Talc

Plastics bring out the best

by Dr. W. Schober* & Mike O'Driscoll, *Editor*

The last seven years or so have seen a marked change in the structure of the talc industry. The players are now fewer, the competition even tighter. From a market viewpoint it simply means that suppliers now have to guarantee even higher product quality than before in order to compete. Without question, the ever expanding Luzenac Group has hit the headlines most frequently with its steady acquisition programme of major and minor talc producers. With signs of recovery underway from the early 1990s' recession, the ceramics and paints markets should begin to bounce back, although the primary growth area for talc remains in the plastics sector, with some bright prospects in the paper market.

Talc types

Usage of the term talc does not reflect the diversity of this mineral in nature and it can be very confusing for the talc using industries to make the right differentiation. On the one hand, talc is a pure magnesium-silicate that can be found for example in Italy, India, China, Australia and the USA, while on the other hand, it is a general term for a polymineralic rock. Several terms are applied to talc:

Steatite is a fairly compact modification of talc, found in many cases in micro-crystalline form. This technical term also describes the mineral suitability for use in electrical insulation. Alumina and iron content are each limited to 1-1.5% in order to meet the requirements of the electroceramic industry.

Soapstone describes impure block talcs, which are sufficiently massive for cutting.

Talc is most frequently accompanied by **chlorite**, where the Mg^{2+} ion has been substituted by an Al^{3+} ion (eg. talcs from France, Austria, Italy, etc.). Chlorite has similar properties to pure talc and also has a lamellar structure which is useful in most of the typical applications.

The minerals most commonly associated with talc and chlorite are:

Carbonates	Magnesite	Norway, Italy, Finland
	Dolomite	Austria, Italy, USA, China
Mica	Sericite	Austria
	Muscovite	Austria, South Africa
Quartz		Austria, France, Spain, Turkey
Tremolite		USA, Sweden

Apart from their mineralogy, talc and chlorite deposits are classified by brightness and platy structure (aspect ratio). Lamellar talc is the most common modification. The compact, structured talc very rarely occurs in Europe (only Germany, Spain) and the main deposit is to be found in Australia. This type of talc is mainly used for electroceramics and only shows poor properties for plastics.

Pure talc is characterised by its hydrophobic properties, its slipperiness of surface, and the lowest Mohs' hardness of 1. Commercial talc grades are harder due to impurities. The crystal shape of talc is lamellar. Crude talc colours are grey to green, and rarely white. Talc is inert in most chemical reagents, while chlorite has a higher solubility.

Production round-up

Clearly, the most significant change in the talc supply industry has been the increasing influence of the *Luzenac Group* during the early part of the 1990s. The group, a member of UK-based natural resources giant *The RTZ Corp. PLC*, is now the world's largest talc producer. The accompanying tables tell the story of increasing domination in the market place by Luzenac.

Of course, Luzenac's most significant acquisition was the talc business of *Cyprus Minerals Co.* in 1992. This move brought in operations throughout North America, and also overseas in Belgium and Spain. Subsequent to this, Luzenac gained another US talc operation through the acquisition of *Montana Talc Co.* in mid-1994. By the end of 1995, Luzenac intended to merge its two Spanish subsidiaries into one company called *Luzenac SET*.

Outside of the Luzenac network, the few remaining major players are located in Finland, Norway, Italy, China, South Korea, India, and Australia. Smaller producers are located in Canada, Sweden, the UK, Brazil, Mexico, and South Africa.

Of note is the fact that Finland's largest papermaker, *United Paper Mills* increased its share of talc producer *Finnminerals Oy* to 100% in early 1994.

Other highlights beyond the Luzenac empire include an increase in production capacity during 1994 by *Haicheng Talc Mine Co.* of China to 200,000 tpa. In early June 1993, *Pegmin*

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Major talc producers

Producer/Country	*Location (mine/plant(p))*	*Production (tpa)*
Luzenac Group		
Talc de Luzenac, France	Trimouns/Luzenac-sur-Ariège	300,000
Luzenac Naintsch, Austria	Rabenwald, Lassing, Kleinfeistritz/Oberfeistritz, Lassing, Weisskirchen	160,000
Luzenac SET, Spain	DIMTA, Malaga	20,000
	SET, Respina, Puebla de Lillo/Boñar León	30,000
Luzenac Val Chisone, Italy	Fontane,Crosetto/Malanaggio	50,000
Luzenac NV, Belgium	Ghent (p)	55,000
Luzenac America, USA	Antler, Yellowstone, Beaverhead/Three Forks, Sappington, Montana	550,000
	Hamm, Ludlow, West Windsor,Vermont	est. combined
	Canfield, Ohio (p)	10,000
	Grand Island, Nebraska (p); Alpine, Alabama (p); Houston, Texas (p)	
Luzenac Inc., Canada	Penhorwood/Timmins, Ontario, St Pierre de Broughton,Quebec	70,000 (combined)
Other majors		
Australia		
Western Mining Corp.	Three Springs	160-200,000
China		
Haicheng Talc Mine Co.	Fanjiapu, Liaoning	200,000
Finland		
Finnminerals Oy (owned by United Paper Mills)	Sotkamo, Polvijarvi/Vuonos, Kaavi	360,000
India		
Golcha Group	200 mines in Rajasthan	250,000
Khetan Business Corp.	Udaipur	50,000
Italy		
IMI Fabi	Lanzada/Torre St. Maria	100,000
Netherlands		
Westmin Talc (owned by Western Mining)	Amsterdam (p)	30,000
Norway		
Norwegian Talc Minerals (ultimate owner Plüss-Staufer)	Altermark, Framfjord, Knarrevik	35,000
South Korea		
Il Shin Industrial Co. Ltd	Dongyang, Chungchongbuk	30,000
USA		
Barretts Minerals (ex-Pfizer, now Minerals Technology Inc.)	Barretts, Montana	200,000
R.T. Vanderbilt	Balmat, New York	230,000

(Pty) Ltd of South Africa commissioned two new micronising plants for feldspar and talc production. In early 1993, *Talco Sardinia* planned to start up a talc processing facility near Orani, in the Nuoro area of Sardinia. However, technical, commercial, and logistical reasons prevented the project coming to fruition.

In Italy, *IMI Fabi* recently acquired Luzenac's subsidiary *Unitalc*, and is now the country's leading talc producer.

Late 1994, saw *Zemex Corp.* of Toronto, Ontario (owner of *The Feldspar Corp.* and *Suzorite Mica Products Inc.*) acquire cosmetic grade talc producer *Clark Minerals Inc.* of New York state, and ceramic talc producer *Pioneer Talc Co.* of Texas.

South Korea's *Il Shin Industrial Co. Ltd*, while suffering bankruptcy through 1993, is nevertheless continuing to produce talc in the face of cheaper Chinese imports — some 32,000 tonnes was produced in 1994.

White talc in demand

Talc is available in large quantities around the world, but large scale occurrences of high brightness talc are relatively rare. Not many European talc mines contain white talc with brightness levels above 90. It is important to note that when talking about talc mines one has to consider that only a certain past of the extracted mineral exhibits the highest brightness values.

For example, the mines of *Talc de Luzenac* at Trimouns, France only contain about 1% talc with a brightness of 90 (approximately 2,000 tpa), but none with higher values.

In contrast, Luzenac's Italian operation, *Luzenac Val Chisone*, is able to gain more than 30% high brightness talc from its mine, and has been extracting very white (>90) talc from its Fontane and Crosetto mines since the beginning of this century (some 40,000 tonnes were extracted in 1994, 50,000 tonnes was forecast for 1995).

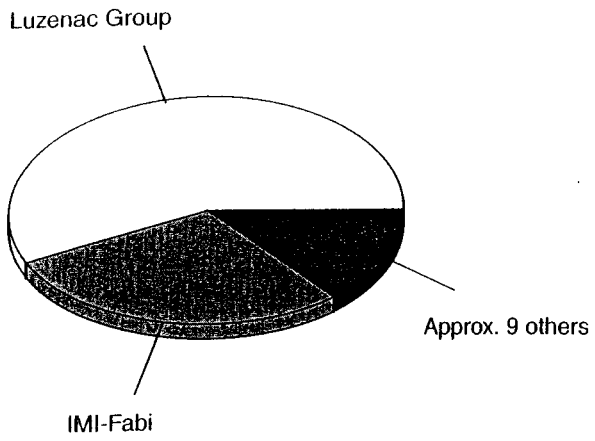

Figure 1. Talc suppliers for PP in Europe 1993 (estimated market share)

Moreover, new talc resources estimated at 2m. tonnes were delineated in 1993 in an extension of Val Chisone's mined deposit beneath the Rosetto valley. The talc is similar mineralogically and in quality, particularly its brightness. Production from this new section of the deposit is expected to start before 2000.

Finnminerals Oy refines a small tonnage (3-5,000 tpa) of white talc exceeding 90 brightness at its Kaavi plant by flotation. That volume is not exciting compared to the requirement for white talc for the plastics industry.

As the European market has a much higher demand for white talc grades, the talc mining industry used to import material from overseas. Talc de Luzenac and *Luzenac Naintsch* imported from India and China, Luzenac Val Chisone from China, *Norwegian Talc* from India, China and Egypt, and *IMI-Fabi* from China.

Total imports of lump talc to Europe amount to around 100,000 tpa. Most of the volume is medium brightness talc (from Australia and the USA) with only 20-25,000 tonnes of that volume having a brightness exceeding 90. Most of that quality is sourced from China and India.

China and India have excellent reserves of high brightness talc. However, not all talc arriving from these countries is of adequate and acceptable qualities. Sometimes asbestiform by-products could also be found.

China exports nearly 700,000 tpa of lump talc and about 500,000 tpa of ground powder talc. The main destinations are Japan and South Korea. Talc imports from China are increasing at the moment, as are the number of offering parties, but the talc grades arriving in Europe are very often selected on price rather than quality. Good qualities cost money, because ore selection by hand and careful handling involve additional costs in China.

Market applications

The main filler markets for talc are paper, paints, and plastics, with the latter representing talc's main growth area (and as such is examined in detail below). The total European talc market has been estimated at approximately 1.2m. tonnes.

In the **paint** industry, talc is used for its platiness and chemical resistance either to create internal porosity in decorative paints, improving their opacity so as to minimise the use of more expensive titanium dioxide pigment, or in protective coatings where resistance to corrosion is desired.

The low hardness of talc permits it to be used in putties and primers in order to obtain easy sandability.

In contrast to the USA where nearly all talc in **paper** is used in pitch control, European talcs are widely used as fillers and coating pigments. The major consuming countries for paper filler talcs are Finland, Sweden, France, and Germany; for talc coating pigments, Finland (especially in lightweight coated papers); and for pitch control, Germany, Sweden, and Finland.

Owing to the switch from acid to alkaline papermaking, well-established in Europe and more recently introduced in North America, there has been increasing use of ground and precipitated calcium carbonate in paper, at the expense of talc and kaolin.

Another sector in the paper market, that of recycling paper, has given talc a potential growth market for use as a deinker. Recycled paper may use up to 10-15% of talc.

Other market applications such as **animal foodstuffs, fertilisers, rubber,** and **asphalt roofing** consume talc owing to its combination of platiness and water repellency serving to prevent the caking of powders or pellets.

Talc in thermoplastics

Talc has been used in polypropylene for more than a decade. This sector is the biggest outlet for talc in plastics. Total consumption in Europe is approximately 90,000 tpa. Talc can be divided into two groups by brightness – the whitest grades (>90) for white, crayon-colours and opaque PP, and all other grades for grey and black compounds.

Competition is increasing, as the other talc and mineral producing companies also try to participate at a higher rate. Some of the toll grinders mentioned above are also trying their luck to fill capacities of their grinding units.

Nevertheless only a few of the established talc mining companies are major players in this business. The major talc suppliers for PP in Europe are Val Chisone and IMI-Fabi of Italy and Talc de Luzenac of France.

In the 1980s, mainly 200 and 325 mesh talc was used. This generation of compounds has been surpassed and 30μ and 20μ topcut talcs have been the standard for two years. Even 10μ products started to be used on wide scale last year. The life cycles of talc products are becoming shorter and shorter. The increasing fineness will introduce a new limit to the number of potential suppliers because the grinding facilities required are highly specialised and expensive.

The technical reason for the increasing use of ultra-fine talcs in PP is to improve mechanical and surface properties.

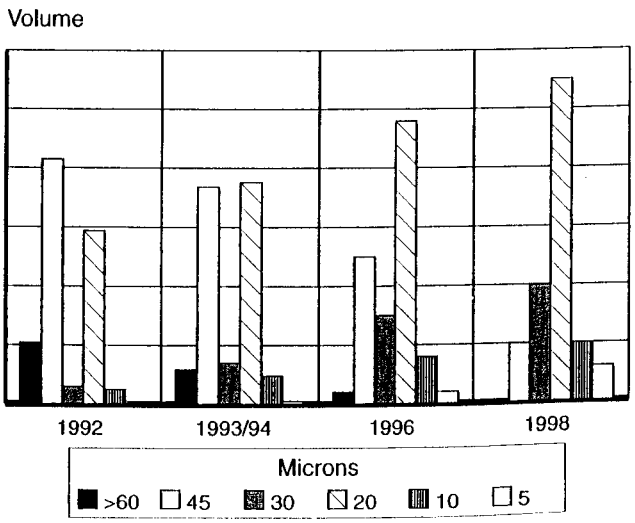

Figure 2. Talc product mix in Europe by fineness (estimates for the near future)

Having appreciated these quality aspects, many compounders intended to take advantage but failed to find suitable feeding equipment for their screws. Today only a few companies are able to compound talc grades of 8μ topcut and less due to the highly fluidised nature of these talc products. However, it is likely that machinery suppliers will soon find economic ways for compounding ultra fine products.

The talc industry has not yet been successful in developing suitable compacting methods for ultra fine talc grades. Talc granules made from wet pellets risk remaining moist while talc granules made by dry mechanical evaporation systems sometimes show promising results, but the reproducibility is missing.

This increase in specific weight will be important for compounders in solving feed problems. It is also important for mineral suppliers for transportation reasons.

Nevertheless, it is necessary to consider that prices for micronised talc were much higher in the past and did not offer good cost performance for the compounding industry. The recession in plastics, the increased competition among talc producers, and the improved and more efficient grinding technology have also resulted in a change in this segment. Meanwhile, 20μ talc has become reasonably cheap recently, so we can expect the same for finer grades in future.

For delamination of minerals it is important to consider both high energy and investment costs. Toll grinders and newcomers often use ball or impact mills, as used for ceramic minerals and clays. Besides the risk of contamination, talc's platy structure cannot be preserved in the same way.

Micronised talc has been used for the nucleation of PP for more than 10 years now. This sector is small and represents a potential volume of less than 2,000 tpa. Only the purest talcs are used, with the main suppliers being the Luzenac group and IMI-Fabi.

Other plastics applications

LLDPE

Micronised talc is increasingly used as an anti-blocking agent for films where pyrogenic silica could be replaced. Most of the film producers have started advanced trial work or are already using ultra fine talcs.

In order to maintain good colour and transparency, only the whitest and purest talc can be used. Addition rates are up to 2,000 ppm. Fineness was formerly 10μ, but should be at least 8μ, or even a 5μ topcut. The extremely high prices for these ultra fine talcs limits their usage.

This application will never be a huge outlet for micronised talc, since the potential in Europe is not more than 4,000 tpa. Nevertheless, it will help to generate good volumes and economies of scale for production of these ultra fine grades, from which other sectors such as PP will also benefit.

Polyamide

This sector does not show any sign of dramatic development. A small tonnage of silane treated talc is used for Nylon 6.6 and 6. The future potential for this market sector is somewhat limited, for the following reasons:

1. Without surface treatment, talc only offers poor technical improvement. The main target of silane treatment is the linkage between the polymer matrix and the talc.

2. Since talc does not have elastic plates, the impact resistance cannot be much improved or maintained.

3. Calcination of talc was tried in the past to improve the strength of the mineral. This measure does not seem to be the right solution as most talc properties are lost and calcined clay provides better and cheaper performance.

For these reasons it is believed that all types of polyamides will provide an outlet for wollastonite, calcined clays and mica, but not a realistic potential for talc.

EPDM

This market segment does not really exist in Europe. In the USA there is a market for single-ply membranes for roofing insulation, where EPDM plays an increasing role. The big rubber companies (*GoodYear, Dunlop, Firestone*) are mainly involved in this business. Treated talc of 10μ and high specific surface (15-17m^2/g) is used as a filler for this application. Surface modification not only improves polymer wettability but also reinforcing properties in rubber. Higher modulus and tear strength, as well as lower compression set, are the results.

The common application of talc as an anti-caking mineral for granules and foils during curing and storage is overtaking liquid systems used today. Surface treated talc consumption for rubber in Europe is estimated at only 800 tpa.

Future trends in talc products

Grey talc will maintain its dominant position and shows more advantages in the long-term compared to white grades.

Conclusions are as follows:

1. Compound prices will continuously be placed under pressure. This means that the best performance in relation to cost will be demanded from the raw materials, including mineral fillers and talc.

2. Grey talc is unlimited in volume and therefore cheaply available in Europe.

3. White talcs will always be much higher in price than grey talc. The difference will always be about $150–250/tonne depending on source and quality guarantee requirements. As such, white talc should only be used if it is essential ie. for white or opaque compounds.

4. The usage of ultra fine talc grades will increase. However, this does not mean having to acquire new screw-feeding systems. Masterbatches of ultra fine mineral filled polymers will gain ground, similar to today's pigment and flame retarding preparations.

5. Blends of industrial minerals will gain importance eg. talc with wollastonite, co-grinding of talc and mica, and carbonate blends, as new properties could be developed.

6. Talc is no longer a mineral commodity for plastics, in which everybody can participate. Those times are evidently over. Today, a lot of expensive R&D work has to be done, as processing technologies are changing fast and must be developed according to individual needs. In addition product life-cycles are becoming shorter.

At times it is difficult for the mineral using industry to find the right talc grade for the required profile of the compound. When defining talc it cannot be done on the principle that "the higher the purity — the better the quality". Each modification shows its advantages in defined applications in practice. The aim for producers and users is to apply the most suitable mineral to the right field of application.

It is evident that both grey talc and talc have potential for new applications, as not all their features are yet known or have been used.

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