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Application note

Chlorine isotopes in HCl determination using GASEX-OEM-HD-05-12 spectrometer

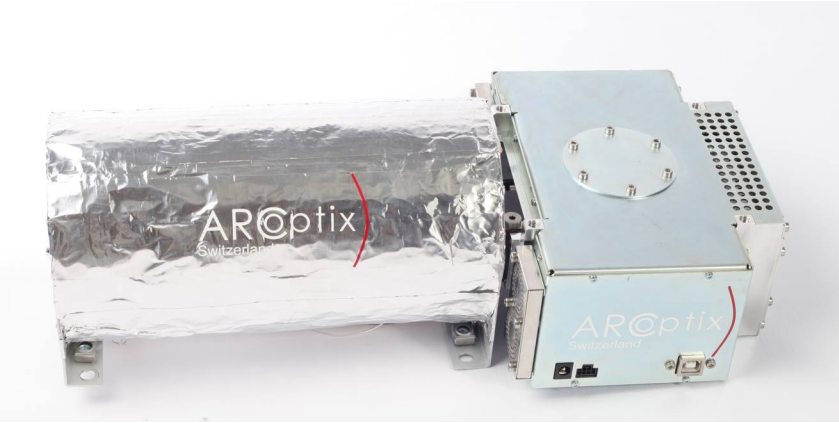

Figure 1 – *GASEX OEM - HD-05-12 , used in this study*

Introduction

The Arcoptix GASEX HD-05-xx spectrometers are specialized gas spectrometers used for a range of applications. Recently developed version featuring a resolution of 0.5 cm^-1 made it possible to refine the “spectral vision” of Gasex by a factor of 4 with respect to the previous models. In application note, we report a utilization of the GASEX-OEM-HD-05-12 for measurement of the isotope ration of two natural and stable isotopes of Chlorine : ^{35}Cl and ^{37}Cl in the HCl gas mixture.

Method

A spectrum of HCl has been measured at 75 ppm concentration and 180°C (at ambient pressure) using 5N nitrogen as a background. The spectra have been analyzed for the ratio of absorbance corresponding to the two natural isotopes, and correlated to the Hitran simulations.

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Results

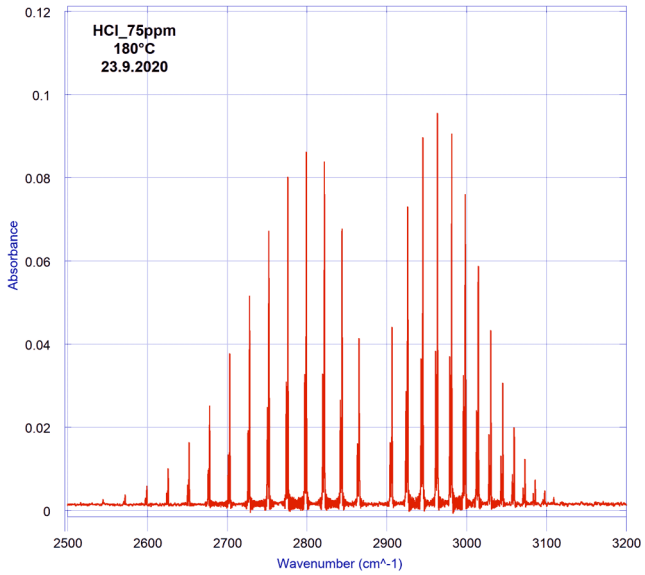

Figure 2 *– Full view of the fundamental absorption band of HCl recorded with the GASEX OEM - HD-05-12 , at 180 °C. Each absorption peak is represented as doublet corresponding to Chlorine isotopes 35 a and 37 respectively.*

For comparison, we have made a absorption spectrum of the same concentration of HCl in nitrogen, with another model of gas spectrometer, namely GASEX-OEM-ST-20-12 with the resolution of 2 wavenumber.

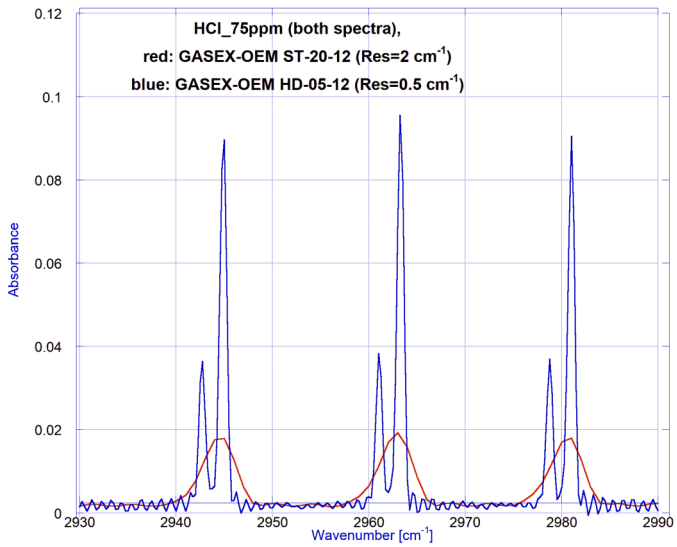

Figure 3 *– A detail of the spectrum of HCl measured with two different model, showing the influence of the resolution on the instrument line-shape function. The spectrum with the lower resolution does not offer a possibility of isotope resolution while higher resolution is clearly offering the distinction of the two respective isotopologues of HCl.*

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In further we analyzed the detail of ratio of the content of the two isotopologues of HCl. The spectra are correlated with the Hitran simulation for the two respective isotopes of Chlorine in the molecule of HCl.

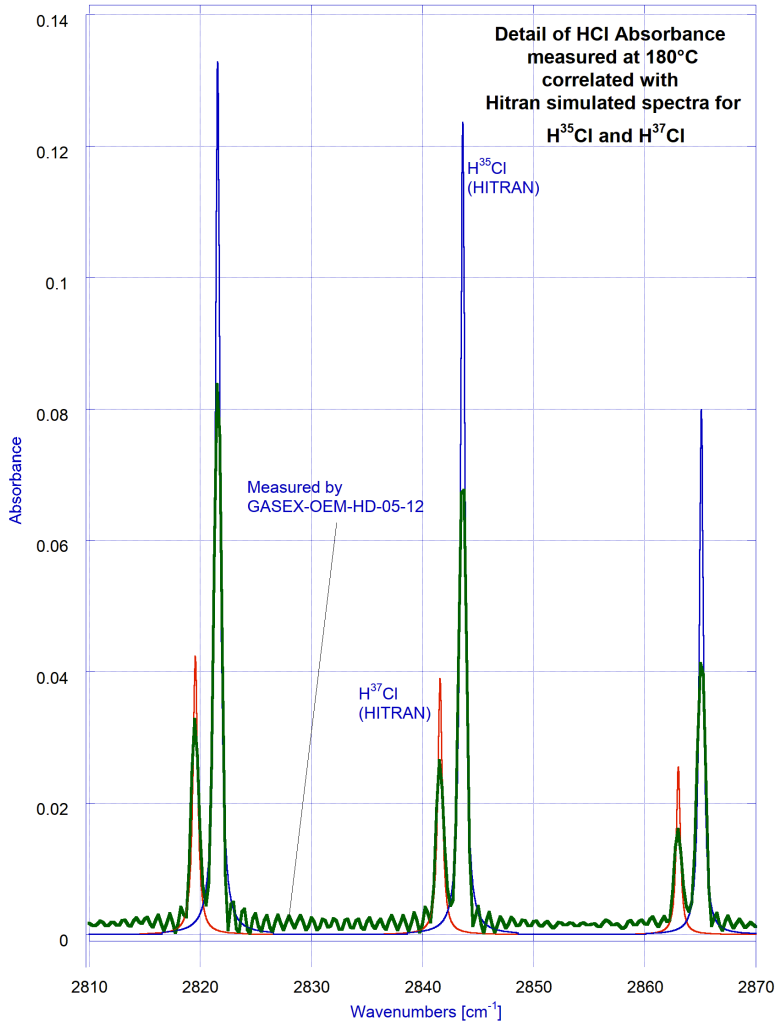

Figure 4 *– Detail of the absorption spectrum measured with the resolution of 0.5 cm^{-1} using the GASEX-OEM-HD-05-12 spectrometer. The measured spectrum is plotted together with the HITRAN calculated spectra for the respective isotopologues of HCl. The plot shows an excellent agreement of the wavelengths for the theoretical and for the measured spectrum.*

An excellent agreement of the peak positions of theoretical spectra calculated using the Hitran database for the two isotopologues of HCl with ^{35}Cl and ^{37}Cl in the HCl gas mixture. A more detailed view on the spectra allows the isotope ratio evaluation.

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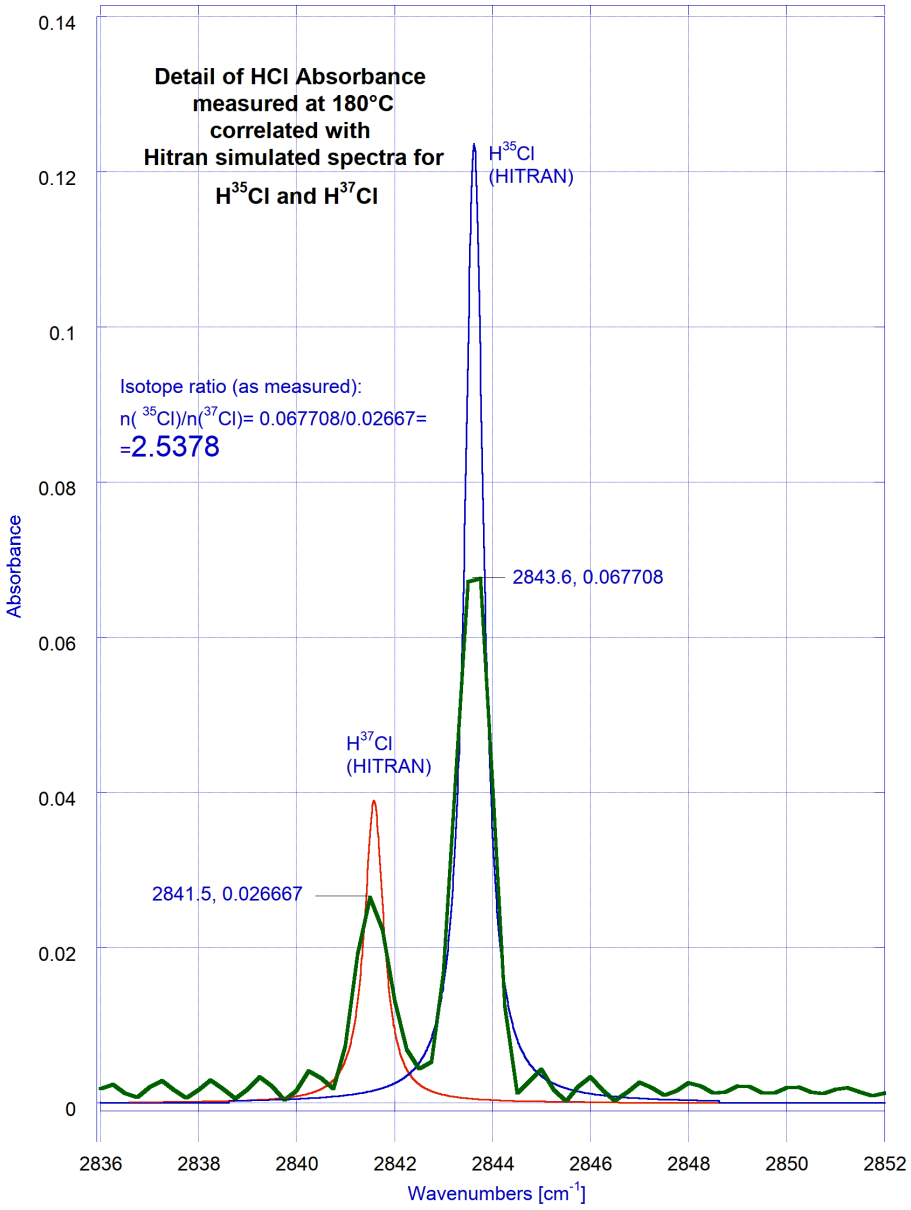

Figure 5 *– Two-peaks detail of the absorption spectrum measured with the resolution of 0.5 cm^{-1} using the GASEX-OEM-HD-05-12 spectrometer, together with the respective Hitran calculated spectra. The established isotope ratio based on this measurement equals to 2.53. (This does not correspond to the natural ratio of the chlorine isotopes of 3.2). The explanation of this would require further investigation.*

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Conclusion.

The high resolution (Res=0.5 wavenumbers) GASEX-OEM-HD-05-12 spectrometer is compared to the standard resolution (Res=2 wavenumbers) GASEX-OEM-ST-20-12. Both instruments can be used for determination of the concentration of HCl (and practically all hetero-nuclear gases. However only the high resolution spectrometer offers fine enough resolution to determine the isotope ratio of some gases, as demonstrated here on the example of HCl.