

ANALYSIS OF HOUSEHOLD CLEANING SOLUTIONS BY ATR INFRARED SPECTROSCOPY

INTRODUCTION

One of the many advantages of attenuated total reflection (ATR) infrared (IR) spectroscopy is the ability to analyze small amounts (as little as 10 μL) of strongly IR-absorbing samples, such as aqueous solutions. The Harrick [ConcentratIR2™](#) is a multiple reflection ATR accessory equipped with a diamond ATR crystal. This application note demonstrates the ability of the ConcentratIR2™ to quickly and clearly distinguish aqueous solutions with trace amounts of other substances, such as ethanol, using a minimal amount of sample.

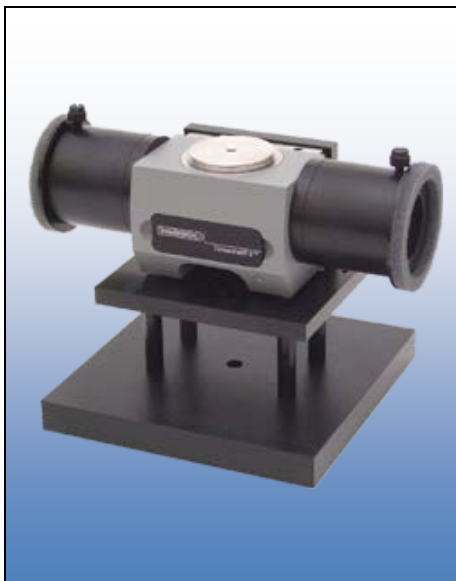


Figure 1. The ConcentratIR2™ multiple-reflection ATR accessory.

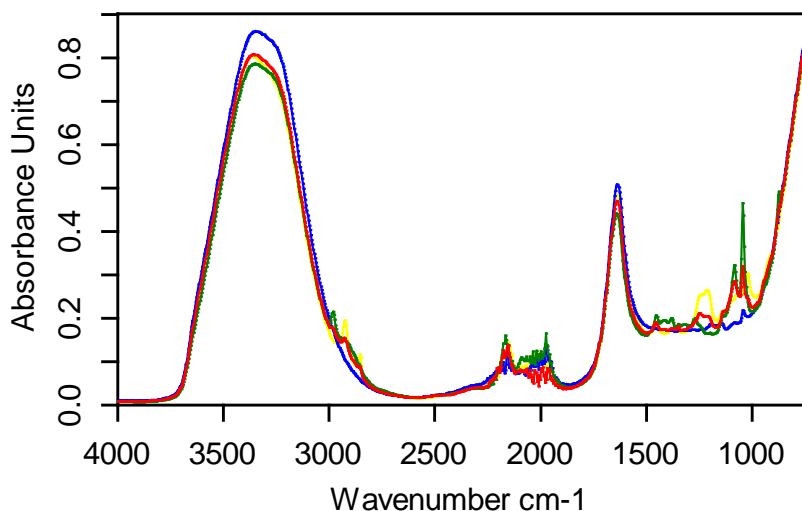


Figure 2. Spectra of water and of various cleaning solutions. The samples shown are Ecover (yellow), Meyer's Room Freshener (green), Meyer's Glass Cleaner (blue), and JR Watkins (red).

EXPERIMENTAL

IR spectra were collected on an FT-IR spectrometer equipped with a DTGS detector, with the ConcentratIR2™ placed in the sample compartment. Spectra were collected at an 8 cm^{-1} resolution, a gain of 8, and signal averaged over 32 scans. The aperture was set to 100% (fully open). Spectra were collected in the range 4000-500 cm^{-1} . The spectrometer and accessory were purged with filtered air (water and carbon dioxide removed) supplied by a Parker Balston Model 75-62 FT-IR Purge Gas Generator at 40 SCFH.

The samples used were Ecover Natural Dishwashing Liquid, JR Watkins Room Freshener, Meyer's Clean Day Room Freshener, and Meyer's Clean Day Glass Cleaner. All samples are available in most grocery stores. Ethanol was obtained from Thomas Scientific, and tap water was used for the water sample. Each sample was analyzed by placing one drop on the diamond ATR crystal.

RESULTS AND DISCUSSION

It is clear from the spectra that all samples were aqueous solutions. Note that bands in the spectral range $\sim 2200\text{-}2000 \text{ cm}^{-1}$ are due to the diamond ATR crystal. The characteristic strong, broad water bands at

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around 3300 cm^{-1} and 1650 cm^{-1} are present in all samples, as shown in Figure 2. Additional peaks indicate the presence of other compounds. Subtracting water from the sample spectra renders a clearer picture of these additional peaks.

Figure 3 shows the spectral region $3000\text{--}2750\text{ cm}^{-1}$, where bands characteristic of C-H stretching are found. Ecover, Meyer's Clean Day Room Freshener, and JR Watkins all have C-H stretching bands characteristic of organic compounds. Meyer's Room Freshener appears somewhat similar to the spectrum of ethanol, indicating that it may have some ethanol in its mixture. Variations in the bands in this region may be due to C-H stretching bands of low-level concentrations of various other organic compounds, likely hydrocarbons. Ecover and JR Watkins both have peaks at 2920 cm^{-1} and 2850 cm^{-1} , suggesting that they may contain a common organic compound.

Figure 4 shows the spectral region $1800\text{--}800\text{ cm}^{-1}$. Here Ecover, Meyer's Clean Day Room Freshener, and JR Watkins display the same or very similar bands as those seen in ethanol, suggesting its presence in their mixtures. Meyer's Clean Day also shows some absorbance in the region. Bands not present in ethanol are

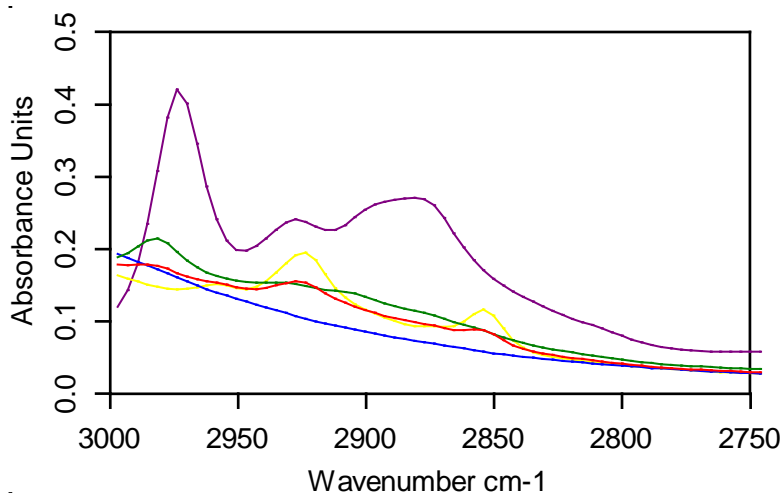


Figure 3. Spectra of ethanol (purple) and of various cleaning solutions over the spectral range $3000\text{--}2750\text{ cm}^{-1}$. Samples shown are Ecover (yellow), JR Watkins (red), Meyer's Room Freshener (green), and Meyer's Glass Cleaner (blue).

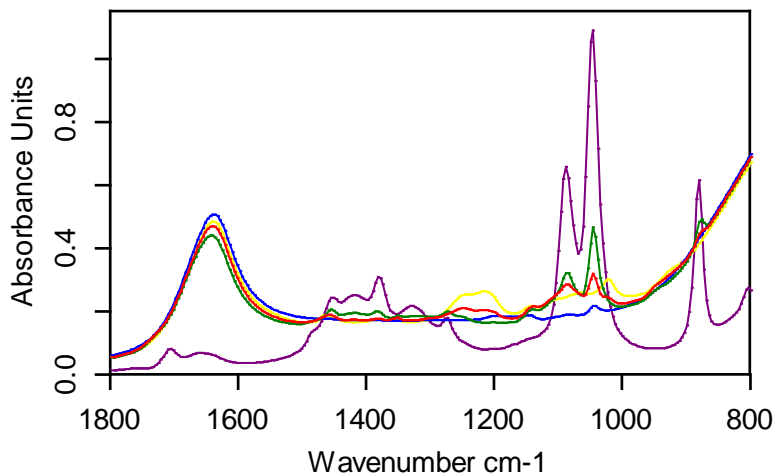


Figure 4. Spectra of ethanol (purple) and various cleaning solutions over the spectral range $1800\text{--}800\text{ cm}^{-1}$. Samples shown are Ecover (yellow), JR Watkins (red), Meyer's Room Freshener (green), and Meyer's Glass Cleaner (blue).



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seen in this region as well, such as the one around 1220 cm^{-1} in Ecover and JR Watkins.

CONCLUSIONS

The HarrickConcentratIR2™ ATR accessory allows for rapid analysis of small amounts of liquid sample containing water. The ConcentratIR2™ allowed for easy determination of the presence of ethanol in various cleaning supplies.



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