# Application of mid IR-Spectroscopy:
## Measuring of Hydrogen Peroxide Concentration in Bleaching Baths


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## Introduction

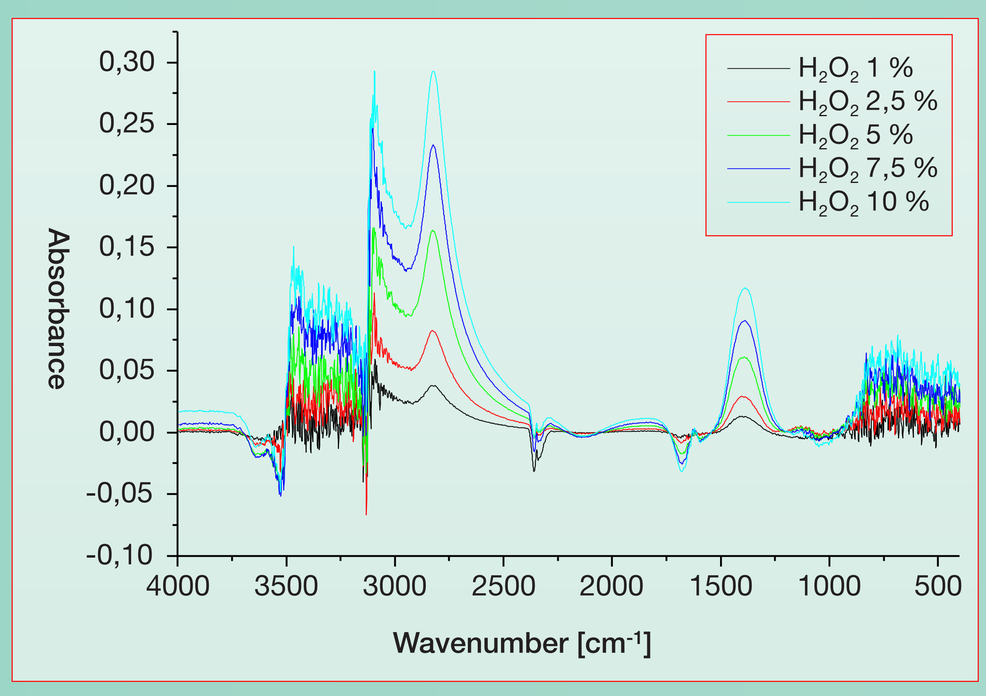
**Hydrogen peroxide is commonly used in bleaching processes (e.g. in textile and paper treatment), chemical oxidation processes in general and for sterilization purposes. The determination of the concentration of hydrogen peroxide in these solutions is of great technological, ecological and economical importance. The methods and instruments for the determination of this substance, which are commercially available, are time consuming, costly, cannot be used for on-line monitoring or are not applicable for hydrogen peroxide concentrations used in the mentioned applications.**

### Conditions in bleaching solutions

- Temperature: up to 100 °C
- Hydrogen peroxide concentration: 0,1–10 %
- pH: 6–12
- clear to turbid solution or even wet fibers

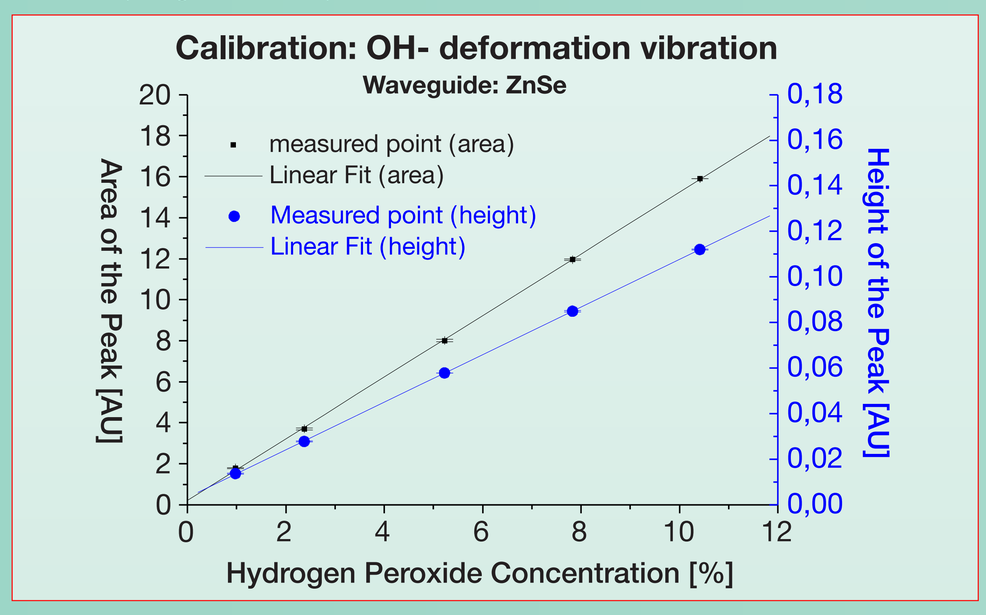
## Spectrum of hydrogen peroxide in the mid-IR

The infrared spectrum of hydrogen peroxide displays the O—H-stretching (2930 to 2680 $cm^{-1}$) and deformation vibrations (1530 to 1260 $cm^{-1}$). Additionally the O—O stretching vibration (890 to 800 $cm^{-1}$) was found in measurements using Ge as waveguide (ZnSe absorbs infrared light below 1000 $cm^{-1}$). The spectrum of pure water was subtracted from these spectra.



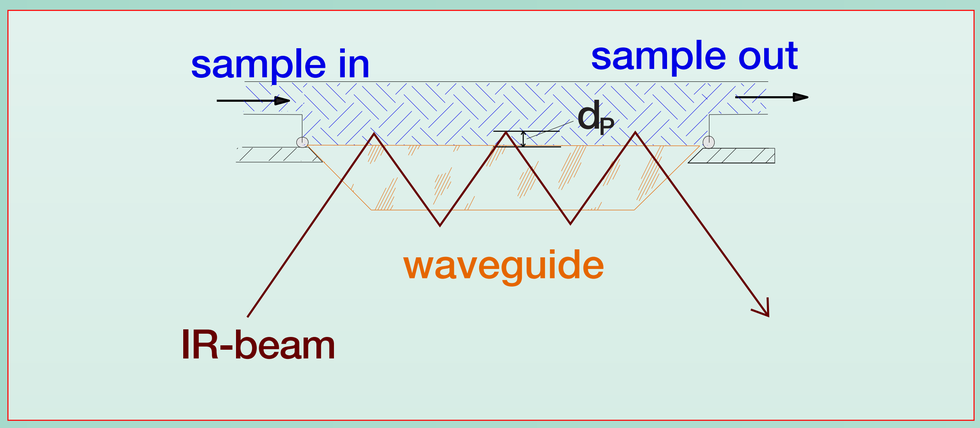

## Quantitative evaluation of hydrogen peroxide spectra

The specific vibrations were used for quantitative determination of hydrogen peroxide in aqueous solutions. The spectrum of water does not interfere with these measurements. A linear correlation between the peak areas or the peak heights and the hydrogen peroxide concentration in the range of 1–10 % (weight in water) was obtained.




## Instrumentation

The work presented here uses the technique of attenuated total reflection (ATR) of infrared light for measuring of hydrogen peroxide. The flow through measuring cell applied either ZnSe or Ge crystals as waveguides. The used spectrometer was a Bruker IFS 88 (Germany). Data evaluation was done with Microcal Origin 5.0 (USA). The aqueous hydrogen peroxide solutions were continuously pumped through the sample unit with a peristaltic pump (Minipuls 3, Gilson, USA) at a speed of 48 r.p.m (used tubing: inner diameter 1.02 mm). Temperatures during the measurements varied between 20 and 23 °C.

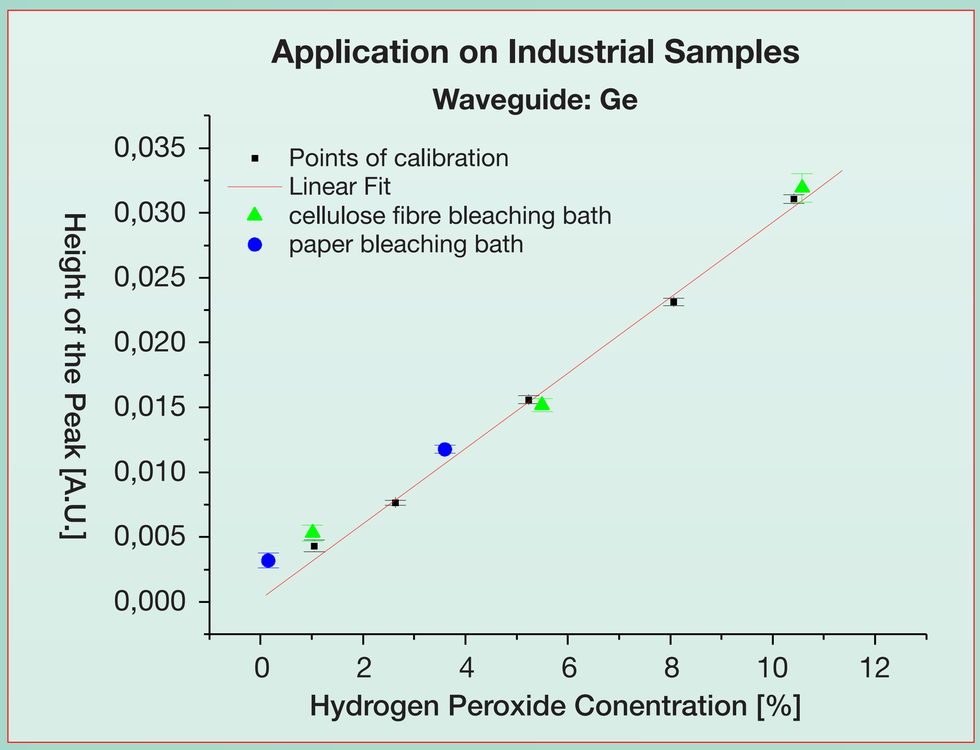



## Application

The optimized method was used to measure different hydrogen peroxide concentrations in industrial samples (i.e. different bleaching solutions) spiked with known amounts of hydrogen peroxide. The results fitted quite well with the calibration graphs established with neat hydrogen peroxide solutions. Germanium was used as waveguide because of its enhanced chemical stability for the investigated solutions.

### Industrial samples:

- cellulose fiber bleaching bath: colorless, clear solution, pH: 12,9
- paper bleaching bath: yellowish, turbid solution, pH: 7,2




## Outlook

**In the forthcoming work influences of the conditions in industrial samples onto the measurements such as temperature, pH and ionic strength, will be investigated. Furthermore a measuring system will be developed which enables to detect the hydrogen peroxide concentration directly and on-line during bleaching processes.**

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