

## Application News

Spectroscopy - FTIR

### Tea Bags in the focus of identification Single reflection ATR measurements With Infrared Spectroscopy

No. SCA-110-091

Tea is as hot and cold drink the next alternative to juice, water or coffee for refreshing the liquid household of the human body. Tea starts to get over the years also in Germany a strong competition to the coffee cooking. To attract possible consumers the supplier of tea work on the extraction and the presentation of the tea. A new package like a tetrahedron form is looking more exclusive than the standard bag to present the tea particles, it can have the function of an eye-catcher. The idea to use the tube form which can be used as spoon for stirring the tee is another trial. Diverse suppliers of tea invested into such new appearance of the tea.



Fig. 1: diverse tea packing from tetrahedron, stick to classical bag form from diverse suppliers

The nice appearance of the bags in all forms raised the question from what kind of material these bags are. Over the years the consumer was trained to the cellulose bags in its classical form as in Germany, pads in other countries, partly also tetrahedron forms seen

in Japan. Doing the evaluation of this bags the thinking in cellulose or similar materials were the first idea.

Such identification of material can be easily done with the FTIR technique. With this analysis technique it is possible to analyze materials destroying free. The ATR measurement technique is a tool which helps to use the sample as it is. In this case simply the bags without tea particles were placed under anvil of the diamond based single reflection unit.

For this measurement the QUEST™ from Specac was used. This is a full diamond single reflection accessory. The sample was placed on top of the diamond window. With the flat anvil the bag was pressed against the diamond.



Fig. 2: Single reflection ATR – The Quest, a full diamond ATR version from Specac, mounted to Shimadzu FTIR sample compartment

## Discussion of the analysis

In figure 3 are shown the reflection spectra of 5 different sources of tea bags:

1. Teekanne "Minze",
2. Teekanne Filter,
3. Bio Darjeeling, ALDI Süd
4. REAL Kräutertee
5. Maßmer Rooibos Vanille

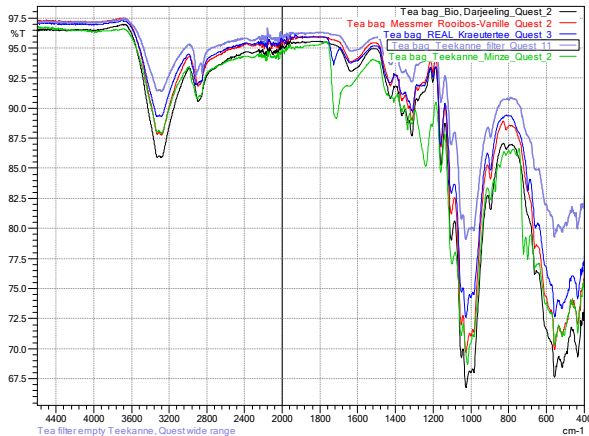


Fig. 3 Infrared spectra from 5 sources of tea bags in classical style. Two show significant differences caused by an additive (  $\sim 1700\text{cm}^{-1}$  and  $\sim 1250\text{cm}^{-1}$  strong bands).

All spectra are dominated by the profile from cellulose as it is commonly used as material for tea bags. Two sources Teekanne Minze and REAL Kräutertee have an addon inside which is visible in a strong band in the CO vibration area ( $\sim 1700, 1250\text{cm}^{-1}$ ).

Sample 2 the filter shows the expected hit quality when using the search in libraries.

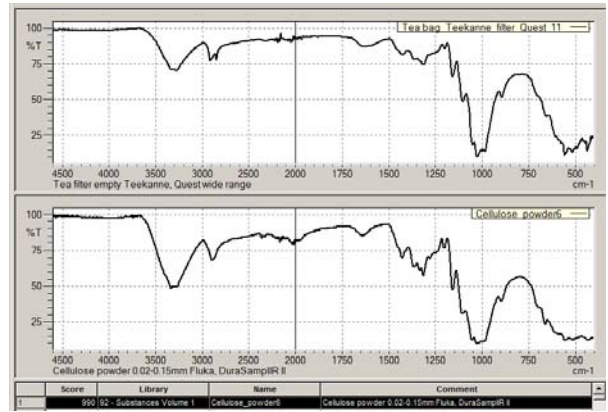


Fig. 4: search result of the filter in the library collection, Cellulose was found with a match of 990. Score maximum is 1000.

The difference of the Teekanne cellulose is to see in the signals at 1716, 1333, 1240, 872, 846, 720 and 698  $\text{cm}^{-1}$  which are broad and strong as well as small and sharper (Fig. 3 the green spectrum). With the subtraction of the Teekanne filter (fig.4) from the Teekanne Minze bag the following spectrum was received and this searched in libraries. The match is PET (Fig. 5).

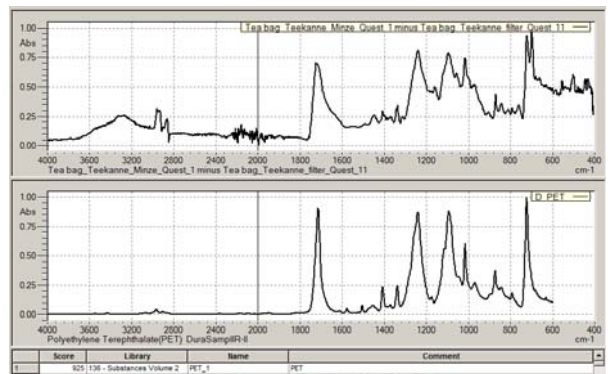


Fig. 5: Difference spectrum from two tea bags, which was used for the search in libraries, resulted in PET match with a score of 920, which is a good result.

The additive is PET as a thin layer covering the fabric. The signal size is roundabout 25 mAbs which is a very small signal

correlating to the thickness of the PET layer on the cellulose fabric. The penetration of the infrared beam into the fabric surface is approx. 2µm. In case the spectrum has the information from more than one substance the thickness discussion can start with having thickness of lower than 2µm. This is the discussion of the classical or regular teabags.

In the following the view is directed to the modern appearance of tetrahedron styled bags.

For this purpose several samples were collected:

1. Teekanne Assam Gold
2. Lipton Earl Grey
3. Loyd Rosehip Apple

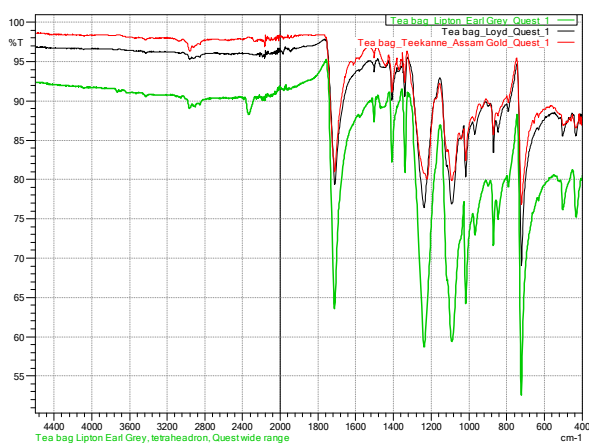


Fig. 6: Reflection infrared spectrum from three tetrahedron bags, the samples are from PET (polyethylene terephthalate )

In figure 6 are the infrared spectra from three bags of tetrahedron form. The baseline of the measurements is different in height. The position most nearest to the 100% of the baseline is correlating to the hardness and sum of contact to the measurement window of the accessory. By subjective view to the bags it is: red line, a more hard PET, signals are low because the contact of the PET net

from the bag is poor even when folded several times to get a more homogeneous fitting to the surface. Green line shows spectrum from the smoothest material with narrow grid lines used in the net of the bag. In this case a lot of fibers are filling up the measurement area from the diamond crystal and this result in higher spectrum signal.



### ■ Conclusion

The infrared spectroscopy is able to identify the fiber and the polymer layer on a fiber with single reflection ATR method. It is easy and simple to handle. Very important is that the technic is destroying free in comparison to other analytical techniques in which first an extraction has to be done from the sample. Naturally with help of energy dispersive fluorescence (destroying free) or elemental analysis (AAS, ICP needs destroying) more details from such a tea bag can be evaluated. In the focus are rare earth and heavy metals in food.

### ■ Instrumentation

- IRTracer-100
- LabSolutions IR software
- Quest ATR accessory with monolithic diamond from Specac
- Shimadzu Libraries



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