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Research Article

FOURIER TRANSFORM INFRARED SPECTROSCOPY STUDIES ON TALCUM POWDERS

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ABSTRACT

The FT-IR spectra of the talcum powder samples are recorded in the region of 4000 - 400 cm⁻¹. The IR absorption of particular bands present in all the talcum samples confirmed the chemical structure talc and the band around 3575 cm⁻¹, 3426 cm⁻¹ present in the samples that are indicate the present of chlorite. An attempt has been made to determine the more presentation of chlorite calculated extinction co-efficient (K) of the specific band of the FT-IR spectrum. The percentage of talc compounds are calculated and discussed

Key Words:

Talc, FTIR

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INTRODUCTION

Talc is a clay mineral composed of hydrated magnesium silicate with the chemical formula H₂Mg₃ (SiO₃)₄ or Mg₃Si₄O₁₀(OH)₂. In loose form, it is the widely used substance known as baby powder, also known as talcum powder. It occurs as foliated to fibrous masses, and in an exceptionally rare crystal form. It has a perfect basal cleavage, and the folia are non-elastic, although slightly flexible. It is the softest known mineral and listed as 1 on the Mohs hardness scale. As such, it can be easily scratched by a fingernail. It has a specific gravity of 2.5–2.8, a clear or dusty luster, and is translucent to opaque. Talc is not soluble in water, but is slightly soluble in dilute mineral acids.

Impacts

Talc powder is a household item, sold globally for use in personal hygiene and cosmetics. Suspicions have been raised that its use contributes to certain types of disease, mainly cancers of the ovaries and lungs. It is classified in the same 2B category in the IARC listing as mobile phones and coffee. Reviews by Cancer Research UK and the American Cancer Society conclude that some studies have found a link, but other studies have not (1,2).

The studies discuss pulmonary issues, (3) lung cancer, (4,5) and ovarian cancer.^[16] One of these, published in 1993,

was a US National Toxicology Program report, which found that cosmetic grade talc containing no asbestos-like fibres was correlated with tumor formation in rats forced to inhale talc for 6 hours a day, five days a week over at least 113 weeks (6). A 1971 paper found particles of talc embedded in 75% of the ovarian tumors studies (7). Research published in 1995 and 2000 concluded that it was plausible that talc could cause ovarian cancer, but there was no conclusive evidence (8,9).

FTIR Study

Fourier Transform Mid-Infrared (FT-MIR) spectroscopy has been recognized as a powerful analytical technique in the industry for many years (10) and it has been employed to measure some quality parameters of talc. It has an advantage of easy sample preparation, rapid measurements and no use of chemicals in contrast to traditional solvent methods accompanied by chromatographic techniques. FTIR is a rapid technique with minimum sample preparation.

Fourier Transform Near- Infrared Spectroscopy is one of effective and rapid technique to determine if these types of talk have been adulterated. BP neural network combined with NIR for the determination of talc-containing flour is ideal can be used for talc-containing flour; the result of cluster analysis should that it need to seek better methods for talc-containing wheat flour.

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MATERIALS AND METHODS

In the present study, different company's talcum powder purchased from markets. The FT-IR spectra of talcum powder samples are recorded in the region 4000 to 400 cm^{-1} and are shown in Fig. 1-5. For this study all the spectra of talcum powder samples are expanded into these regions. All these spectrums are analyzed quantitatively.

Qualitative study

Table 1 shows the frequencies of the characteristic bands or shoulders in the spectra of talc powder samples as well as their assignment to functional groups, their vibrational mode and their intensity. The bands and shoulders in the spectra of all samples are almost the same with respect to spectrum of talc.

The infrared spectra of the initial compounds clearly exhibits the presence of talc by the very sharp O – H stretching at nearly 1670 cm^{-1} and the sharp symmetric Si – O – Si stretching is observed at 672 cm^{-1} . The asymmetric Si – O – Si stretching is observed at 1017 cm^{-1} . Whereas adsorption bands observed at 3575 cm^{-1} and 1400 cm^{-1} correspond to the brucite layer hydroxyl group of chlorite.

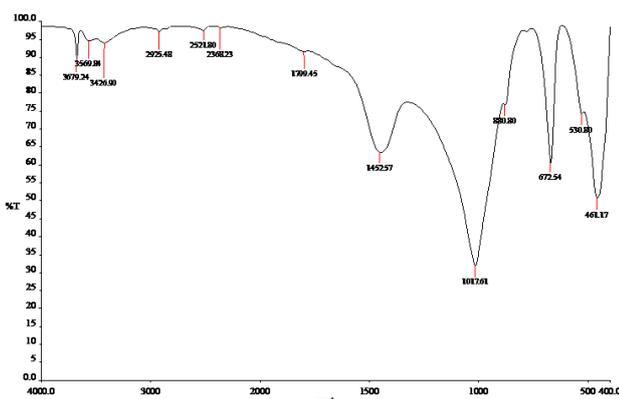


Fig 1 FT-IR absorption spectrum of talcum powder sample – 1

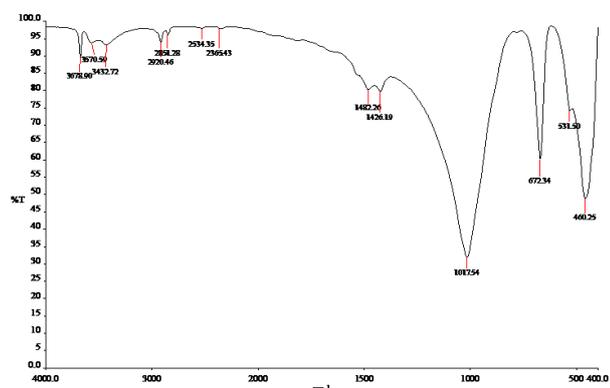


Fig 2 FT-IR absorption spectrum of talcum powder sample – 2

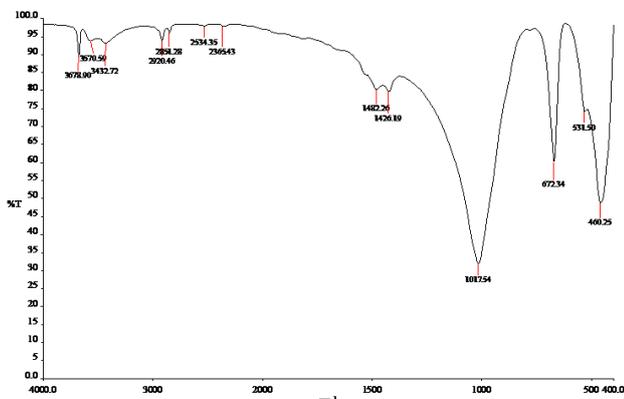


Fig 3 FT-IR absorption spectrum of talcum powder sample – 3

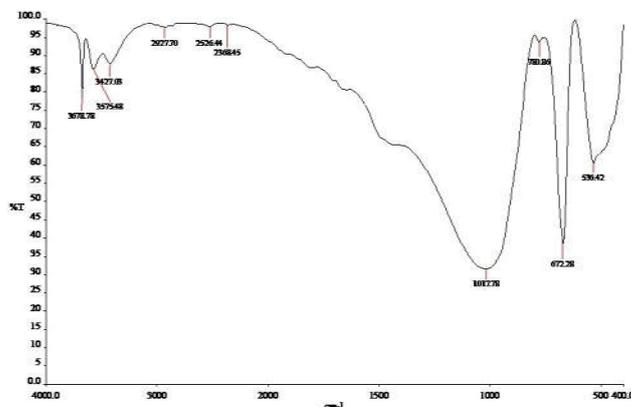


Fig 4 FT-IR absorption spectrum of talcum powder sample – 4

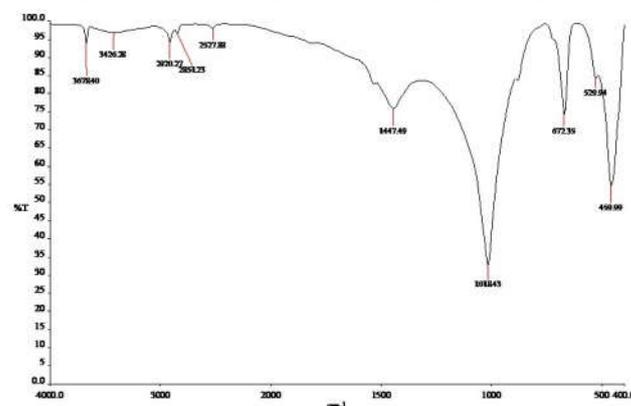


Fig 5 FT-IR absorption spectrum of talcum powder sample – 5

Quantitative analysis

The absorption band at 3575 cm^{-1} is confirmed the presence of chlorite. So this band is used for quantitative analysis of harmful of talc powder. So this band is considered for the determination of excess of chlorite in talc. The amount of variation may be expressed in terms of the extinction coefficient (K) value. The extinction co-efficients are calculated for prominent absorption bands at 3008 cm^{-1} using the following relation [11].

$$K = \frac{DA}{m} \quad \text{cm}^2/\text{mg}$$

Where D - optical density of absorption band $\log [I_0/I]$

A –Area of pellet (in cm^2)

m –mass of the samples in the pellet (in mg)

The extinction co-efficient (K) values of respective bands found from the spectra of different talc samples are given in the table 3.2. The Extinction Co- efficient value of 3679 cm^{-1} is maximum in sample 3 and minimum in sample 5. The Extinction Co- efficient values of 3575 cm^{-1} is maximum in sample 4 and minimum in sample and nil effective in other samples. This is confirmed that the sample 4 talc powder have excess of chlorite (12). This may very harmful for human body.

Table 2 Extinction co-efficient (K) values of all talc powder samples

Wavenumber	k values X 10 ⁻³ cm ² /mg				
	S1	S2	S3	S4	S5
3679	305.00	180.00	613.00	360.00	112.00
3575	010.00	011.00	00	300.00	00
3426	120.00	166.00	322.00	320.00	010.00
2521	095.00	073.00	015.00	015.00	022.00
1452	555.00	055.00	319.00	00	233.00
1017	2300.00	2390.00	1020.00	1357.00	2330.00
672	1000.00	1009.00	2019.00	2029.00	0686.00
460	1500.00	1590.00	1029.00	00	0999.00

Extinction co-efficient value of band 3426 cm⁻¹ is maximum in sample 3 and minimum present in sample 5. The presence of k value more in sample 1 and less in sample 5 at 1452 cm⁻¹. The presence of k value more in sample 1 and less in sample 3 at 1017 cm⁻¹. The presence of k value more in sample 4 and less in sample 5 at 672 cm⁻¹. The presence of k value more in sample 3 and less in sample 5 at 460 cm⁻¹.

Talc powder is a household item, sold globally for use in personal hygiene and cosmetics. Suspicions have been raised that its use contributes to certain types of disease, mainly cancers of the ovaries and lungs. It is classified in the same 2B category in the IARC listing as mobile phones and coffee. Reviews by Cancer Research UK and the American Cancer Society conclude that some studies have found a link, but other studies have not.(13,14). Now a day in marketing talc powder getting adulterated with wheat or some flours(15).

However excess of Mg, Si Concentration is very dangerous for human body and this discussion the sample 5 may very less concentration of compounds compare to other samples. Sample three have excess of chlorite clearly with k values. Hence, among the five samples S5 sample is best for use as talcum and may restrict from the disease impacts.

CONCLUSION

In the present work, local marketing talc powder compounds investigated by observed and quantified FTIR spectra. Among the five samples S5 is less concentration of brucite and chlorite and more concentration in S3 was confirmed from the extinction co-efficient values (K). Hence finding the best alternative is challenge corn starch-based powder is associate with substantially lower risk if inhaled. However, talc containing products are still readily available at many shops. The bottom line is that it is better not to use talc or talc containing products.

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