

ATR-FTIR characterization of old pressure sensitive adhesive tapes in historic papers

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ABSTRACT

In this study, several deteriorated pressure sensitive adhesive tapes (PSATs) applied in the past for repairing ripped paper documents of 19th century and books of 20th century were analyzed by attenuated total reflectance-Fourier transform infrared (ATR-FTIR) spectroscopy technique. The comparison of FTIR spectra of the old tapes with those of some commercially available tapes subjected to accelerated aging allowed us to identify, in a fast and nondestructive way, the main classes of old tapes on the basis of their backing (cellophane, cellulose acetate, polyvinyl chloride and polypropylene) and adhesive (natural rubber, synthetic rubber and acrylic polymer) compositions. This procedure's results were very useful to the paper restorers and conservators, who will have the possibility of choosing the most appropriate conservation treatment for the removal of pressure sensitive adhesive tapes that can be found on many paper documents.

1. Introduction and research aims

Pressure sensitive adhesive tapes (PSATs) have been too often utilized in the past for repairing ripped paper books and documents, resulting in disfigured and damaged books; PSATs were also difficult to remove [1,2]. Generally, a pressure sensitive tape consists of a carrier or backing material on which a pressure sensitive adhesive is applied. Backing materials may include paper, tissue and plastic polymers, such as cellophane, cellulose acetate, polyvinyl chloride and polypropylene. Apart from polymers, the plastic backings may also contain plasticizers, stabilizers, inorganic materials, coatings, etc. As regard the adhesive component, there are a number of adhesives that can be used in the manufacture of the PSATs, such as natural rubber, synthetic rubber and acrylic polymers [3–5].

Restorers and conservators suggest that the tapes most frequently encountered on archival materials, books and artworks on paper are office tapes and packaging tapes that possess plastic backings and rubber-based or acrylic adhesives [1,2].

One of the main problems in paper restoration is the identification of PSATs after years of natural aging in order to select the most suitable tape-removal methods. To this end, the specific literature deals mainly with physical/chemical analyses and trial-and-error procedures, or focuses on specific adhesives with known composition [6–8].

To bypass these difficulties, a research project has been undertaken in our Institutes for exploiting the attenuated total reflectance-Fourier transform infrared spectroscopy (ATR-FTIR) as a noninvasive diagnostic technique.

The first step of the project was to carry out ATR-FTIR analysis of some widely utilized commercially available tapes in order to characterize both backing and adhesive chemical composition. The second step was to perform the infrared analysis of the same samples after accelerated aging in order to induce any chemical change detectable by FTIR, useful for the characterization of old deteriorated pressure sensitive adhesive tapes selected in this work.

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Table 1
Commercially available pressure sensitive adhesive tapes selected for ATR-FTIR analysis.

Tape label	Type	Commercial name	Manufacturer	Supplier chemical information
C	Office tape	Comet® cellophane	TESA	Backing: cellophane Adhesive: not available
CA-A	Office tape	Scotch® n° 810 Magic® Tape	3M	Backing: cellulose acetate Adhesive: acrylic
Pvc-NR	Packaging tape	Tesa® 4100	TESA	Backing: polyvinylchloride Adhesive: natural rubber
PP-SR	Packaging tape	Tesa® 4280	TESA	Backing: polypropylene Adhesive: synthetic rubber
PP-A	Office tape	Scotch® Tape 508	3M	Backing: polypropylene Adhesive: acrylic

For this purpose, different accelerated aging test has been performed, such as thermal degradation at high temperature for different periods, sunlight exposure (through a window glass) and moist heat in climatic chamber.

Artificial aging in standardized moist conditions (ISO 5630/3, 80 °C, 65% RH) for 3 months did not bring about significant changes of spectra. Sunlight exposure showed significant variations after 4 months while 12–168 h at 120 °C in dry oven already yielded spectra similar to those of the old adhesive tapes. For this reason, we selected the latter aging technique for comparing some commercially available tapes with old tapes.

By considering the state of degradation, several old PSATs recovered from printed books of 20th century and some archival documents of 19th century were chosen for the experiment.

The final aim of the research is to provide a fast and noninvasive method for the identification of the main components of the pressure sensitive adhesive tapes most frequently found on archival documents and books. The FTIR analyses bring about more accurate information that was obtained by visual inspection only, and useful for paper restorers and conservators, for tape removal.

2. Experimental

2.1. Materials and methods

The PSATs selected in this work included five commercial adhesive tapes with known composition (see Table 1) purchased from

local shops and supermarket and 20 naturally aged tapes (labeled T1–T20) recovered from cadastral maps of 19th century (coming from the Trieste cadastral system archive – *Ufficio del catasto tavolare di Trieste*) and from old printed books of 20th century, as listed in Table 2.

Most of the selected old tapes found on paper documents were brittle, hard and highly discolored (Fig. 1). In many cases (T1–T20 samples), the PSATs were already partially detached from the paper sheet allowing the ATR-FTIR analysis of both the adhesive and backing sides directly on the paper document or on a fragment of tape that was easy to remove. Sometimes, the backing of the tape was completely detached from the sheet and it was no longer present, while the yellowish-brown adhesive penetrated into the paper. In these cases, it was possible to analyze only the adhesive residue still present on the paper surface. Despite the strong yellowing, the FTIR analysis of these areas did not provide significant information (data not shown) probably because the concentration of the adhesive residue was below the detection limit of the instrument.

2.2. Instrumentation

2.2.1. FT-IR spectrometry

A Perkin-Elmer Spectrum 100 FTIR, equipped with the Universal ATR Sampling Accessory (ZnSe cell), was used to obtain 4 cm⁻¹ resolution spectra in the 550–4000 cm⁻¹ region, averaging 8 scans. The ATR device allowed us to analyze both adhesive and backing

Table 2
Old pressure sensitive adhesive tapes recovered from archival documents and books and selected for ATR-FTIR characterization.

Tape label	Appearance of tapes	Paper material provenance (year of publishing or manufacture)
T1	Soft, slightly yellowed	Coated dust jacket (1960)
T2	Soft, slightly yellowed	Coated dust jacket (1979)
T3	Hard, brittle, and highly discolored	Soft cover Book (1928)
T4	Hard, brittle, and highly discolored	Book paper (1950)
T5	Hard, brittle, and highly discolored	Cadastral map (unknown date)
T6	Hard, brittle, and highly discolored	Cadastral map (1864)
T7	Hard, brittle, and highly discolored	Cadastral map (unknown date)
T8	Hard, brittle, and highly discolored	Cadastral map (unknown date)
T9	Hard, brittle, and highly discolored	Cadastral map (1832)
T10	Hard, brittle, and highly discolored	Cadastral map (1882)
T11	Hard, brittle, and highly discolored	Archival document paper (1893)
T12	Hard, brittle, and highly discolored	Book paper (1960)
T13	Hard, brittle, and highly discolored	Book paper (1969)
T14	Soft, clear and colorless	Book paper (1960)
T15	Soft, clear and colorless	Cadastral map (unknown date)
T16	Soft, clear and colorless	Cadastral map (1821)
T17	Soft, clear and colorless	Cadastral map (1887)
T18	Soft, clear and colorless	Book paper (1961)
T19	Hard, brittle, and highly discolored	Book paper (unknown date)
T20	Soft, slightly yellowed	Coated dust jacket (1960)

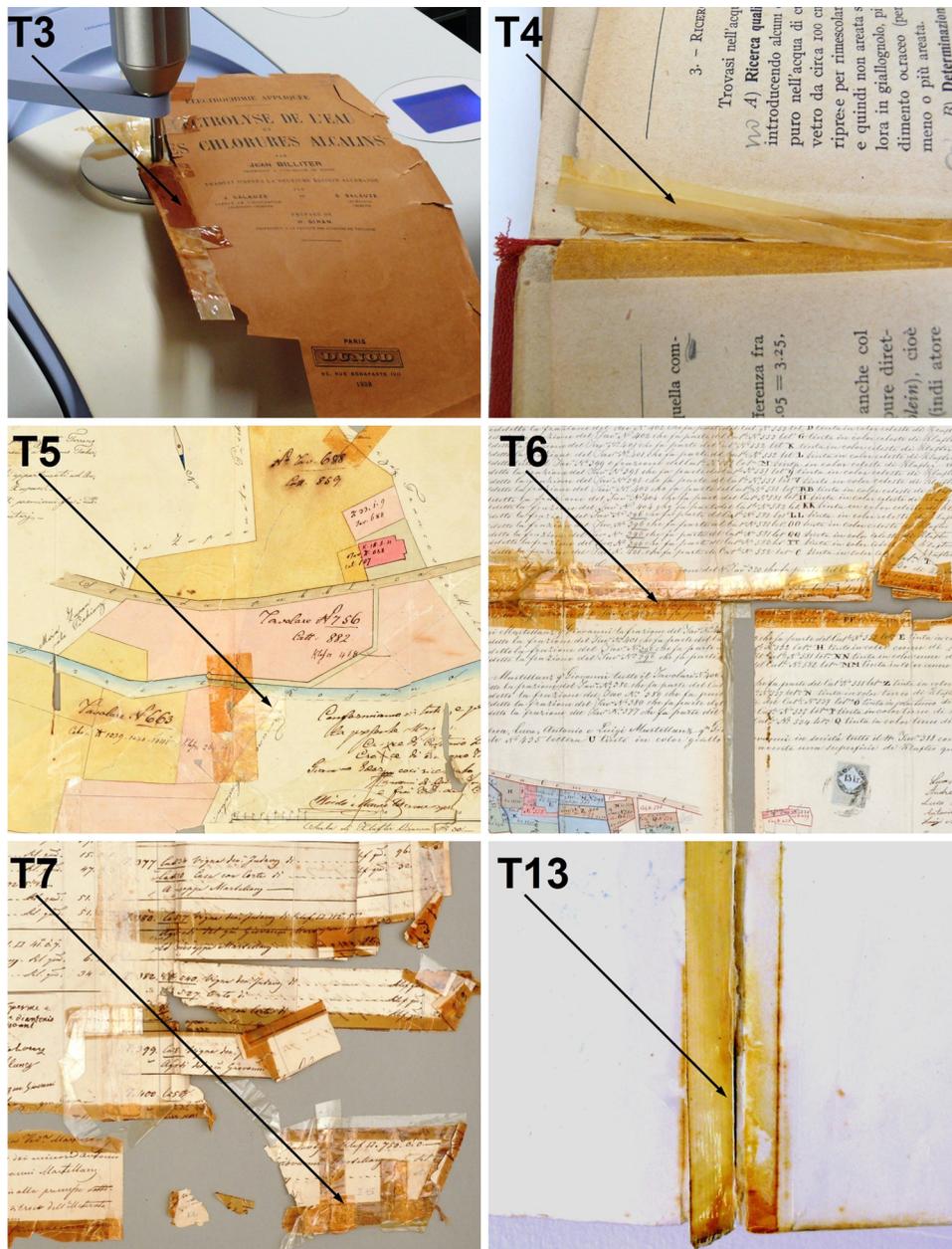


Fig. 1. Some of the cadastral maps of 19th century and paper book papers of 20th century with different pressure sensitive adhesive tapes (T3–T7 and T13) selected for this study.

sides of tapes at room temperature and humidity, without any destructive or microdestructive technique of sampling.

The tapes were set down on the surface of the sample holder and were subjected to some pressure in order to assure the contact with the diamond beam window. To permit convenient comparisons, the spectra were normalized assigning the value 1 to one or another peak, depending on the type of backing or adhesive analyzed.

The commercially available pressure sensitive adhesive tapes were analyzed and compared to the spectra of a spectral library built in recent years by recording FTIR spectra of standard materials. The ATR-FTIR spectra of commercial tapes, before and after artificial aging, are then used as references for the identification of naturally aged tapes.

2.2.2. Accelerated aging

As depicted in Section 1, accelerated aging was performed with a controlled temperature natural air convection oven, in which

the commercial adhesive tape samples were heated at 120 °C for 12 h (168 h for Pvc-NR tape) in order to better simulate the FTIR profile of old tapes. The aged samples were left at room temperature and humidity for at least 24 h before the ATR-FTIR analysis.

3. Results and discussion

3.1. ATR-FTIR analysis of backing side of PSATs

The comparison of ATR-FTIR spectra of both naturally and artificially aged backing of the tapes with those of reference standard polymers did not show significant changes allowing an easy characterization of the main polymeric substrate, which forms the plastic film, such as cellophane, cellulose acetate, polyvinylchloride and polypropylene.

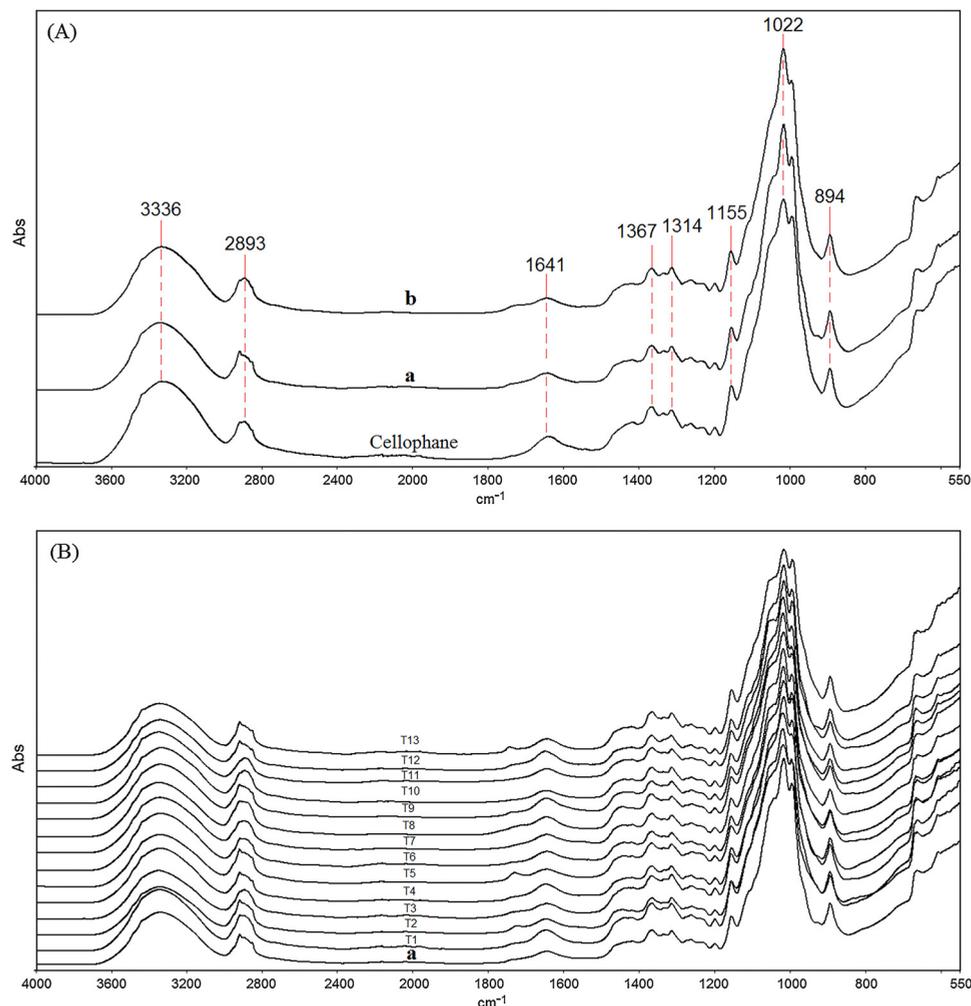


Fig. 2. (A) ATR-FTIR spectra of cellophane, backing side of unaged (a) and artificially aged (b) reference tape C. (B) ATR-FTIR spectrum of backing side of unaged reference tape C (a) compared with those of backing of naturally aged tapes T1–T13.

3.1.1. Cellophane-based backing tapes

The ATR-FTIR spectra of backing of both unaged and aged commercially available tape C show (Fig. 2A) bands corresponding to cellophane standard collected in our database and in agreement with literature data [9,10]. Cellophane is made from regenerated cellulose and has the same chemical structure of cellulose [11]. Therefore, the major FTIR bands assignments of cellophane are similar to those of cellulose polymer: a broad peak at 3336 cm^{-1} (stretching of OH groups), a signal at 2893 cm^{-1} (assigned to CH stretching), a band at 1641 cm^{-1} (absorbed water), a peak at 1367 cm^{-1} (attributed to OH bending), a signal at 1314 cm^{-1} (assigned to CH_2 wagging), a band at 1155 cm^{-1} (due to C–O antisymmetric bridge stretching and C–O–C pyranose ring skeletal vibration); a strong band at 1022 cm^{-1} (attributed to the characteristic C–O–C stretching) and a small band at 894 cm^{-1} (corresponding to the glycosidic C1–H deformation with ring vibration contribution and O–H bending) [12].

The backings of naturally aged tapes T1–T13 show the ATR-FTIR spectra and absorption bands (Fig. 2B) that are consistent with the spectrum of the backing of reference tape C. The FTIR profiles do not change with aging and the main difference is due to adsorbed water (broad band at $\sim 1640\text{ cm}^{-1}$) and to weak oxidation signals, as shoulders, at about $1730\text{--}1740\text{ cm}^{-1}$ (see also [Supplementary material, Table S1](#)).

3.1.2. Cellulose acetate-based backing tapes

The ATR-FTIR analysis of backing of unaged commercially available tape CA-A confirms that the polymer used for its manufacture is principally cellulose acetate characterized by a weak and broad band at 3475 cm^{-1} (due to O–H stretching), a doublet at 2920 and 2851 cm^{-1} (stretching of CH_2 groups), a characteristic peak at 1735 cm^{-1} (assigned to C=O stretching of ester group), a band at 1367 cm^{-1} (due to CH_3 of methyl group), a strong absorption band at 1216 cm^{-1} (attributed to C–O stretching of acetyl group), a strong broad band at 1031 cm^{-1} (C–O–C stretching of pyranose ring) and a weak peak at 900 cm^{-1} (probably due to C1–H stretching deformation), in accordance with the spectrum of cellulose acetate (Fig. 3A) and with literature data [13–15].

Artificially aged commercial samples do not show significant variations, but the disappearance of the band at about 750 cm^{-1} is possibly due to a plasticizer additive.

Infrared spectra of backings of colorless, naturally aged tapes T14–T17 are very similar to the spectrum of the backing side of unaged reference tape CA-A (Fig. 3B); thus, they are constituted by cellulose acetate (see also [Supplementary material, Table S2](#)). The band at about 750 cm^{-1} remains, suggesting that these colorless tapes have been applied recently.

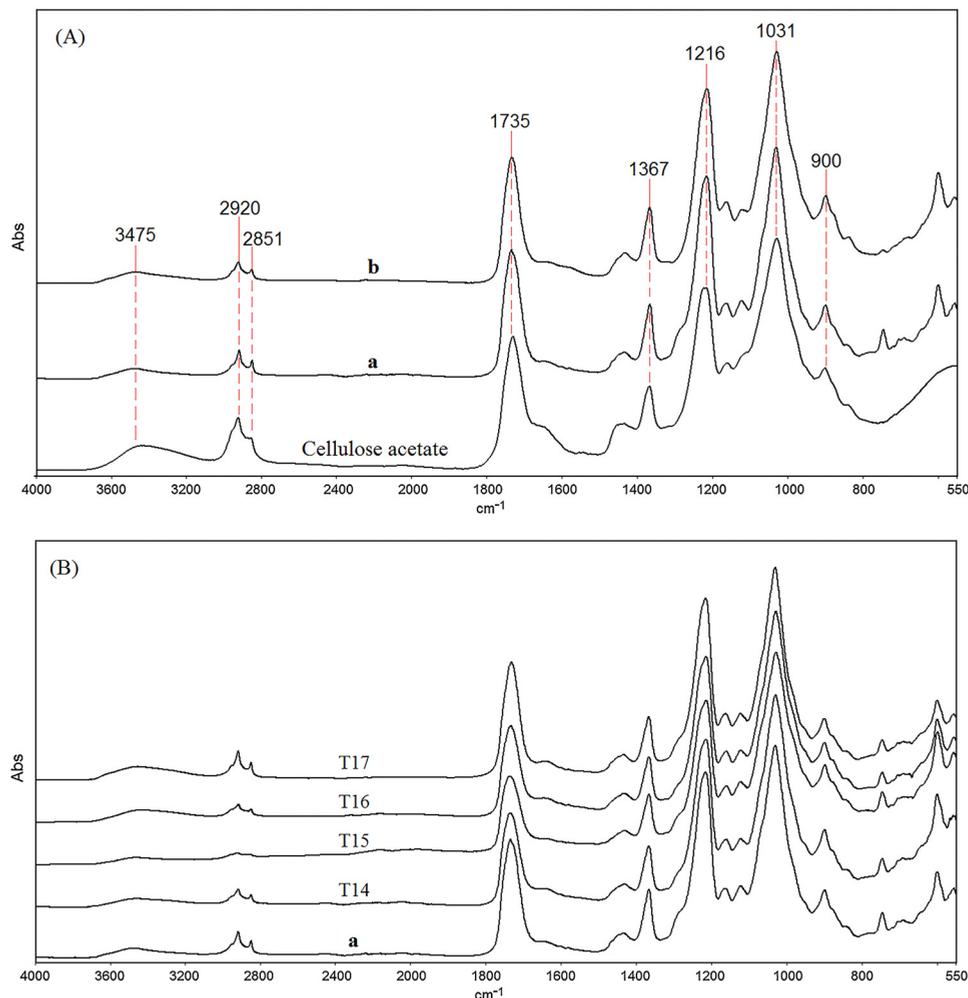


Fig. 3. (A) ATR-FTIR spectra of cellulose acetate, backing side of unaged (a) and artificially aged (b) reference tape CA-A. (B) ATR-FTIR spectrum of backing side of unaged reference tape CA-A (a) compared with those of backing of naturally aged tapes T14–T17.

3.1.3. Polyvinylchloride-based backing tapes

The ATR-FTIR spectra of both unaged and artificially aged backing of tape Pvc-NR (Fig. 4A) clearly show a close correspondence with the spectrum of the polyvinylchloride. The characteristic absorption bands assigned to the C-Cl stretching vibration are observed in the region between 700 and 600 cm^{-1} in particular at 683 and 611 cm^{-1} . In addition to these signals, the major features are two peaks at 2918 and 2850 cm^{-1} (assigned to CH_2 stretching), a doublet at 1425 and 1432 cm^{-1} (due to CH_2 bending), two peaks at 1329 and 1253 cm^{-1} (assigned to CH bending of CHCl group) and a band at 963 cm^{-1} (attributed to CH_2 rocking) [16]. The peak at 1735 cm^{-1} observed in unaged Pvc-NR spectra is probably due to the presence of lubricant or plasticizer additive [16,17], while the absorbance increase observed, at the same wave number, after thermal degradation of Pvc-NR tape, is due to the formation of oxidative products.

Although the IR spectra of naturally aged tapes T18 and T19 (Fig. 4B) confirm the presence of polyvinylchloride from the characteristic pattern of the C-Cl stretching vibration band at $\sim 600\text{--}700\text{ cm}^{-1}$, other additional peaks, which may confuse the spectral interpretation, are observed. In particular, the absorption bands at ~ 1650 and $\sim 1550\text{ cm}^{-1}$, typical of amide I and amide II groups, and the peaks (for tape T19 only) at ~ 3690 and 3620 cm^{-1} and at 1115 and 1010 cm^{-1} , characteristic of clay minerals,

escape a clear interpretation (see also [Supplementary material, Table S3](#)).

3.1.4. Polypropylene-based backing tapes

The spectrum of the backing of unaged commercial tape PP-SR shows (Fig. 5) the typical absorption bands of polypropylene [18,19]. The major ATR-FTIR features are as follows: a characteristic quadruplet at 2951 , 2871 cm^{-1} (attributed to C-H stretching of CH_3 groups), 2917 , 2837 cm^{-1} (due to C-H stretching of CH_2 groups) and two absorption peaks at 1455 cm^{-1} (assigned to C-H bending of CH_2) and at 1375 (attributed to C-H bending of CH_3). Other minor peaks are observed at 1165 cm^{-1} (C-C stretching plus C-H rocking of CH_3), at 996 cm^{-1} (C-H rocking of CH_3 group), at 972 cm^{-1} (C-C stretching plus CH_3 rocking) and at 840 cm^{-1} (C-H rocking of CH_2 group) in accordance with the reference spectrum of polypropylene. Accelerated aging did not change substantially the FTIR spectrum of the backing tape PP-SR and only a weak increase of oxidation bands in the $1770\text{--}1600\text{ cm}^{-1}$ region was observed after artificial aging. The infrared spectrum corresponding to the backing side of naturally aged tape T20 is very similar to the spectrum of reference backing of unaged tape PP-SR (Fig. 5); thus, it is easy to identify polypropylene as the base material (see also [Supplementary material, Table S4](#)).

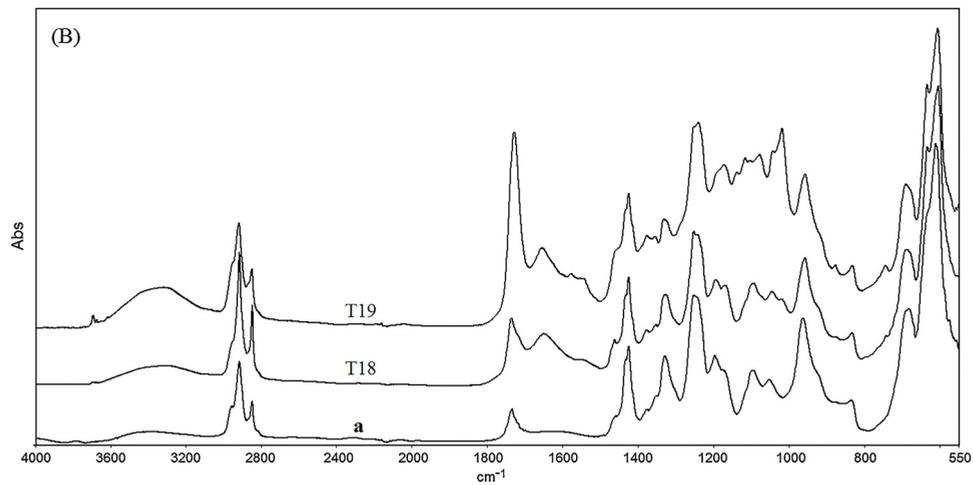
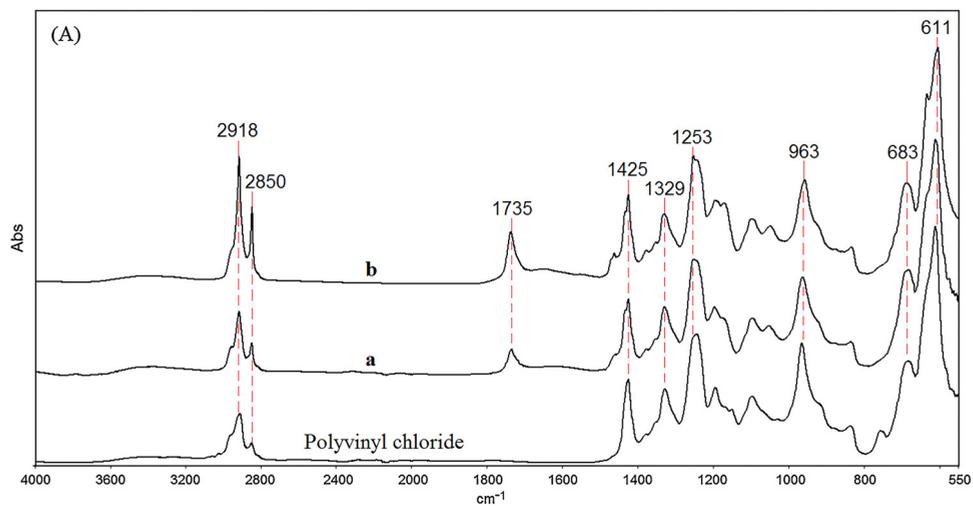


Fig. 4. (A) ATR-FTIR spectra of polyvinyl chloride, backing side of unaged (a) and artificially aged (b) reference tape Pvc-NR. (B) ATR-FTIR spectrum of backing side of unaged tape Pvc-NR (a) compared with those of backing of naturally aged tapes T18 and T19.

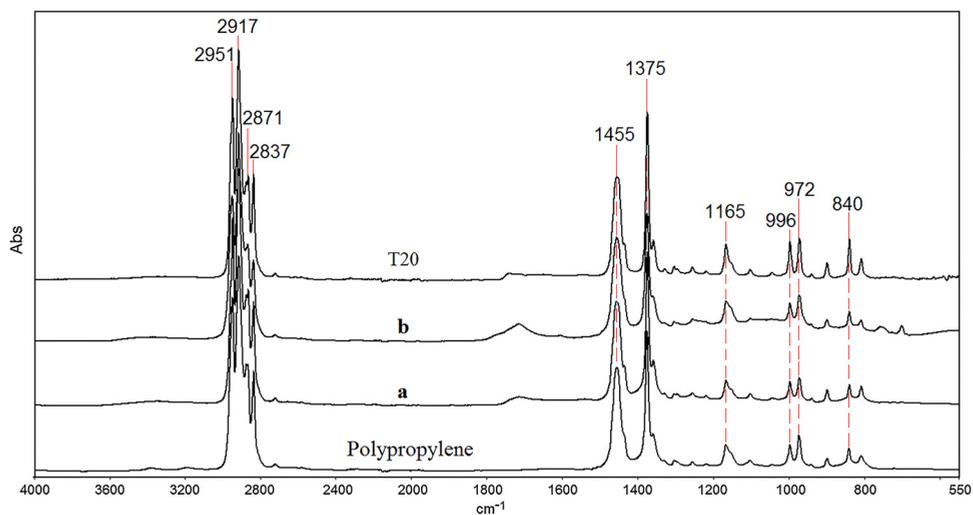


Fig. 5. FTIR spectra of polypropylene, backing side of unaged (a) and aged (b) reference tape PP-SR compared with that of backing side of naturally aged tape T20.

3.2.1. Rubber-based adhesives tapes

3.2.1.1. *Unaged rubber-based commercial adhesives.* The infrared spectrum of adhesive side of unaged Pvc-NR tape shows (Fig. 6A) the characteristic peaks of natural rubber in accordance with the spectrum of standard natural rubber (cis-polyisoprene) and with supplier information. The assignments of main absorption peaks for unaged Pvc-NR adhesive are observed at 3036 cm^{-1} (due to =C-H stretching group), at 2958 cm^{-1} (attributed to CH_3 stretching) and at 2924 and 2854 cm^{-1} assigned to CH_2 and CH_3 stretching, respectively. The absorption at 1663 is assigned to C=C stretching while peaks at 1449 and 1375 cm^{-1} are due to C-H deformation of CH_2 and CH_3 groups, respectively. The feature at 842 cm^{-1} is due to =C-H wagging while the absorption band at 744 cm^{-1} is attributed to CH_2 rocking [20,21].

Fig. 6B shows the infrared spectra of adhesive side of both unaged C and PP-SR tapes compared with the reference spectrum of synthetic rubber (styrene-isoprene copolymer). According to bibliography, there are some diagnostic bands that can be used in order to identify the aromatic components of synthetic rubber [22]. In addition to the normal aliphatic absorptions at 2956 , 2923 , 2854 ,

1451 and 1376 cm^{-1} , the spectra of both C and PP-SR adhesive tapes contain the characteristic bands of ring vibration at 1600 and 1492 cm^{-1} and the bending of aromatic =C-H and C=C groups of polystyrene at 750 and 699 cm^{-1} , respectively.

Moreover, the FTIR spectrum of adhesive of unaged tape C shows (Fig. 6B) an additional peak at 1735 cm^{-1} generally attributed to the stretching vibration of C=O of carbonyl group. This FTIR feature may be due to the presence of one or more additives used in the preparation of the adhesive, such as tackifier resins, antioxidants or cross-linking agents [23,24].

3.2.1.2. *Artificially aged rubber-based commercial adhesives.* The FTIR spectra of artificially aged rubber-based adhesives of commercial tapes Pvc-NR, PP-SR change drastically. In Fig. 7, it is evident that the major features that appear after artificial aging are observed as a broad peak at $\sim 3450\text{ cm}^{-1}$ (attributed to the OH group of the moisture absorbed by the more polar degraded rubber), a strong absorption band at $\sim 1715\text{ cm}^{-1}$ (due to the presence of carbonyl groups C=O formed in the rubber chain) and a strong increase of absorbance in the fingerprints region with maximum absorption between 1100 and 1000 cm^{-1} assigned to C-O-C ether group [25–27]. Moreover, observing the spectra of artificially

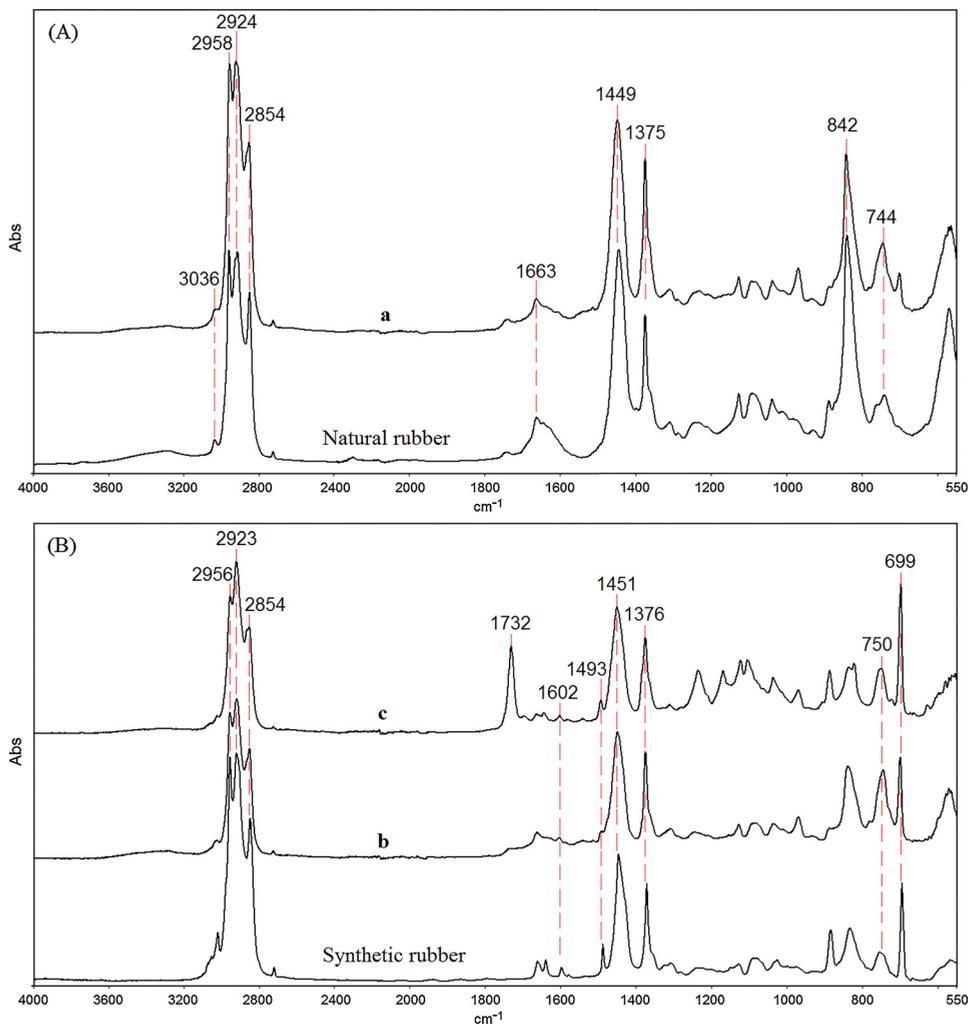


Fig. 6. (A) ATR-FTIR spectrum of natural rubber (cis-polyisoprene) compared with that of adhesive side of unaged tape Pvc-NR (a). (B) ATR-FTIR spectrum of synthetic rubber (styrene-isoprene copolymer) compared with those of adhesive side of unaged tape PP-SR (b) and tape C (c).

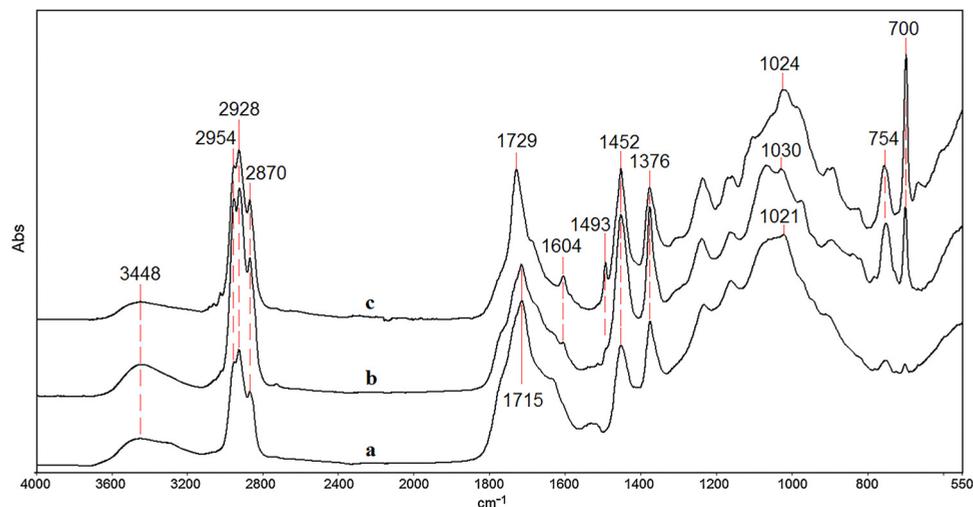


Fig. 7. ATR-FTIR spectra of adhesive side of artificially aged reference tapes Pvc-NR (a), PP-SR (b) and C (c).

aged PP-SR adhesive, there are two diagnostic bands at ~ 700 and $\sim 750\text{ cm}^{-1}$ (assigned to the bending vibrations of aromatic group) that can be used in order to identify the presence of styrenic component of synthetic rubber.

For example, the FTIR spectra of either unaged or artificially aged unknown adhesive side of tape C show these typical bands of synthetic rubber (Figs. 6B, c and 7c, respectively).

3.2.1.3. Naturally aged rubber-based adhesives. The adhesive side of tapes T1–T13 were analyzed and compared with both unaged and artificially aged commercially available tapes, used as reference. The first difficulty was the presence in some cases of overlapped bands of backing polymer because of low concentrations of adhesive still stuck on the old tape. In this instance, the spectral difference between the adhesive side and the backing side of the tape yields the neat spectrum of the adhesive.

Most naturally aged tapes present different FTIR profiles while in some cases no degradation detectable by FTIR analysis has been found. For example, the ATR-FTIR spectra of the adhesive side of slightly yellowed T1 and T2 tapes do not show substantial differences when compared with the reference spectrum of unaged, natural rubber-based Pvc-NR adhesive. Similarly, the absorption bands of the adhesive of slightly yellowed tape T20 mimic those of unaged synthetic rubber-based PP-SR adhesive (Fig. 8 and Supplementary material, Table S5).

These results can be explained by considering the role of the atmospheric oxygen and the light in the degradation process. In fact, all the slightly yellowed tapes T1, T2 and T20, were stuck on the internal side of coated dust jackets that may have protected the adhesives from the oxidation and photodegradation.

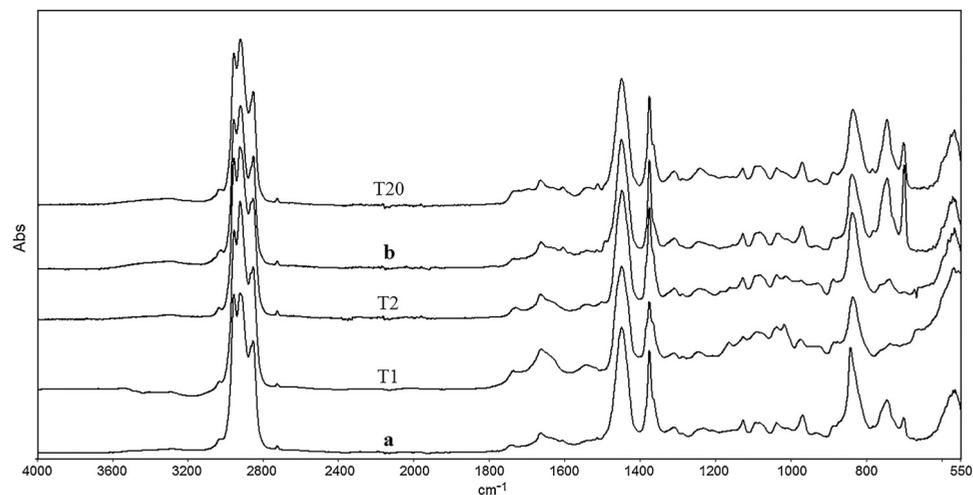


Fig. 8. ATR-FTIR spectra of adhesive side of unaged Pvc-NR (a) and PP-SR (b) reference tapes compared with those of adhesive side of naturally aged tapes T1, T2 and T20.

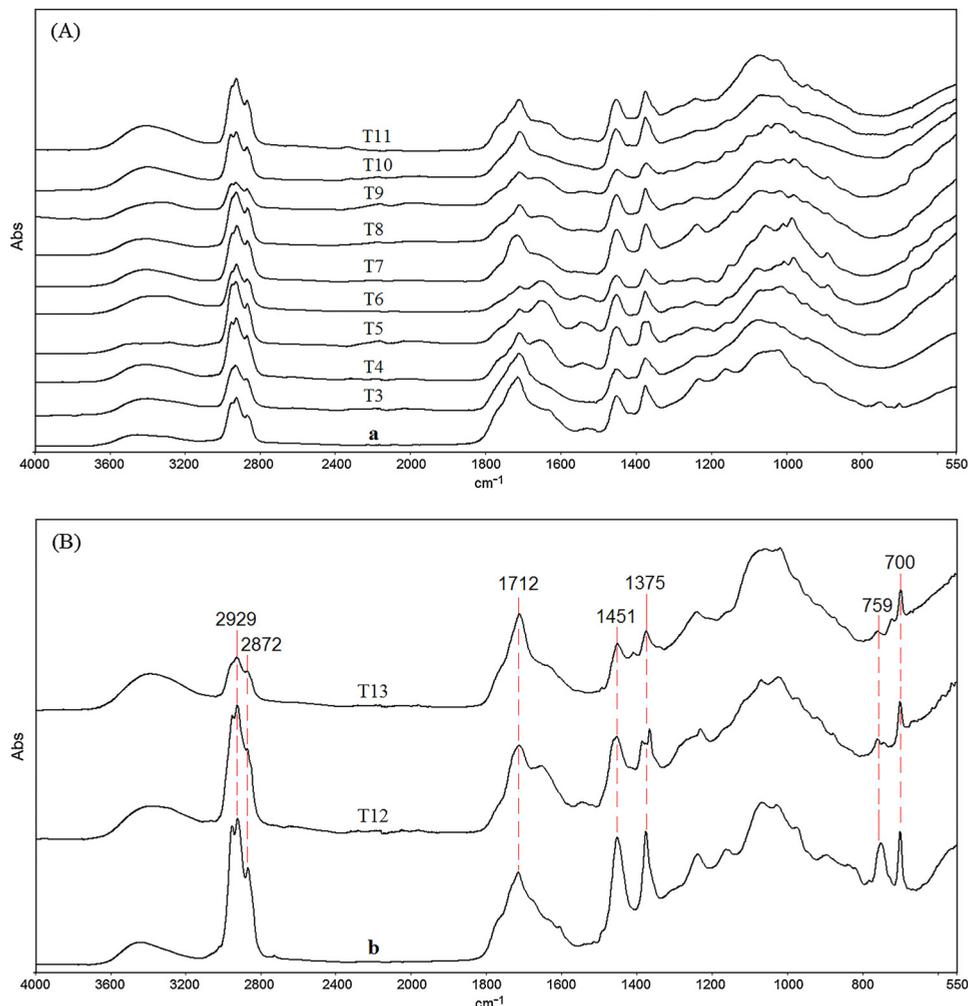


Fig. 9. (A) ATR-FTIR spectrum of adhesive side of aged reference tape Pvc-NR (a) compared with those of adhesive side of naturally aged tapes T3–T11. (B) ATR-FTIR spectrum of adhesive side of aged reference tape PP-SR (b) compared with those of adhesive side of naturally aged tapes T12 and T13.

In other cases (T3–T13 and T19 tapes), the FTIR spectra of the naturally aged highly discolored adhesive tapes showed the typical deterioration signals. Observing the FTIR spectra of the adhesive side of T3–T11 samples, it can be seen that the main absorption bands are very similar to that of the reference spectrum of artificially aged Pvc-NR adhesive (Fig. 9A). In particular, the common features observed in all spectra are a broad peak at $\sim 3400\text{ cm}^{-1}$, a band at $\sim 1715\text{ cm}^{-1}$, the absorptions of CH_2 and CH_3 groups at ~ 1450 and $\sim 1375\text{ cm}^{-1}$, respectively, and the strong absorbance about between 1100 and 1000 cm^{-1} (see also [Supplementary material, Table S6](#)). These results led us to the conclusion that the adhesives of the highly discolored tapes T3–T11 were originally composed of natural rubber that has been oxidized over time.

FTIR spectra of T12 and T13 adhesive samples show the two additional diagnostic peaks at ~ 750 and $\sim 700\text{ cm}^{-1}$ due to the presence of aromatic group. The close correspondence with the spectrum of the adhesive side of artificially aged PP-SR (Fig. 9B) indicates that the adhesive of highly discolored tapes T12 and T13 is mainly composed of synthetic rubber (see also [Supplementary material, Table S7](#)).

3.2.2. Acrylic-based adhesives

The FTIR spectra of both unaged and artificially aged adhesive side of commercial tape CA-A (Fig. 10A) present characteristic peaks corresponding to an acrylic polymer in accordance with chemical supplier information. The presence of aliphatic chains of alkyl ester is revealed by the absorbance at 2957 , 2929 and 2872 cm^{-1} , assigned to C–H stretching of CH_2 and CH_3 groups. The characteristic strong absorption band at 1731 cm^{-1} (due to C=O stretching of ester group), the broad peak at 1231 cm^{-1} (due to C–O stretching) and the strong absorption at 1159 cm^{-1} (originated from the stretching vibration of C–C(=O)–O group) can be used to identify the acrylic composition of the adhesive tape CA-A [16,28]. Moreover, it is clearly shown (Fig. 10A) that artificial aging, in our conditions, of this adhesive tape does not cause any change detectable by means of ATR-FTIR analysis.

Fig. 10B shows the FTIR spectra of the adhesive side of colorless naturally aged tapes T14–T18 compared with that of unaged CA-A adhesive. It clearly indicated that the absorption bands in the region between 3000 and 2800 cm^{-1} and at ~ 1730 , ~ 1450 and $\sim 1160\text{ cm}^{-1}$ are the characteristic absorption peaks attributable to the acrylic component of these adhesives. Since no substantial

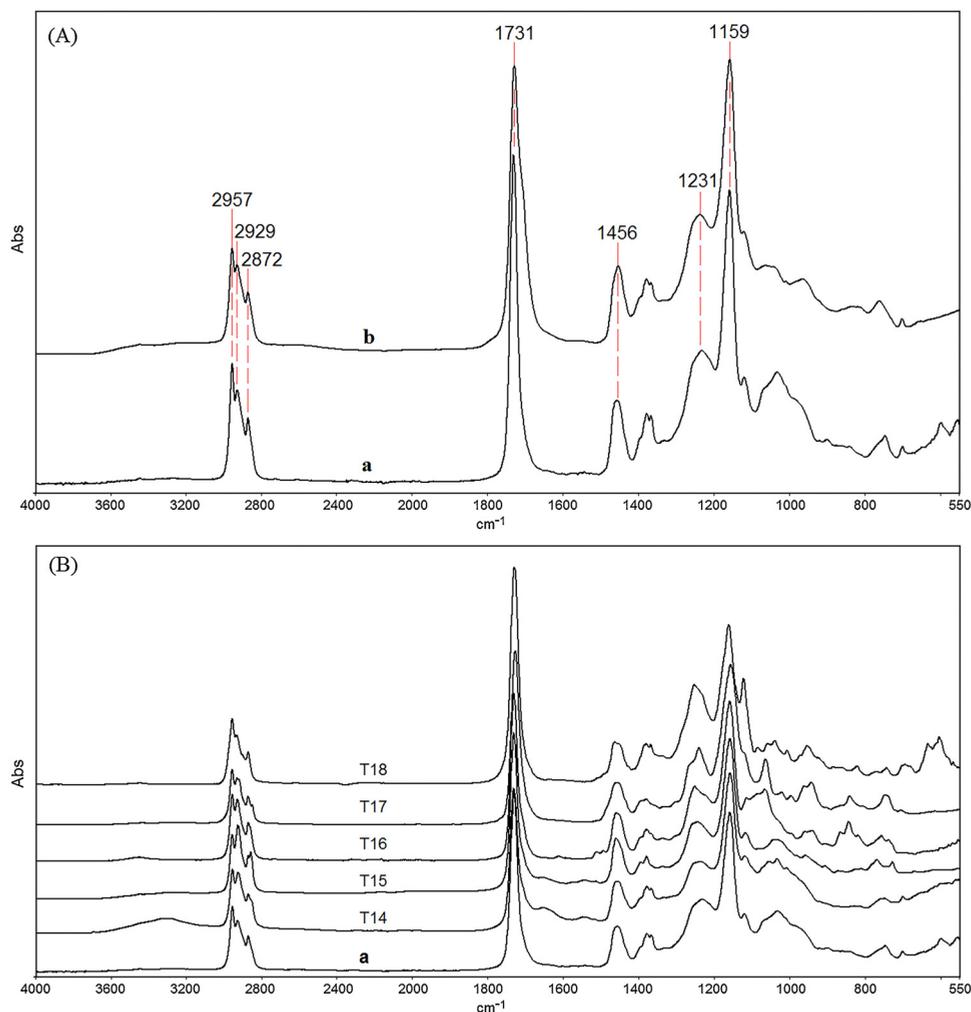


Fig. 10. (A) ATR-FTIR spectra of adhesive side of unaged (a) and aged (b) tape CA-A. (B) ATR-FTIR spectrum of adhesive side of unaged reference tape CA-A (a) compared with those of adhesive side of naturally aged tapes T14–T18.

modifications, detectable by FTIR technique, were found after either artificial or natural aging of the acrylic-based adhesives analyzed (see also [Supplementary material, Table S8](#)), we can confirm their chemical stability toward degradation processes that can take place in the common conservation environments [1,8].

4. Conclusions

The ATR-FTIR analysis appears as a very useful noninvasive technique for the characterization of the main components of pressure sensitive adhesive tapes commonly used in the past to repair ripped archival materials and books.

The results presented here show that all the backing materials of tapes analyzed are easy to identify by means of ATR-FTIR spectroscopy because no significant changes are observed after years of natural aging. Conversely, adhesive materials are less stable and show different behaviors on the basis of their composition and environmental conditions. In particular, rubber-based adhesives have a lower chemical stability than acrylic adhesives.

Accelerated aging by means of thermal treatment technique simulates with good approximation the drastic changes detectable by ATR-FTIR analysis that some rubber-based adhesives tapes undergo after several years of natural aging.

The findings of this preliminary study can help paper conservators to choose preservation treatment for the removal of PSATs that can be found on paper materials.

A further goal of this project is to create a wide ATR-FTIR database, which can provide information about the manufacture of a particular adhesive tape or may allow the characterization of the PSATs of unknown composition.

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