Talc MITAL - functional solutions for varnish-and-paint materials

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According to data by F.Lehner talc is the third mineral filler in Europe by its volume of usage in varnish-and-paint materials (VPM) industry (275.000 tons per year). Widely spread, talc is equal to none of the fillers in its variety of brand assortment by functional properties. This is explained first of all by the fact that talc is practically versatile and may be used as functional filler.

The properties of talc used as VPM filler depend on the natural properties of mineral raw material and technology of processing. That's why when analyzing functional properties of talc used in VPM industry it is expedient to distinguish the two reasons which determine them.

Natural characteristics of talc:

- Mineral composition. Talc producers pay most attention to its study since the mineral structure in particular determines to the utmost the chemical composition, solidity and elasticity of talc particles, and only partly determines the main technological properties of this filler. We should display the main mineral-constituent complexes of marketable talc especially in combination with their positioning by major world producers:
- MONDO Minerals (and other European talc subdivisions of OMYA) works with carbonate-type talc from Scandinavia (floated and natural talc magnesites), China and Australia. The usage of efficient floating concentration methods ensures the generation of high-concentrated marketable talc with stable from main raw material – talc magnesites. According to this the company lines up its priorities of talc usage in industry;
- Luzernac company – the world's largest talc producer – actively uses chlorites and their associates along with carbonate-type talc, and complex talc-containing products as well. At the same time the chlorite-type talc is featured by the company as raw material having unique properties for critical domains of usage including VPM industry;

- crystallographic peculiarities of the mineral complex which determine its optical constants, dominating fractional composition of pounding products; morphology of particles affecting the degree of anisotropy;
- chemical composition of talc. Some producers groundlessly maximize these properties. However, it's important to keep in mind that the chemical composition of available surface of particles is more important for the usage in VPM industry rather than the average chemical composition of talc. In its turn, it is formed by the substances which are artificially immobilized onto the surface of the particles during production (pounding, surface processing). At this the ionic and rheological properties of talc, its pH, hydrophilic-hydrophobic balance, value, sign and position of surface charges, other properties;
- natural color properties are of secondary importance in the usage of talc. In subsequent production they may be altered by optical bleaches, color pigments or coloring agents. But in most cases these are more costly techniques than the choice of naturally white talc. Acceptable color properties determine the suitability of the usage of talc in white coatings and as a component of clear tone pigment pastes for the sake of saving white pigments.

Properties conditioned by the processing technology:

- morphological surface properties including the shape of the particles (plate, scaly, fibrous, block), surface condition (degree of irregularity), degree of anisotropy. These properties are affected by both natural factors and processing technology. These properties determine the effectiveness of talc application as a component of VPM.

Protective properties of the filler (barrier effect) are determined by the length of the way of aggressive media to the protected surface and by the number of the phase separation frontiers for absorption of UV-radiation through a multi-layer structure of talc particles in the coating. The greater the characteris-

tic correlation of filler particles and the better they are dispersed, higher spreading capacity and UV-, atmosphere and corrosion-resistance may reach VPM and coatings which contain them.
Hardening of the coatings which contain talc is due to the participation of the filler in orientating macromolecules of polymer, relaxation of resulting tensions and deformational effects in the polymer matrix;
- chemical composition of particles surface determines such filler characteristics as wettability, adhesion to polymer and other surfaces, ionic and sorption surface properties, acid-base balance, lyophilic behavior, anticorrosion and electric properties, polarity, surface energy value etc.
Chemical modification of filler particles surface is enhancing or regulating of natural chemical and physical properties according to the domain of use. The use of modified talc is a way to reduce outlay during processing and to achieve additional functional advantages during operation. For surface processing of fillers GEOKOM uses functional polymers, silicon-organic and other finishes and their complexes;
- size and granulometric distribution of particles affect rheological properties of the VPM, its spreading capacity, sedimentation stability, mechanical properties of the coating. The use of makes of talk well-founded by particles size and distribution is a way to create a well-balanced recipe of VPM. The main approach which GEOKOM Company applies to filler production, including MITAL, is forming narrow fractional composition with maximum density particles packing and providing variant types based on average size. Therefore it's possible to choose any type of MITAL with necessary dispersion ability for virtually any application. In order to retain the advantages of macro-scaly difference of chemically modified talc it's necessary to use dispersive equipment which does not provide intense pounding and surface development. It's important to consider that mechanical methods of talc pounding, especially high-active methods, affect forming hydrophilic-hydrophobic surfaces of particles, their size, free surface energy balance etc. [1]
Due to the diversity of natural properties of talc it often happens that the properties of the same mineral type vary considerably from one specific deposit to another. GEOKOM uses mineral raw material from several deposits which have individual technological qualities and supplement or partly substitute for each other. The assortment of MITAL talc is determined by the morphology of particles, since the shape of the particles and their anisotropy, according to our opinion, are the distinctive parameters of talc which consider both the properties of the origin of the mineral and its processing technology. Other properties may be provided by ore-dressing, surface modification or fractioning, for instance. Subsequent differentiation of assortment of MITAL types is made by their whiteness and granulometric composition.
MITAL of grades "92", "97", "99" is large-crystal talc ranging from white-grayish to bright white color, may have insignificant inclusions of carbonates (dolomite, magnesite); macroscale-type particles prevail with high shape and elasticity factors and small thickness. These grades of talc are most versatile in use since they combine quite high anisotropy of particles, softness (1-1.5 according to Moos scale) and whiteness (up to 99% according to CIELab, ISO 787/1). A large variety of dispersion ability grades is available: 3 to 30 mkm by average median diameter of particles.
MITAL of grades "90" and "96" is middle-size crystal talc of white-grayish and white colors in association with chlorite/clinochlore (magnesia aluminum silicate with flaky micaceous crystalline structure) may have insignificant inclusions of carbonates, middle-size scales and lamellar differences prevail. These grades of MITAL are versatile and efficient; their undressed forms have high surface energy of particles and increase chemical stability of surfaces (probably, due to the presence of aluminous clinochlore groups), and are characterized by slightly higher hardness (1.5 – 2.0 according to Moos scale) and flexibility of particles. These grades may also be supplied in granulated form in order to reduce dust formation and facilitate dosing. According to data by Luzernac [2], chlorite-type talc has comparably low need for film formers and ensures higher solidity of varnish-and-paint coatings and UV protection, increased color stability while ageing of the coating, etc. Besides, they are safer from the ecological point of view since the maximum allowable concentration of chlorite in air is 4 to 5 times higher than that of talc.
MITAL of types MT-GShM, MT-KhS, MT-EGS is small-crystal talc of light-grey color of steatite type (deposit of Onotskoye). Depending on selectivity degree during production may have various inclusions of carbonites and chlorite; micro-size particles and blocks are easily generated during pounding. On the basis of this type of talc the State Standard GOST 19284-84 was elaborated in the USSR.
MITAL of type "80" is polycrystal talc of grey color in association with magnesite, particles of scale-plate and block types, enriched with anti-rust additives, which determines its major application field – primers and enamels for protective coatings.
It's not easy to ensure the optimum properties of talc without excessively increasing the cost of product. It's understood that in the conditions of various demands of the industry the tendency for maximum compliance must be restrained by the allowable price limit. Most often just a few parameters and the

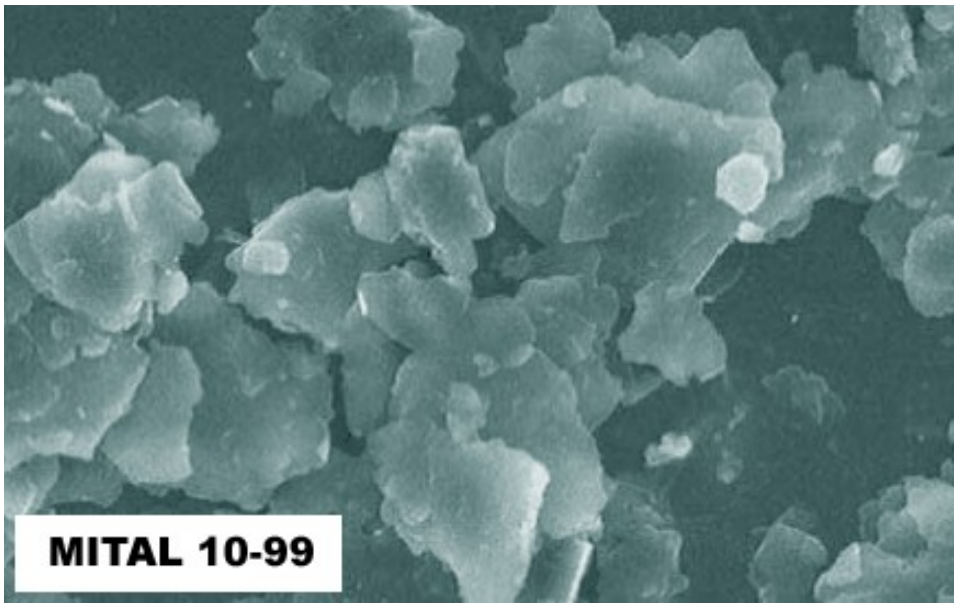
guarantee of minimal price are important. Thus, considering all the variety of the specific properties of talc we may nevertheless point out the most important ones for a specific domain of application. So, color is not important when talc is used in primers, but may be a determinative factor when white silky or mat coatings are created. The lack of inert (carbonate) admixtures in talc is not critical if carbonate fillers are included in the VPM recipe, etc. Things which are important are correct analysis and well-founded priorities.

Correct comparison is the basis for correct decision, since otherwise it is hard to get evaluation which would be adequate to actual quality. VPMs are multi-factor models. As for fillers, in most cases it is possible and sufficient to get adequate express-evaluations of main parameters: color properties, granulometric distribution, film builder absorption, milling degree, spreading capacity, etc. In case when these evaluations are based on more complex recipe comparisons, it's advisable that the qualitative modification of the studied parameter would be entailed by recipe optimization for the value of this parameter with observing recipe limitations. And most often the qualitative and cost evaluation of consequences should be applied; otherwise the results may be inadequate. For instance, in [3] various types of talc of different mineral and chemical composition and dispersion ability (D_{50} = 7.3 …22.7 mkm by Sedigraph) were compared when used as components of polyether paste fillings made according to the same recipe without considering properties of different types of talc. It's scarcely correct to analyze the properties of the fillers recipes without considering the change of viscosity when the same amounts of talc with different dispersing ability are used, for when other conditions are equal, larger fractions have smaller specific surface of particles and consequently smaller need for film builder.

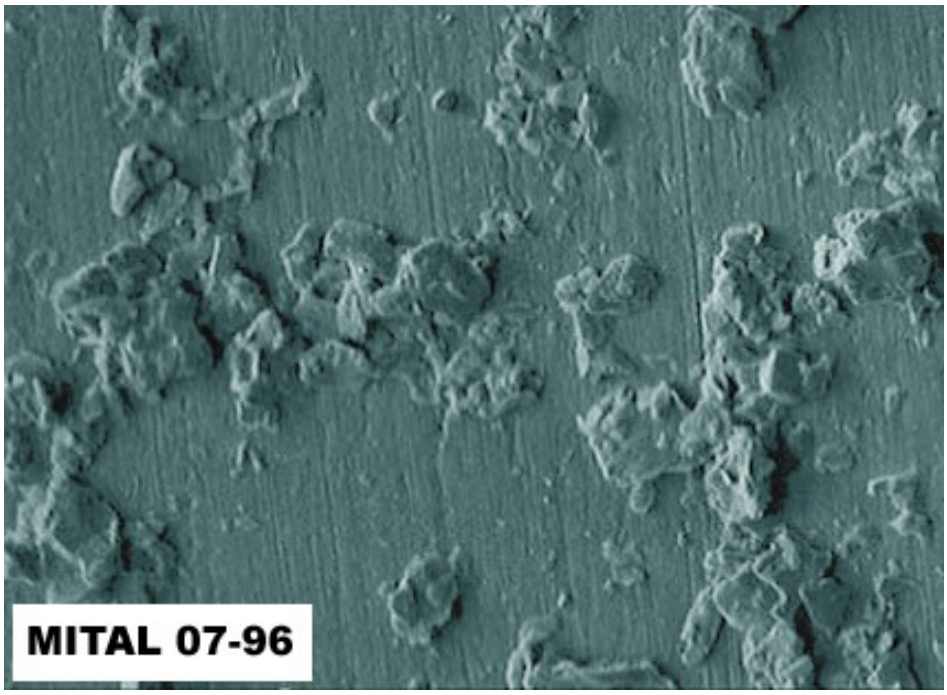
This approach could lead to the fact that, in particular, narrow-fractioned talcs MITAL 15-96 and MITAL 15-90 elaborated by GEOKOM especially for high-filled heavy duty systems. Their usage allows generating higher filled compositions. Therefore it's necessary to consider the impact of the differences which are a function of differences in oil absorption [2].

This approach could lead to the fact that in particular narrow-fractioned talcs MITAL 15-96 and MITAL 15-90, elaborated by GEOKOM especially for high-filled heavy duty systems (fillings, middle- and large-dyspersated primers and decorative compounds) will have no advantages. However this problem was solved by GEOKOM considering the specificity of these materials: the fractional composition of talcs MITAL 15-96 and MITAL 15-90 is formed so as to limit the presence of relatively large-dyspersated fractions which worsen the decorative properties of the coatings and hamper the application of fine layers, and the presence of fine-dyspersated particles which leads to increase of absorption of costly film-builder and reduces the value of KOKP. At the same time the threshold of fine-dyspersated part is defined in such a way as to form marketable fraction with minimal reproducible value of film filler absorption (depending on the technological production facilities) and with maximal density of particles packing. At the same time this improves grindability of filling coatings.

The table presents functionally significant properties of talcs Finntalc and MITAL used in production of fillings.



Indicator	Finntalc		MITAL	
	M50	M30	15-90	15-96
Color preferences:				
whiteness Wlab, % (ISO 787/1, C/2°)	91.0	90.7	90.2	95.3
yellowness, % (ASTM D1925-70, C/2°)	4.8	2.7	3.2	2.9
brightness Ry (DIN 53162, C/2°)	79.1	77.9	78	90
reflection index R457, % (ISO 2470)	76.6	75.8	77.0	87.0
Leftover on the sieve, %				
No. 0063	4.6	0.9	0.3	0.4
No. 0045	32.0	6.2	3.5	4.4
Dimension of particles, micron (defined by “Microsizer 201” unit)				
Average (D50)	39.6	15.4	15.7	15.3
Maximum (D98)	103	68	62	65
Minimum (D10)	6.5	4.1	3.8	3.6
Grinding degree, micron	55-60	35-40	35-40	35-40
Oil absorption, g/100 g	23	31	20	21

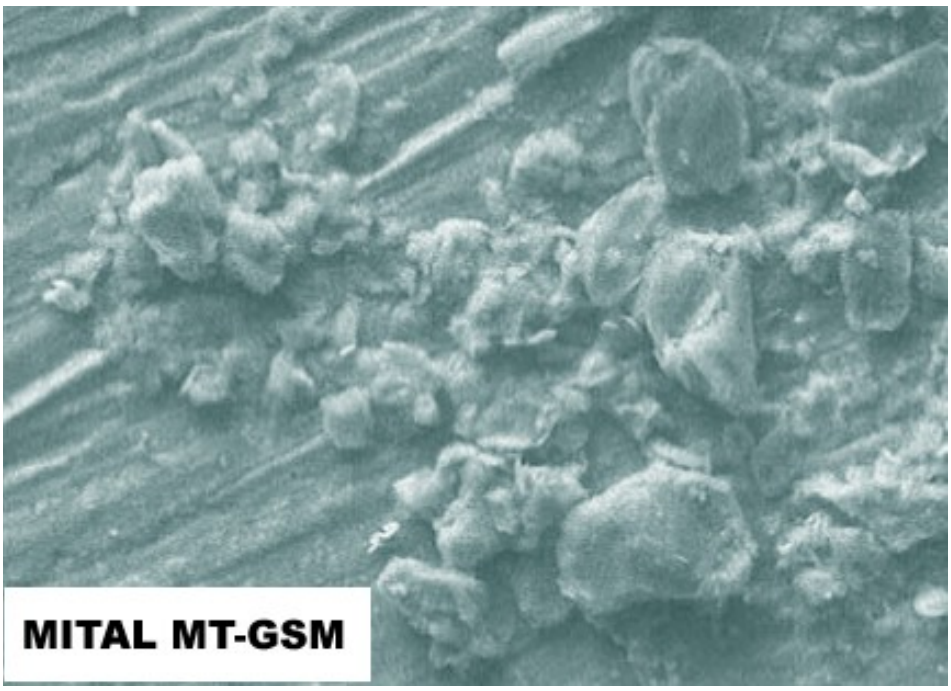


From the data of the table follows that the types of MITAL 15-96 and 15-90 which granulometric characteristics are close to those of Finntalc M 30, have the following properties:

- considerably lower oil absorption, reaching that of Finntalc M 50. This is conditioned first of all by the mineral composition (presence of chlorite) and specific state of the surface particles of these talcs, as well as by more compact packing, allowing to obtain VPM with higher filling degree;
- type “90” has close color properties to that of the two Finntalc types. The usage of the “96” type allows to obtain whiter fillings or to reduce the consumption of white pigment.

On the other side of MITAL assortment range of dispersion ability are the types MITAL 03-99, MITAL 03-96 and MITAL 03-90 – types of extra fine-dyspersated talc. The technology of its production has been perfected by GEOKOM over the last 2 years. Their application ensures both maximum sedimentary stability, viscosity of compositions, solidity and protective properties, spreading capacity, whiteness and minimum impact on coating brilliance as well.

Talcs with medium size of particles remain the most demanded among the assortment of GEOKOM produce (7-10 microns defined by the method of laser light diffraction): types “80”, “90”, “92”, “96”, “99”. Their application allows resolving various problems of quality management of water-dispersive and organic-diluted VPM.



GEOKOM willingly cooperates with VPM producers on the issues of choice of specific types of its produce, since the opportunity of narrow fractioning of fillers and consideration of natural properties of raw material are just a part of available variety of optimization versions, including very efficient and numerous modification technologies.
Partnership relations, well-grounded problem statement and combined effort for solution are the major components of success.

1. **Yildirim I.** Surface Free Energy Characterization of
Powders. Dissertation. Virginia Tech., 2001.
2. **Jakeman R., Pauly J.J**. **Formulating with fine talc-chlorite grades in decorative paints.** EUROPEAN COATINGS. №12. 2004.
3. Talc in Polyester Putties. Technical Bulletin 1502. Mondo Minerals OY.