FILE NAME: Johnson & Johnson (JAJ)

DATE: 1973 Feb 26

DOC#: JAJ065

DOCUMENT DESCRIPTION: Report - Mineralogical Examination of Five Talc Samples by Colorado School of Mines Research Institute

MEMORANDUM

COLORADO SCHOOL OF MINES RESEARCH INSTITUTE
P.O. BOX 112
GOLDEN, COLORADO 80401

TO W. H. Ashton DATE February 26, 1973

FROM W. P. Reid and W. T. Caneer PROJECT NO. C10704

SUBJECT Mineralogical Examination of Five Talc Samples

In compliance with your request, mineralogical studies were made on the following talc samples:

30-71-S
30-B-71-S
30-C-71-S
32-71-S
34-71-S

The purpose of these studies was to determine the mineralogy of these samples with an emphasis on the occurrence of any asbestos type minerals. X-ray Diffraction and microscopic studies were made on as-received samples, heavy liquid separates, and on acid leached residues.

SUMMARY

The following table shows the nature and relative abundance of minerals in each sample.

Sample	Mineralogy
30-71-S	Major (>40%) talc [$Mg_3Si_4O_{10}(OH)_2$] Moderate (20-40%) magnesite ($MgCO_3$) Trace (<1%) chlorite Trace calcite ($CaCO_3$) and dolomite [$CaMg(CO)_3)_2$] Trace opaques (Fe oxides, etc.) Slight trace (<0.1%) tremolite-actinolite (Ca-Mg-Si-O-OH)
30-B-71-S	Major talc Moderate magnesite Trace dolomite and calcite Trace opaques Slight trace chlorite Slight trace tremolite-actinolite

EXHIBIT
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Sample	Mineralogy
30-C-71-S	Major talc Minor (5-20% magnesite Very minor (1-5% chlorite) Trace calcite and dolomite Slight trace opaques
32-71-S	Major talc Moderate magnesite Very minor chlorite and possible serpentine [$Mg_3Si_2O_5(OH)_4$] Trace calcite and dolomite Very minor opaques Slight trace anthophyllite (?) [$(Mg_1Fe)_7(Si_8O_{22}(OH)_3$]
34-71-S	Major talc Minor magnesite Very minor chlorite Very minor dolomite Trace mica [K-Al-Si-O-OH] Trace opaques

Relative to possible asbestos type minerals the above table shows that Samples 30-71-S and 30-B-71-S contain slight traces of tremolite-actinolite minerals. Sample 32-71-S is suspected to contain a very minor amount of serpentine which may be chrysotile. In addition a slight trace of possible anthophyllite was observed in this sample. It is recommended that more studies be made on greater quantities of Sample 32-71-S to confirm the presence of these minerals.

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RESULTS AND DISCUSSION

Each sample of ground talc ore was separated into the following fractions by centrifuging in heavy liquids: specific gravity less than 2.90; specific gravity greater than 2.90. After making an X-ray diffractogram of the greater than 2.90 specific gravity fractions, the sample was leached with 1:1 HCl to remove magnesite. The insoluble residue was then examined for amphiboles under the petrographic microscope. The weight percent in the various fractions as well as the mineralogy of each fraction is shown in the following table.

Sample	Weight, %	Mineralogy
30-71-S	100.0	
Specific gravity < 2.90	74.5	Major (>40%) talc Very minor (1-5%) dolomite Trace (<1%) chlorite Trace calcite and magnesite
Specific gravity > 2.90	25.5	Major magnesite Very minor talc Trace dolomite and calcite
HCl leach residue	0.4	Major opaques (magnetite, etc.) Major talc Slight trace (<0.1%) tremolite-actinolite
30-B-71-S	100.0	
Specific gravity < 2.90	76.4	Major talc. Minor (5-20%) magnesite Trace dolomite Slight trace chlorite

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Sample	Weight, %	Mineralogy
30-B-71-S (cont'd)		
Specific gravity >2.90	23.6	Major magnesite Very minor talc Trace calcite
HCl leach residue	0.4	Major talc Major opaques (magnetite, sulfide, etc.) Slight trace tremolite-actinolite
30-C-71-S	100.0	
Specific gravity <2.90	90.5	Major talc Minor magnesite Very minor chlorite Trace dolomite
Specific gravity >2.90	9.5	Major magnesite Minor talc and dolomite Trace calcite
HCl leach residue	<0.1	Major opaque Minor talc
32-71-S	100.0	
Specific gravity <2.90	58.4	Major talc Very minor magnesite Very minor chlorite and serpentine (?) Trace calcite
Specific gravity >2.90	41.6	Major magnesite Very minor talc Trace dolomite Slight trace calcite

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Sample	Weight, %	Mineralogy
32-71-S (cont'd)		
HCl leach residue	2.5	Major talc Minor opaques Slight trace anthophyllite (?)
34-71-S	100.0	
Specific gravity <2.90	80.9	Major talc Very minor magnesite Very minor chlorite
Specific gravity >2.90	19.1	Major magnesite Minor dolomite Trace mica
HCl leach residue	0.4	Major opaques Minor talc

In an attempt to verify the presence of serpentine in Sample 32-71-S X-ray diffraction step scans were made over the critical diffraction peaks of serpentine. Figure 1 shows the results of the step scanning. Since both chlorite and serpentine have diffraction peaks in the 7Å region, it is possible to confuse these minerals based only on a 7Å peak. However, a corresponding peak in the 14Å region verifies the presence of chlorite. Curve 1 (Figure 1) represents a step scan across the 7Å region for the as-received Sample 32-71-S. As may be seen two peaks occur at 7.1Å and 7.3Å. In order to determine if these peaks represent chlorite or possibly serpentine, step scans were made across the 14Å region. If this 7.1Å and 7.3Å peaks represent chlorite, then there should be corresponding peaks at 14.2Å and 14.6Å. Curve 1A is a step scan across the 14Å region. At 14.2Å peak occurs which corresponds to the 7.1Å peak. These 2 peaks represent chlorite. However, no 14.6Å peak is present which suggests that the 7.3Å represents serpentine-not chlorite.

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Since chlorite has a specific gravity greater than 2.65 and serpentine has a specific gravity less than 2.65, step scans were made on the fraction of Sample 32-71-S which has a specific gravity less than 2.65. The less than 2.65 specific gravity fraction was 0.4 weight percent of the total sample. If serpentine is present the 7.3Å peak should be enhanced and the 7.1Å chlorite peak should be diminished. Curve 2 represents a step scan across the 7Å region of the fraction with a specific gravity less than 2.65. As may be seen the 7.3Å peak is enhanced and the 7.1Å peak is diminished relative to the as-received sample. Curve 2A (step scan across the 14Å region) shows no 14.6Å peak.

Based on the above step scanning data there is good reason to suspect that serpentine is present in Sample 32-71-S. It is possible that other minerals such as kaolinite or a very iron rich chlorite could give similar data. However, based on the geological and chemical factors associated with this sample, it is more probable that chlorite present will be magnesium-rich rather than iron rich and that serpentine is a more likely occurrence than kaolinite.

Microscopic examination of the fraction with a specific gravity less than 2.65 revealed very minor (1%) amounts of possible serpentine fibers. Identification of the serpentine was facilitated by staining with 1% iodine in glycerine.

It is recommended that further work be done on this sample.

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