NON-SOVIET KAOLINS

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USA. The export of kaolins by the USA has increased significantly in recent years (Table 1). Several hundred thousand tons were shipped to Europe. This was made possible by the opening up of deposits of exceptionally high-quality white kaolins in the state of Georgia and by efficient quarrying methods and compounding based on an in-depth study of the service properties of the individual kaolin fractions and on an investigation of the possibility of obtaining products with predetermined properties from them.

These studies resulted in the following fraction classification of kaolins: coarse (particles larger than 2 μ), optimum (particles of 2-0.25 μ), and fine (particles finer than 0.25 μ).

The particles of less than 2 μ consist of plates of the hexagonal system and occur as individual crystals or anisotropic aggregates. In the wet state they are plastic, their dry strength is high, and their after-shrinkage considerable.

The particles larger than 2 μ are more isometric and occur in the form of flakes which consist of firmly joined columnar, often vermicular aggregates. They are brittle and their after-shrinkage and dry strength are low but compounding with a fine fraction can give the finished product an optimum combination of strength and after-shrinkage.

The fine fraction of the kaolin consists mainly of montmorillonite and contains colloidal ferrotitanium admixtures as a result of weathering. The proportion of this fraction in the finished product is a significant factor in the mechanical strength.

TABLE 1. USA Exports of Kaolins, Tons 10^3

Year	Total amount	Supplied for the production of	
		paper	white burning ceramic
1965	3604	1183	185
1970	4926	2535	120
1971	4886	2172	216

Modern centrifuging methods make it possible to regulate the grain size distribution of the kaolins and to identify kaolin varieties with specific useful properties in the various stratigraphic horizons in the quarries in order to prevent contamination with unwanted inclusions.

The montmorillonite content and variations in the crystal lattice are usually controlled by means of differential thermal analysis. The chemical composition of the kaolins from the principal deposits in the USA is given in Table 2 [1, 2].

Czechoslovakia. The kaolins of Karlovy Vary are used in the European ceramics industry and are a mixture of kaolins

TABLE 2. The Chemical Composition of USA Kaolins

Location of deposits	Particles finer than 2 μ, %	Oxides, %									
		SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	K_2O	Na_2O	SO_3	other admixtures
Georgia	Not known	45,20	38,05	0,494	1,95	0,26	0,30	0,04	0,02	0,05	13,51
	70*	45,68	38,51	0,442	1,43	0,24	0,14	0,14	0,04	0,02	13,51
Florida	73*	46,00	37,80	0,60	0,40	0,10	0,15	0,25	0,20	0,035	14,0

*Washed kaolin.

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TABLE 3. The Characteristics of Czechoslovakian Kaolins

Indices*	Commercial grades			
	Sedlice 1a	Osmoza	Imperial	Premier
Bottoms on 0.06 mm screen, %	0,02	0,03	0,03	0,03
Viscosity,†	15—40	20—60	15—40	15—30
Bending strength, kg/cm^2	14	18	12	14
Total shrinkage (Seger cone 14), %	17,0	16,9	16,8	16,6
Water absorption (Seger cone 14), %	5,1	5,0	5,0	5,5
Refractoriness, Seger cone	36	35—36	35—36	35—36
Content, %				
SiO_2	47,25	47,46	47,30	47,35
Al_2O_3	37,20	37,50	37,58	37,40
Fe_2O_3	0,85	1,0	0,90	0,95
TiO_2	0,20	0,30	0,25	0,25
CaO	0,70	0,50	0,65	0,70
MgO	0,20	0,10	0,05	0,05
other admixtures	12,45	12,60	12,50	12,50
alkali (calculated from the shortfall for 100%)	1,15	0,54	0,77	0,80

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*The plasticity of all kaolins is good and their color white.

†The slips contain 1.5% Na_2OH_3.

from deposits at Sedlice, Imakov, Osmoza, Kaolina, Podlezi, and Bohemia near the city of Karlovy Vary in Western Bohemia.

The kaolins are sorted, washed, and processed to four commercial grades. The chemical composition and properties of the kaolins are given in Table 3. The Karlovy Vary kaolins were formed in the Tertiary period as a result of the kaolinization of granites which differed not only in their content of feldspar and plagioclase but also in that of quartz, biotite, and muscovite. It is an interesting fact that the quality of the Karlovy Vary kaolins varies with the height of the deposit above sea level, i.e., it improves with the bedding depth owing to differences in the tectonic conditions. The principal structure-forming minerals of Karlovy Vary kaolins are quartz and kaolinite, and the kaolins usually contain also muscovite or illite or their combinations with small montmorrillonite inclusions. Sometimes there are mere traces of these minerals and sometimes they are absent altogether. Biotite occurs only in the deep-lying strata.

The secondary hard minerals sometimes include tourmaline and zircon and here and there also topaz and zirwaldite, and the secondary heavy minerals occur in the form of pyrite, siderite, hematite, anatase, and small amounts of rutile. The latter two minerals were formed from biotite which in the original state contained about 4% TiO_2. Kaolin with a relatively high content in organic substances was found to contain pseudomorphoses of anatase or mixtures of anatase with rutile.

The quantitative ratios of the principal minerals in the individual fractions of the kaolins of the deposits now being worked are almost identical. The kaolinite content is highest in the fine fractions and it decreases slowly with an increase in the particle size while the percent quartz and mica (muscovite and illite) increases. In the Osmoza kaolins, for example, the kaolinite content is 80-90% for grains of 1-8 μ only 55-20% for grains of 32-63 μ.

It was established that the illite improves the rheological properties of the kaolins.

The iron and titanium content of the various grain size fractions is of considerable significance for the ceramics industry. A product containing a minimum of Fe and Ti can only be obtained by eliminating the clayey substance of particle size finer than 20 μ from the kaolins before washing.

Karlovy Vary kaolins became well known in Europe toward the end of last century. In the 20th century they began to be exported to all European countries with a developed ceramics industry. The main users are industrial establishments in Czechoslovakia and the German Democratic Republic.

As long ago as 1974 the International Congress on Analytical and Applied Chemistry in Copenhagen adopted the commercial grade Sedlice 1a of Karlovy Vary kaolin as the international standard for ceramic kaolins but an in-depth study of the Karlovy Vary kaolins was not undertaken until the sixties [3].

Britain. British kaolins are confined to the Armorican and Hercynic folding and were formed during the geological periods from the granite rocks of Cornwall and Devon. They occur as remanent deposits from purer kaolinite.

The chemical composition of the calcined kaolin is as follows: 52.1% SiO_2, 0.1% TiO_2, 0.75% Fe_2O_3, 42-43% Al_2O_3, 0.1% CuO, 0.1% MgO, 1.5-2.0% K_2O, and 0.1% Na_2O. The main contaminant, therefore, is K_2O.

The kaolins are used for high-chamotte refractories intended mainly for blast furnace shafts (where a low iron content is especially important), for some subsidiary parts of ceramic kilns, and for monolithic products [4].

A thorough analysis of kaolins makes it possible to improve the technology at the establishments of the ceramics and refractories industry and to manufacture products with properties which do not vary.

LITERATURE CITED

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