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FTIR analysis of a molded silicon rubber (VICOLAB)

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Purpose of the analysis

To detect for the possible presence of "latex" (natural rubber or poly(cis-isoprene)) and phthalates (plasticizer) in a molded sample of silicone rubber.

Analytical technique

Fourier Transform Infrared spectroscopy (FTIR) is selected as the analytical tool for this study. The instrument used is a Nicolet Magna Model 560 (USA).

Every chemical substance has a characteristic absorption spectrum in the mid-infrared which can be used as a "fingerprint". Therefore, by recording the FTIR spectrum, it is possible to determine the presence or the absence of certain functional groups in a sample.

Experimental

The FTIR spectrum of a sample taken from the molded specimen is given in Figure 1. Comparison with a polymer sample of known structure allows us to identify the silicone as poly(dimethyl siloxane) or PDMS. In addition, the molded sample is crosslinked, since it swells but does not dissolve in usual solvents for silicone, such as tetrahydrofuranne or toluene.

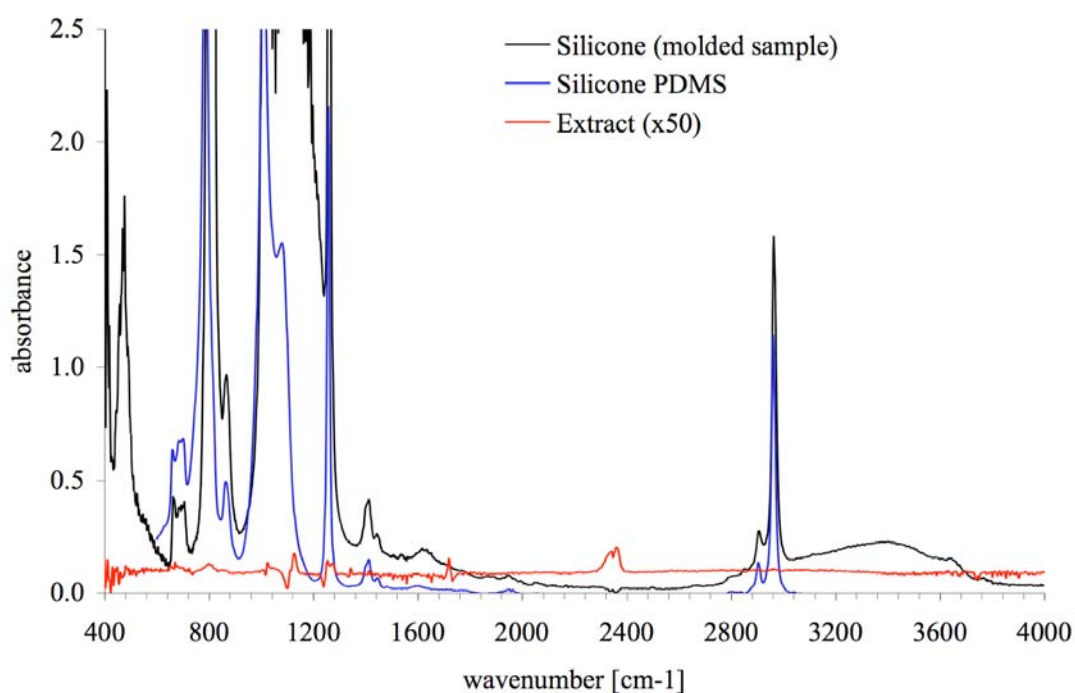


Figure 1 - FTIR spectrum of the molded sample, toluene extract (expanded scale x50) and of poly(dimethyl siloxane)

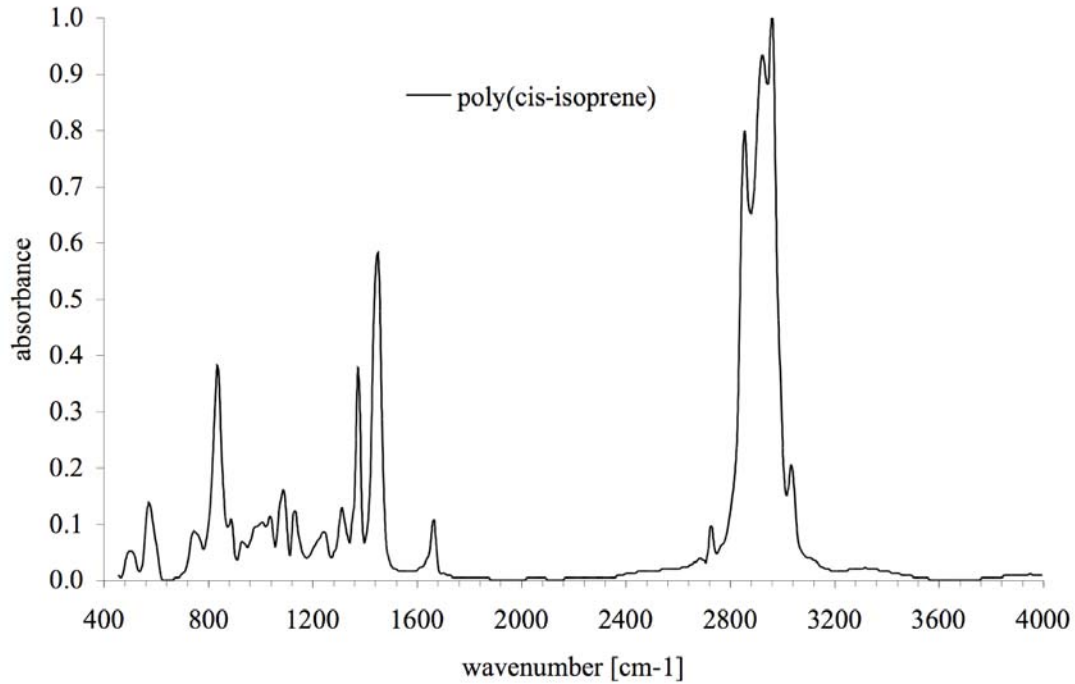


Figure 2 - FTIR spectrum of natural rubber

- Poly(cis-isoprène) or natural rubber contains unsaturated double bonds and methylene groups $>\text{CH}_2$ which absorb at 1663 cm^{-1} and 1450 cm^{-1} , respectively (Cf. Fig.2).
- Alkyl phthalates, such as ethyl-hexyl phthalate (DOP), are commonly used as plasticizer in thermoplastics. These aliphatic esters are characterized by a very strong absorption band at 1732 cm^{-1} ($>\text{C}=\text{O}$ stretch).

None of these bands are present in the FTIR spectrum of the molded silicone rubber (Fig.1). Thus, it is unlikely that "latex" or phthalate is present in the sample. To be certain that these compounds are not present in trace quantities, a small sample of molded material is extracted with toluene (a good solvent for PDMS) for 2 days. A drop of the extract was deposited on a KBr window, and a FTIR spectrum taken after solvent evaporation (Fig.1). The result shows only the baseline, indicating that the molded sample does not contain any extractible material.

Conclusions

The results of FTIR measurements on the molded sample, and on the toluene extract do not reveal the presence of natural rubber ("latex") nor phthalate in the composition of the provided silicone material.