

Application News

No. A448

Spectrophotometric Analysis

Analysis of Corrosive Liquids Used as Wax Remover with Disposable IR Cards

Spectrophotometric analysis of liquid samples can be conducted simply and effectively using the ATR method. However, when the liquid sample has corrosive properties, which is common with the strong acids and strong alkalis used as wax removal substances, ATR is not suitable for analysis because these corrosive substances can cause damage to the prism crystal and metal parts (typically consisting of SS) used to secure the prism. In such cases, transmission measurements using a disposable IR card is an effective alternative method. Here we introduce examples of measurement of weakly alkaline, corrosive ethanolamine and strongly acidic methanesulfonic acid utilizing these disposable IR cards.

IR Cards

Fig. 1 shows commercially available disposable IR cards.



Fig. 1 Disposable IR Cards

Disposable IR cards are available with sample areas (see Fig. 1) consisting of five different types of materials, including: potassium bromide (KBr), potassium chloride (KCl), sodium chloride (NaCl), polytetrafluoroethylene (PTFE), and polyethylene (PE).

IR cards are extremely easy to use, as the following steps illustrate:

- (1) Set the IR card in the sample compartment holder and measure the background (BKG).
- (2) Remove the IR card and apply the sample to the sample area (Fig. 2(a)).
- (3) Re-set the IR card in the sample compartment holder and measure the sample (Fig. 2(b)).

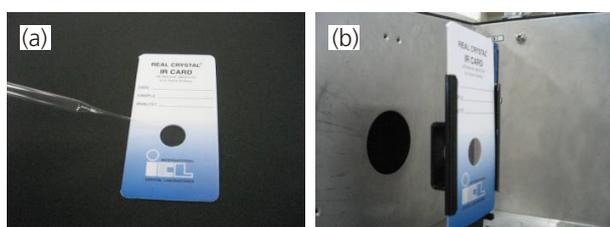


Fig. 2 Photographs Showing Application of a Drop of Liquid Sample on the Sample Area of Disposable IR Card (a) and Setting of IR Card into the Sample Compartment Holder of the IRPrestige-21(b)

When measuring volatile liquids, cover slips and holders are also available to prevent volatilization of the sample. An IR card to which a sample has been applied can be stored in a desiccator; however, applicable laws and regulations must be followed when disposing of the sample.

Fig. 3 shows the infrared transmittance characteristics of four of the above-mentioned IR cards (KBr, NaCl, PTFE, PE). The instrument and analytical conditions used are shown in Table 1.

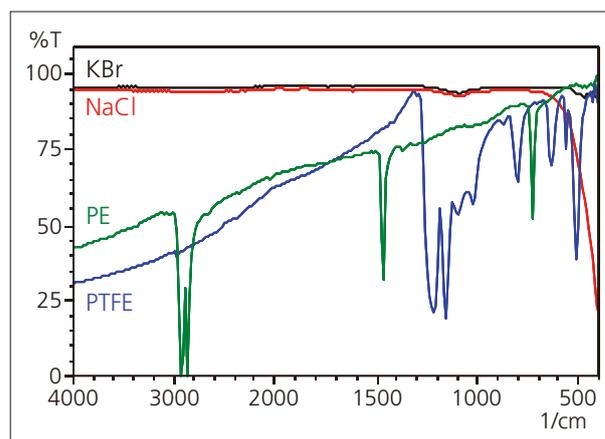


Fig. 3 Infrared Region Transmittance Characteristics of Four Kinds of IR Cards

Table 1 Instrument and Analytical Conditions

Instrument	: IRPrestige-21, with IR Cards
Resolution	: 4 cm ⁻¹
Accumulation	: 45
Apodization	: Happ-Genzel
Detector	: DLATGS

The KBr-window IR card displays excellent transmittance characteristics in the infrared region, with transmittance greater than 90 %. With the NaCl-window IR card, however, since transmittance begins to decrease from the vicinity of 700 cm⁻¹, the supported wavenumber region is limited to between 4000 and 600 cm⁻¹. Similar transmittance deterioration occurs with the PE- and PTFE-window IR cards as well, since the card material shows absorption in the wavelength region. The transmittance characteristics begin to deteriorate with the PE type in the vicinities of 2900, 1450, and 700 cm⁻¹; and with the PTFE type in the vicinity of 1300 cm⁻¹. With the PE-window IR card in particular, the transmittance in the wavenumber region from 3000 – 2800 cm⁻¹ becomes zero, hence making it unsuitable for acquiring data in that region.

■ **Example 1 – Analysis of Alkaline and Corrosive Liquid**

Ethanolamine, a liquid that possesses the properties of both alcohols and amines, is used in synthetic detergents, gas adsorbents, as a solvent for various pesticides, and in pharmaceuticals and cosmetics. Since ethanolamine is a weakly alkaline, yet corrosive liquid, it is unsuitable for ATR measurement because it may damage the prism as well as the metal surrounding the prism.

Fig. 4 shows the infrared spectrum of ethanolamine obtained with the KBr-window IR card.

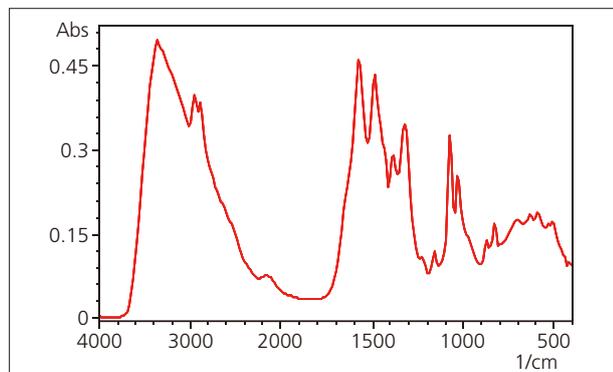


Fig. 4 Infrared Spectrum of Ethanolamine Obtained with KBr-Window IR Card

Fig. 5 and Fig. 6 show the infrared spectra of ethanolamine obtained using the PE- and PTFE-window IR cards, respectively.

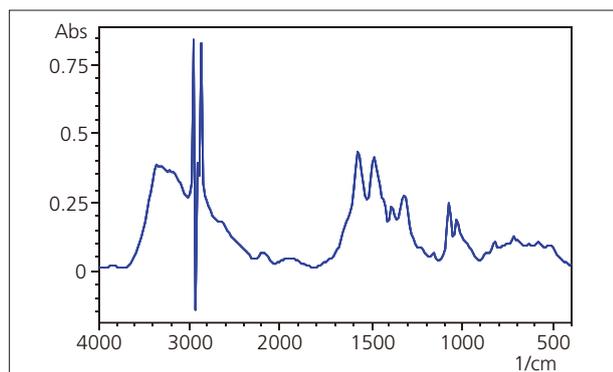


Fig. 5 Infrared Spectrum of Ethanolamine Obtained with PE-Window IR Card

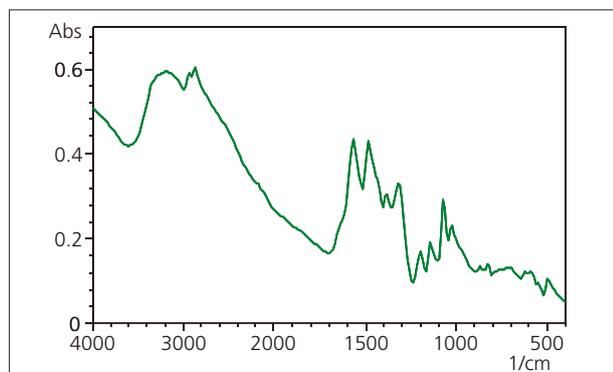


Fig. 6 Infrared Spectrum of Ethanolamine Obtained with PTFE-Window IR Card

Because there is zero transmittance within the wavenumber range of 3000 – 2800 cm^{-1} when conducting measurement with the PE-window IR card, a large amount of noise is generated in the spectrum. When the PTFE-window IR card is used, the baseline is inclined and the remaining absorption from the material is evident in the region of 1200 cm^{-1} .

■ **Example 2 – Analysis of Strongly Acidic Liquid**

Methanesulfonic acid, one of the simplest types of organic sulfonic acid, has excellent properties as a solvent for various heavy metals and heavy metal salts, making it a suitable liquid for a wide range of applications, including use in plating baths, acid catalyst, acidic cleaner, and other applications. Because methanesulfonic acid is a strongly acidic liquid, the ATR method, as in the case of ethanolamine, is unsuitable for its measurement.

Fig. 7 shows the infrared spectrum of methanesulfonic acid, measured using a KBr-window IR card.

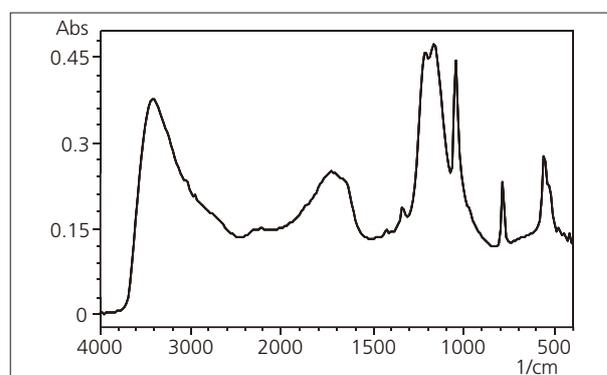


Fig. 7 Infrared Spectrum of Methanesulfonic Acid Obtained with KBr-Window IR Card

■ **Conclusion**

In this study, we introduced disposable IR cards which are effective for measurement of samples that are corrosive to the prism and its surrounding metallic parts used in ATR measurement.