

Fibrous and Mineral Content of Cosmetic Talcum Products

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☐ In searching for sources of fibers ubiquitous to our everyday environment and of respirable size, the authors examined 22 talcum products commonly available on retail shelves and found fiber contents ranging from 8 to 30% by count, with an average of 19%. Fibrous particulates were generally under $1.0\ \mu$ in diameter with lengths ranging from 1.5 to $6.0\ \mu$. From 0.3 to 3.0% quartz was found in 21 of the samples and the remaining sample had 54.4% quartz. The samples were also analyzed for metals; with four exceptions, the levels of cobalt, nickel, chromium and manganese were low. Further research will be needed to assess the significance of these findings.

R EPORTS OF FINDING pulmonary fibrous bodies, previously referred to as "asbestos" and now as "ferruginous" bodies, in the lungs of persons coming to autopsy in hospitals in a number of cities have recently been increasing. The first report of these morphologically distinctive fibrous bodies in the sputum and lungs of asbestos workers was made in 1906 by Marchand.¹ Current interest dates from 1963 when Thompson *et al.*² found these fibrous bodies in the lungs in 26.4% of the autopsies in a series of examinations in Cape Town. Subsequent investigations³⁻⁹ provide evidence that the occurrence of these bodies in the lungs of urban residents is not restricted to those in isolated localities and is not a one-time chance observation.

The identity of the fibrous core of these coated bodies, however, was never determined by the investigators. The fibers were routinely considered as asbestos bodies on the basis of their morphological structure.

In searching for the sources of these ubiquitous fibers, Cralley *et al.*⁹ reported that talcum powder contained a significant percent-

age of respirable fibers and was a potential source of the ferruginous bodies observed in the lungs of humans. This observation led to further study to characterize cosmetic talcum products.

The major purpose of the investigation reported here was to develop and present data on some of the constituents found in cosmetic talcum products and to discuss their health aspects in the light of today's knowledge. It is not our intent to make a general appraisal of health factors in the use of talcum products because of the many variables involved and the limited data available on the consumption of various "sources of talcs" in the formulation and use of cosmetic talcum products. The potential health aspects of some of the data, however, are discussed.

Twenty-two cosmetic talcum products (representing body powder, bath powder, and all purpose powder) purchased off-the-shelf, were analyzed for fibrous content, selected metals, and quartz. The data and a discussion of their possible significance follow.

Analysis of Talcum Products

Talc is a natural mineral, hydrous magnesium silicate, with the general formula (OH):-

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TABLE I
Designated Analyses of Cosmetic Talcum Products

Talcum Product No.	% Fibers	% Free SiO ₂	ppm*				mg/gm**						
			Co	Cr	Ni	Mn	Zr	Ti	Zn	Fe	Mg	Si	Al
1	19	0.3	13	9	13	16	<10	0.9	ND	20	>10	>10	50
2	21	0.4	<10	<10	<10	23	"	0.5	5	10	"	"	6
3	23	0.2	<10	<10	20	78	"	0.3	ND	7	"	"	5
4	19	2.2	67	240	1270	55	"	0.8	40	30	"	"	40
5	30	0.6	<10	<10	14	<10	"	0.2	ND	6	"	"	5
6	18	1.5	21	14	16	13	"	0.1	"	15	"	"	60
7	14	2.1	ND	<10	17	14	"	0.4	"	10	"	"	5
8	19	3.6	< 9	329	479	45	"	0.3	"	15	"	"	3
9	21	53.4	<11	ND	<10	14	20	20.0	ND	8	0.5	"	>100
10	8	0.9	25	<12	24	33	<10	30.0	40	12	>10	"	30
11	8	1.4	18	22	20	61	"	20.0	10	50	"	"	40
12	25	1.3	10	13	17	41	"	0.8	ND	10	"	"	8
13	26	1.7	ND	<10	<10	19	"	0.8	"	10	"	"	10
14	28	1.3	<10	10	<10	26	"	0.8	"	10	"	"	15
15	28	1.9	<10	<10	16	24	"	0.3	"	10	"	"	9
16	12	1.2	<11	<11	16	62	"	10.0	"	20	"	"	15
17	13	1.7	<10	10	19	70	30	10.0	"	20	"	"	12
18	16	0.4	16	< 9	14	18	<10	0.5	5	15	"	"	40
19	18	1.0	<10	<10	21	16	"	0.7	ND	10	"	"	6
20	16	1.2	22	10	29	50	"	0.8	40	10	"	"	40
21	25	3.3	10	9	19	26	"	0.6	5	10	"	"	10
22	14	0.5	14	1170	1210	84	"	0.3	ND	30	"	"	4

*Microgram of metal per gram of sample.

**Milligram of element per gram of sample.

Mg₃Si₄O₁₀. Talc mineral is formed by the hydrothermal alteration of serpentine and tremolite or directly from unserpentinized ultrabasic rocks. Talc may also be formed by the thermal metamorphism of silicious dolomites.¹⁰⁻¹² The characteristics of the mineral deposits vary widely from the pure talc formula and from each other according to the mineralogy involved. Some deposits may contain varying amounts of tremolite, chrysotile, pyrophyllite, or serpentine, or other basic material from which the talc may be derived. The deposits may also contain varying amounts of metals such as iron, nickel, cobalt, chromium, and manganese as associated minerals, as well as silica. Cosmetic talcum may be basically pure talc or may be a formulation of talc with other materials such as clay, chalk, stearates, etc. Zinc, titanium, manganese, and iron compounds may be added as pigments and opacifiers.

The particle-size distribution and percentage by count of fibers in the talcum particulates were determined by dispersing the talcum in water, filtering the mixture through an "AA" membrane filter, and measuring with a phase contrast microscope at 430

magnification. The percentage of free silica was determined by x-ray diffraction. Cobalt, chromium, nickel, and manganese were determined by means of atomic absorption spectrophotometry. Zirconium, titanium, zinc, iron, and magnesium were determined by means of semi-quantitative emission spectrography.

Table I gives analytical data on 22 different cosmetic talcum products. Figures 1 and 2 are representative photomicrographs of two talcum specimens showing the presence of fibers.

Size Distribution of Talcum Particulates

Seven of the twenty-two talcum products were selected for size-distribution measurements of the fibrous and non-fibrous particulate components.

The diameter of 80 to 95% of all the particulates in these samples was under 5.0 microns (μ). The median of the diameter of the non-fibrous particulates in the seven products ranged from 0.7 to 2.0 μ , with a median average around 1.0 μ .

A fiber is defined as a particulate having at least a 1:3 ratio of diameter to length. The fibrous particulates in the seven products were



FIGURE 1. Photomicrograph of talcum specimen showing presence of fibers (430 X).



FIGURE 2. Photomicrograph of talcum specimen showing presence of fibers (430 X).

generally under 1.0μ in diameter, with lengths ranging from 1.5 to 6.0μ .

The 22 talcum products analyzed showed fiber contents ranging from 8 to 30% by count of the total talcum particulates with an average of 19%. Although the specific fibrous materials were not identified, they were predominantly fibrous talc, as shown by x-ray diffraction, with the probable presence in minor amounts of other fibrous minerals such as tremolite, anthophyllite, chrysotile, and pyrophyllite.

The electron microscope, with its higher power of resolution, shows a number of sub-micron diameter particulates not visible by means of phase contrast microscopy.

Free Silica

In 8 of the 22 talcum products (Table I), the presence of quartz ranged from 0.3 to 1.0%; in 13 products, 1.2 to 3.0% quartz, and in 1 product, 54.4% quartz.

Metals

With the exception of talcum products Nos. 4, 8, and 22 (Table I), the cobalt content of the products analyzed was under 25 parts per

million by weight (ppm), chromium under 22 ppm, nickel under 29 ppm, and manganese under 78 ppm. Product No. 4 had a nickel content of 1270 ppm; chromium 340 ppm; and cobalt, 67 ppm. Product No. 8 contained 479 ppm nickel and 329 ppm chromium. Product No. 22 contained 1210 ppm nickel and 1170 ppm chromium. Qualitative tests showed some of the chromium in the talcum products to be in the hexavalent state. The nickel, chromium, cobalt, and manganese in the talcum products may have come from the talc mineral deposit¹⁰ or from the alloy metals of the pulverizing equipment used in reducing the talc.¹³

The zirconium content of the products was all under 10 milligrams per gram (mg/gm) except for products Nos. 9 and 17, which had 20 and 30 mg/gm respectively. The titanium, zinc, and iron ranged from a few tenths to 50 mg/gm of talcum and were probably present as pigments or opacifiers. The magnesium content of the products was over 10 mg/gm, except for product No. 9 which had only 0.5 mg/gm. The magnesium was probably present as an additive in the formulation or as a part of the talc molecule or other amphiboles in the products.

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