cellulose Acetate	5
Cellophane	2
Polyprop + Acrylate	1
Unidentified	1
Total	27

TABLE 4—*Polymer type of adhesive tapes (adhesive).*

Polymer Type	Packaging Tapes	Sticky Tapes
Block Copolymer Group A	5	4
Block Copolymer Group B	2	3
Block Copolymer Group C	3	0
Block Copolymer Group D	1	0
Block Copolymer Group E	2	1
Block Copolymer Group F	1	0
Acrylic Group A	16	9
Acrylic Group B	0	4
Acrylic Group C	1	6
Total	31	27

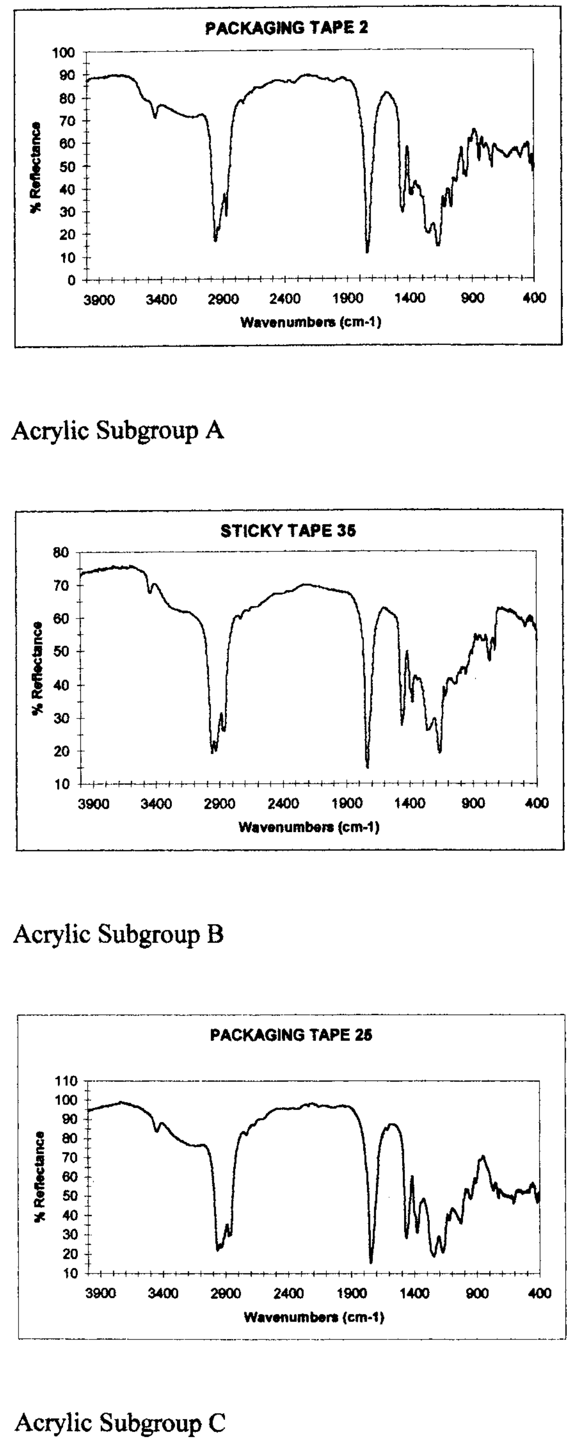

FIG. 1—*FT-IR spectra of acrylic adhesive subgroups.*

Discussion

The initial optical examination was found to be an effective method for discriminating adhesive tapes. Both the color and

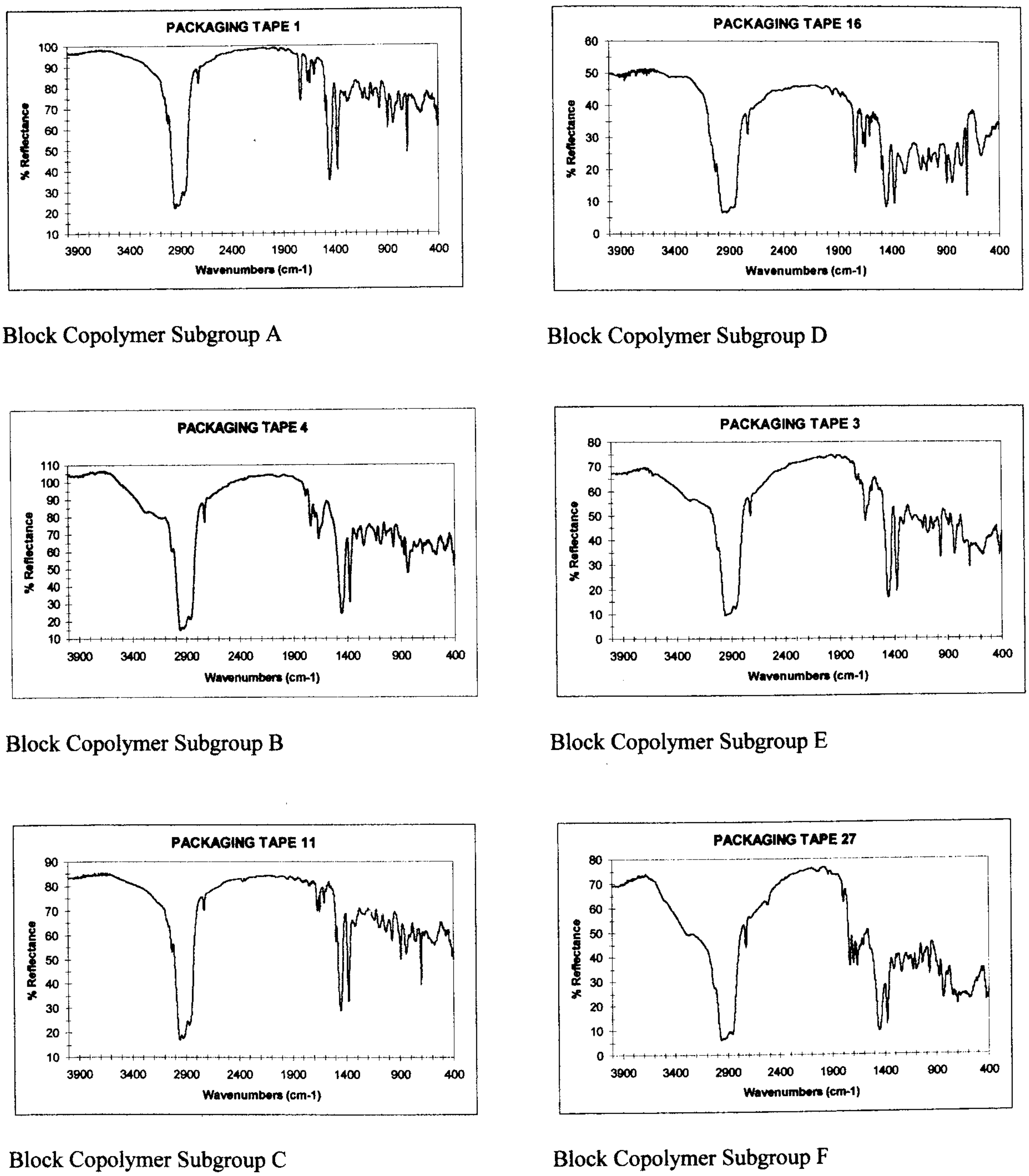

FIG. 2—*FT-IR spectra of block copolymer adhesive subgroups.*

the presence or absence of surface textures were helpful in comparative examinations. These features may be less useful for identification against the database, as the reproducibility between different samples of the same brand was not investigated in this work.

Measurement of the width was a highly discriminatory technique for adhesive tapes. This was particularly so for packaging tapes, where the sample range was from 24 to 50 mm in width. However, it should be noted that many brands of packaging tape are sold in more than one width, usually 24, 36, and 48 mm. This must be taken into account when an analysis is carried out for identification purposes, but does not affect the value of this simple measurement for comparison analysis. Measurement of the thickness of the tape backing was also found to be discriminatory, but this is destructive of the sample as the adhesive must be removed from the backing. However, the removed adhesive may be utilized in the FT-IR analysis. The measurement should therefore be taken toward the end of an analysis sequence. Measurement of the total thickness of an adhesive tape was found to be impractical, due to contamination on the adhesive in case samples and the difficulty in obtaining an accurate value.

The fluorescence of the adhesive tapes under ultraviolet light was a simple and rapid technique providing a good level of discrimination. This technique discriminated 59% of the packaging tape samples and 76% of sticky tape samples, taking intensity into account.

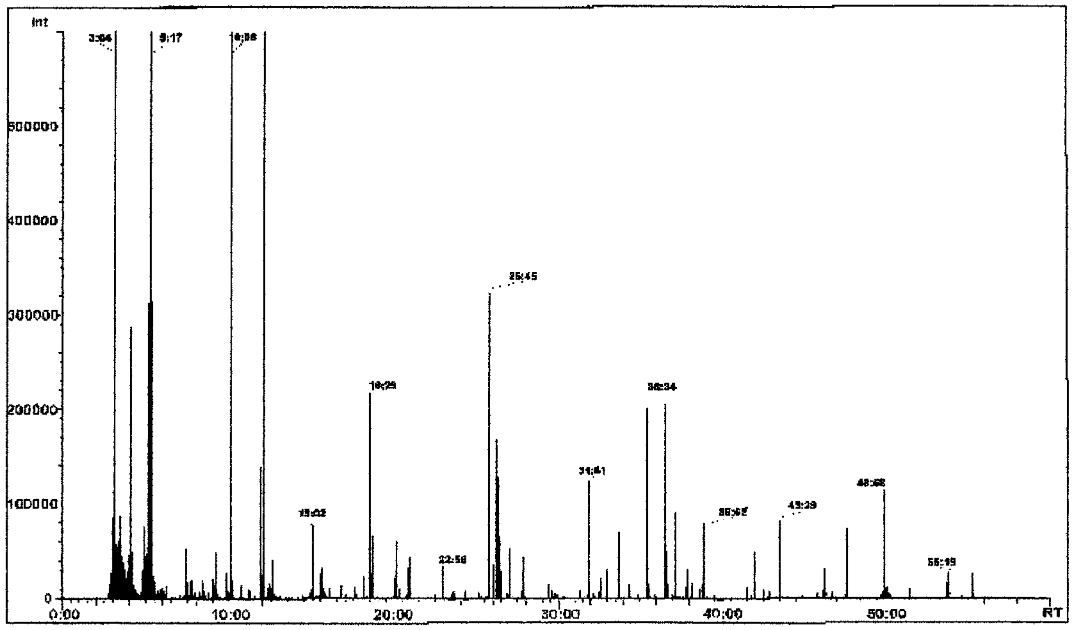

FIG. 3—*Pyrogram of packaging tape—first group.*

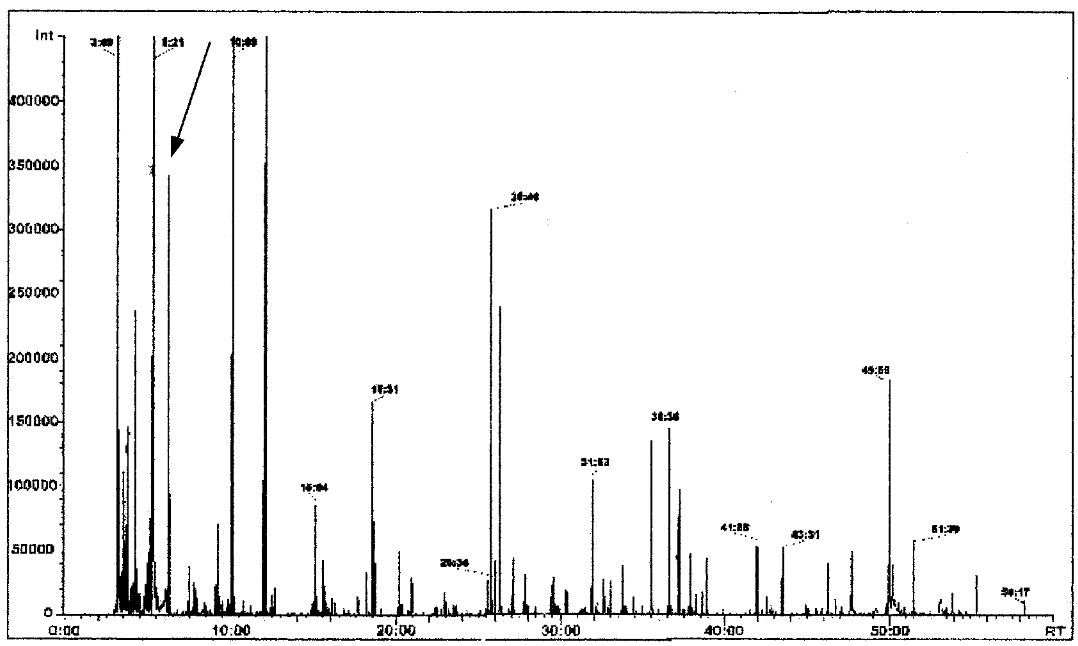

FIG. 4—*Pyrogram of packaging tape—second group (extra peak arrowed).*

The results indicate that fluorescence is brand related rather than being due to the type of adhesive. This is in agreement with an earlier study (3). One exception to the trend was noted. This sticky tape sample was a Scotch tape, yet unlike the other Scotch tape samples it was not fluorescent. It was noted that this was the only Scotch tape sample manufactured in Taiwan rather than the USA.

Although the UV fluorescence of the adhesive tapes was brand related, various intensities were observed within brands for different products. This makes the technique highly discriminatory for comparison purposes. However, variation in intensity within a brand was not recorded on the database due to the subjective nature of the measurement.

The overwhelming majority of the samples showed no fluorescence at longer excitation wavelengths. However, if an unknown adhesive tape does exhibit fluorescence at visible excitation frequencies, this would be a powerful, nondestructive discriminating technique. The samples should therefore be examined at these frequencies. The use of crossed polarizing filters to view birefringence in adhesive tapes falls into a similar category of analysis, with only three packaging tape samples showing distinctive birefringence.

Microspectrophotometry of the packaging tape samples was found to offer the same level of discrimination as visual assessment of color. For comparison analysis, MSP is of only limited value in discriminating packaging tape samples. However, it does provide an objective measure of the color of samples and therefore supports the identification of an unknown sample in a database search.

Ultraviolet spectrophotometric analysis of the backing from the adhesive tape samples was found to be a useful technique for comparison and for the database. This technique discriminated 68% of the packaging tape samples and 73% of the sticky tape samples. UV-visible analysis is dependent upon the type of material as well as the thickness of the sample. The similar spectra exhibited by two of the samples may be explained on the basis that they were the only two samples containing a cellophane backing. No useable spectra were obtained from the thicker frosted tapes, made from cellulose acetate. Failure to obtain a UV spectrum for an unknown sample is in itself useful information.

FT-IR analysis of the backing of the adhesive tapes was found to be a simple technique to determine the base polymer from which the backing was manufactured. For the sticky tape samples, three different base polymers were identified and 53% of the samples were discriminated. For the packaging tapes, only one polymer—polypropylene—was identified in all cases. However, the backing of packaging tapes should still be analyzed by FT-IR, as samples not examined in this work may possess different base polymers. Any variation from an expected result would be significant in comparison work.

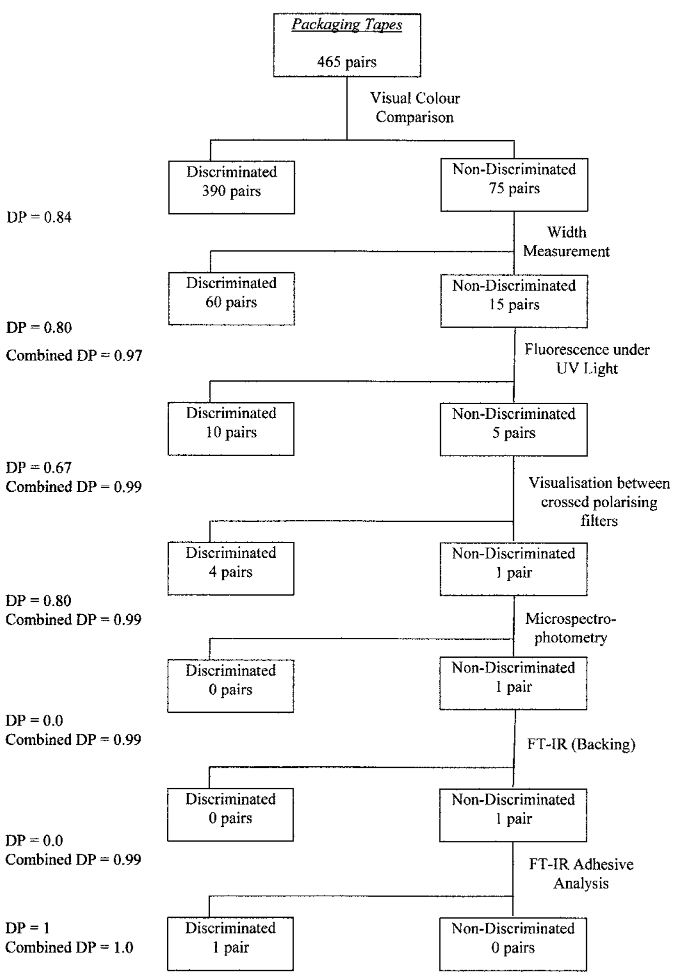

FIG. 5—*DP at each step in the sequence for packaging tape samples.*

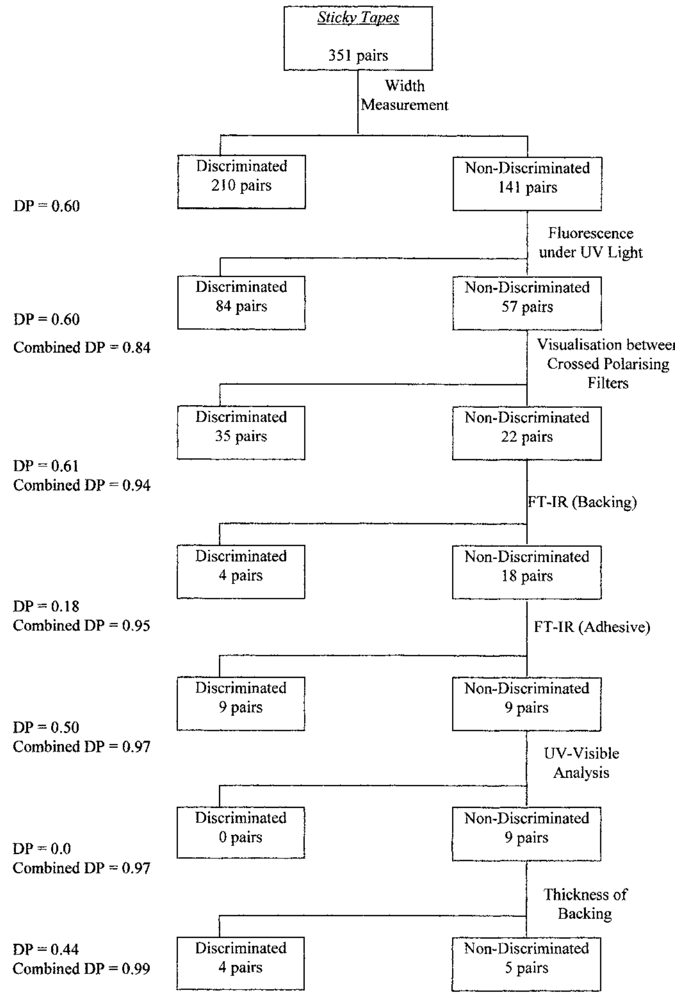

FIG. 6—*DP at each step in the sequence for sticky tape samples.*

FT-IR analysis of the adhesive was an effective technique for discriminating samples. There were a variety of base polymers used in the adhesive and a wide variation within each class. This allowed 77% of the packaging tape samples and 82% of the sticky tape samples to be discriminated. The type of adhesive was found to be somewhat dependent upon the polymer material used in the backing. For example, all of the samples containing a cellulose acetate backing had an acrylic adhesive, while those with a cellophane backing possessed a styrene/hydrocarbon block copolymer adhesive. However, no trend was observed for those samples with polypropylene as their backing material.

The results for PyGC/MS indicate that this technique is more discriminatory than FT-IR for the analysis of adhesive tapes. The six samples examined by PyGC/MS were indistinguishable by FT-IR, but were resolved into two groups, containing two and four samples respectively. However, this additional discrimination by PyGC/MS was only a small improvement on FT-IR, and the technique is both destructive of the sample and time consuming. Therefore, PyGC/MS should be applied as the last step in the sequence of analysis of adhesive tapes. The overall results indicate that for the particular samples examined, a sequence of techniques may be employed to give a very high level of discrimination and thus identification. The cumulative discriminating power of each technique in the analysis sequence is shown for packaging tapes in Fig. 5 and for sticky tapes in Fig. 6. For the packaging tapes (31 samples, providing 465 pairs of samples to compare) the simple physical tests discriminated 97% of the sample pairs. The remainder were discriminated by fluorescence, birefringence, and spectroscopic techniques. For the sticky tapes (27 samples, providing 351 pairs of samples to compare) 60% of the sample pairs were discriminated by the width measurement. The cumulative discrimination after spectroscopic techniques were applied was over 99%. This high level of discrimination provides information on the significance of a failure-to-discriminate in comparative casework.

Caution must still be exercised in applying the database to casework. One pair of sticky tape samples in the survey could not be discriminated by any of the techniques used in this work. However, after consulting with the manufacturers it was determined that these two samples were in fact the same product being sold under different brand names. It is possible that one manufacturing company may sell their product to another to market as a different brand. New companies may enter the market while others drop out. It is also possible that a company may change their supplier or formulation due to cost, availability, or reliability factors. In this situation, the chemical composition of the adhesive tape may be altered while the brand name will remain the same. In other instances, machinery may be upgraded and machining marks due to the manufacturing process may be altered. It is therefore important that the database be frequently updated and expanded to accommodate developments in the market place.

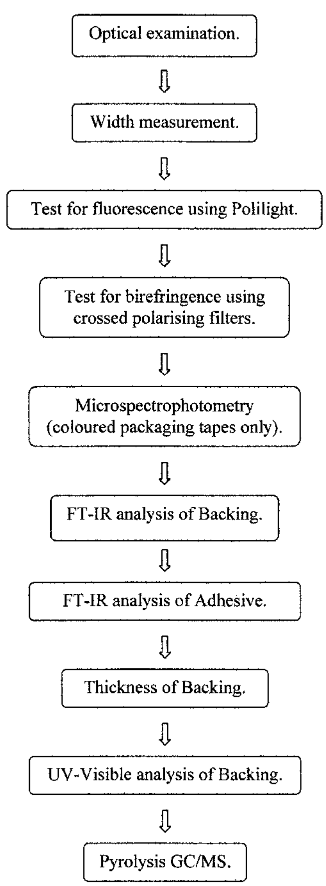

FIG. 7—*Recommended sequence of analysis for adhesive tapes.*

Recommended Sequence of Analysis

If possible, the adhesive tape should be transported to the laboratory along with its support. If removal from the support is necessary, the adhesive tape should be placed onto an overhead sheet. Once submitted to the laboratory, an examination for a physical match should be made in comparative casework (e.g., physical fit between a tape section and the remainder of the roll). Failing that, the sequence of analysis (Fig. 5) should be followed until the two samples are discriminated in a comparison analysis, or the adhesive tape is identified in the database in an identification case. The order of analysis detailed here progresses from nondestructive tests to semidestructive and destructive techniques. This sequence can be used for both packaging tapes and sticky tapes.

Conclusions

In this study, the probative value of each analytical technique for adhesive tape analysis has been determined. Although the analytical techniques utilized were established methods, their absolute and relative evidential value for this application had not been studied previously in Australia. Each technique was evaluated for its discriminating power, both for comparative purposes and for identification of adhesive tapes by comparing unknown samples with the database constructed through this work.

The combined discriminating power of the techniques listed in the recommended analysis scheme is very high. It is possible to uniquely identify the manufacturing source or distributor of an unknown adhesive tape sample in many instances by searching the database. It is also possible to form an opinion on the significance of a failure-to-discriminate result in comparative casework. The database is therefore useable in its present form and is available to interested parties through the website of the National Institute of Forensic Science (http://nifs.com.au/). However, further work is still needed to expand and update the database, as well as compiling data on the relative market share of various products.

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