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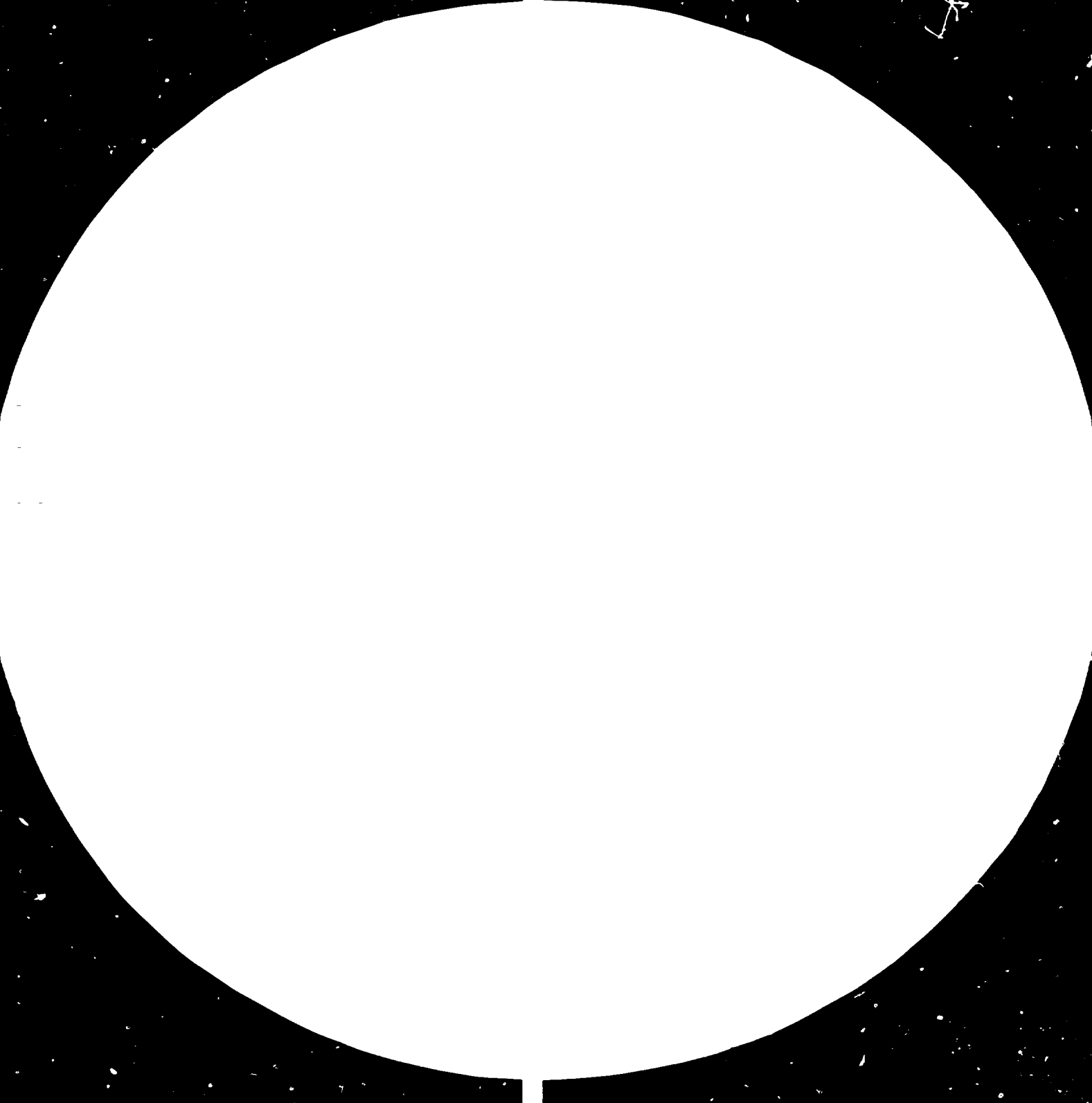
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INDUSTRIAL BENEFICIATION AND PROCESSING  
OF DIATOMACEOUS EARTH

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ABSTRACT

The submitted basic information on industrial beneficiation and processing of diatomaceous earth is introduced by the explanation of the origin of diatomite in a wider sense of the term. The diatomites proper occur in consolidated sediments as slates formed by fine diatom shells cemented with an opal substance. The diatomaceous earth is recovered from non-consolidated sediments, desintegrates easily and its compositions range from rare pure occurrences up to diatomaceous clay. The most appreciated properties of these raw materials lie in their lightweight porosity, high sucking and filtering capacity, resistance to the attack of acids and to high temperatures.

The beneficiation methods of diatomaceous earths are characterized by a great number of types of these raw materials and the ensuing necessity to tailor a special upgrading technology for each of them. The outlined processing technologies are geared to filtering materials, fillers, insulations and other products. The report is concluded by the assessment of the diatomaceous earth for industrial development of developing and least developed countries and by the information of potential further assistance in this field to be extended by the UNIDO-Czechoslovakia Joint Programme for International Co-operation in the Field of Ceramics, Building Materials and Non-metallic Minerals Based Industries in Pilsen

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## I. INTRODUCTORY NOTE

Based upon a request from Turkey passed to the UNIDO-Czechoslovakia Joint Programme for International Co-operation in the Field of Ceramics, Building Materials and Non-metallic Minerals Based Industries in Pilsen by the UNIDO Industrial Technological Information Bank, Industrial Information Section, the basic information on the industrial beneficiation and processing of diatomaceous earth is presented.

There are many denominations for the designation of diatom sediments. Unconsolidated rock composed of siliceous shells or envelopes of diatoms is most frequently denominated diatomaceous earth. The consolidated equivalent rock is called diatomite.

In a wider sense of the term, diatomite is a organogenous sediment composed of microscopic shells of unicellular series of diatoms containing a higher or lower quantity of another inorganic or organic admixture. Apart from the shells of diatoms, also siliceous spicules of sponges are present and in diatomites of sea origin also shells of foraminifers and radiolaria.

Diatomite is a sedimentary raw material formed from the siliceous shells of diatoms which were microscopic plant organisms living in fresh or salt waters. Because of the cellular nature of diatomite (about 80% porosity) and its resistance to the temperature up to 800°C, diatomite is used as a heat, smell and sound absorbing material. It is used

either as powder for loose filling, as calcined and agglomerated material for fluxes, as shaped and fired bricks or as aggregate for light-weight products.



## II. DEFINITIONS OF DIATOMACEOUS EARTH AND DIATOMITE

The diatom sediments are distinguished according to the degree of consolidation:

- 1/ Non-consolidated sediments
- 2/ Consolidated sediments

### 1/ Non-consolidated sediments

Diatomaceous earth or kieselgur is an earth which is grey to green or brown and messy in wet state, however, after drying, it becomes light coloured and disintegrates so that it can be rubbed by fingers to powder.

The quality of diatoms in the rock fluctuates so that compositions range from the pure diatomaceous earth to those with certain content of clayey admixture up to the diatomaceous clay.

A pure diatomaceous earth is rare, it occurs only in small lenses or thin layers.

### 2/ Consolidated sediments

The diatomite proper differs from the diatomaceous earth by a higher degree of consolidation. It is designated in literature as polished slate. Another type of consolidated diatomite is the sucking slate which was formed by fine diatom shells being cemented with an opal substance. It is foliated, porous, sucking greedily water and other liquids.

All technically important properties of diatomites depend on their composition, i.e. on the quality and sort of diatom shells and their purity. Diatomites exhibit their light-weight and porosity, they possess a high sucking and filtering capacity, they are resistant against the attack of acids, to high temperatures, some of them are even refractory. These properties make them a much-sought-for raw material and their application in technical practice is versificated.

### III. BENEFICIATION METHODS OF DIATOMACEOUS EARTH

The selection of beneficiation methods depends on the sort of diatomaceous earth, its mineralogical composition and physical properties (structure, hardness, etc.)

These properties are decisive for both the selection of beneficiation technology and the choice of technological equipment. The upgrading technology depends naturally on the required properties of final product, too. It may be concluded that every diatomaceous earth needs a special beneficiation method for particular kinds of products even if some operations are very similar or coincident. The drying process may be given as example. Some types of excavated diatomaceous earth should be temperately separated and then dried in a rotary drier or in a belt drier, if need be. Other types of diatomaceous earth require blunging and spray drying. Similar situation may be observed also in the other phases of beneficiation.

#### IV. OUTLINE OF TECHNOLOGIES FOR MAIN PRODUCTS BASED ON DIATOMACEOUS EARTH

The exploitation of diatomaceous earth may be in general characterized as follows:

- Filtering materials
- Fillers
- Insulations
- Others

##### 1/ Filtering materials

A prerequisite for the application of diatomaceous earth for filtering materials is especially their chemical purity and suitability from the view of structure, i. e. the optimum shape and size of diatom shells.

The basic technological procedure consists in the initial preparation of the diatomaceous earth followed by drying, firing, separating and sorting to certain granulometric fractions. Even if each of the technological operations has its significance, the firing is the dominating process. The firing (calcination) takes place usually in a rotary kiln and is conducted with addition of suitable fluxes for winning required properties of filtering materials. This process must be adjusted to the properties of the diatomaceous earth and fluxing agents as to support the agglomeration of small fragments of diatoms and their mutual extension. However, the agglomerates must not be very hard (sintered), otherwise the diatomaceous earth would lose its microstructure. The whole firing process, i. e. kiln feeding, number of revolutions, kiln inclination, black-free flame, etc. have to be subjected to these needs.

Firing is one of the most intricate operations in the manufacture of filtering materials.

## 2/ Fillers

The fillers may be either calcined and are usually obtained as one of the products in the manufacture of filtering materials or dried. In the latter case, the dried, ground diatomaceous earth, perfectly granulometrically sorted into particular fractions, is the final product.

## 3/ Insulations

These products may be subdivided in shaped and loose insulations. The shaped insulating materials are formed by the diatomaceous earth and suitable impressed combustibles. This method consists in mixing the prepared diatomaceous earth with a suitable sort of impressed combustibles as wood sawdust, chemical wastes, coal powder, etc., wetting and extruding bricks and further shapes by an auger; the shaped products are then dried and fired. The technological operations as pressing and firing are important and intricate. Pressing is difficult due to thixotropic properties of some diatomaceous earths. Therefore, the types of presses should be selected very carefully. The firing process takes place in chamber and tunnel kilns.

A special feature of this firing is the burning of combustibles impressed in shaped products. A sufficiently long kiln with controlled firing is needed to allow all combustibles to burn out.

Loose insulations are usually obtained by crushing low quality and damaged bricks to granulates of selected grainages.

4/ Other products

Carriers of catalysts for various chemical industries, materials for sorption purposes, polishing, grinding and cleaning agents may be included in this category.

The diatomaceous earth is also applied as carrier of fertilizers, pesticides, herbicides, etc.

This field of application is considerably wide. Potential use depends on the properties of the raw material.

## V. FINAL NOTE

Deposits of diatomites occur in many countries of the world. The major producing countries are the United States of America, West Germany and Denmark. Czechoslovakia has large deposits of diatomaceous earth in South Bohemia on which the manufacture of the following products is based:

- filtering materials for food-stuff and chemical industries,
- fillers for different purposes,
- granulated insulations,
- shaped insulations such as partitions, ceiling plates, panels, shaped blocks and hardened facing plates,
- beneficiated raw materials delivered to other industries to be processed as carriers of catalysts, fertilizers, pesticides, herbicides, etc.

The demands of Czechoslovak industries for these products are fully covered by local production and a considerable amount is also exported.

Many developing and least developed countries possess also the deposits of diatomite or diatomaceous earth and some of them realize the advantages of their exploitation. The UNIDO-Czechoslovakia Joint Programme can extend the following assistance to these countries:

- To mediate fellowship training in mining and upgrading of diatomaceous earth as well as in processing relevant products.
- The preliminary tests of representative samples of local raw materials in total weight of 5 kg can be carried out free of charge after receipt of an official request addressed to UNIDO Headquarters or to the Chief Executive of the UNIDO-Czechoslovakia Joint Programme.

The development of applications is expected especially in food-stuff industries (filtration), chemical industries (filtration, carriers of catalysts, fillers), agriculture (carriers of fertilizers) and especially in all thermal processes where the insulating materials may find a substantially broad field of application.



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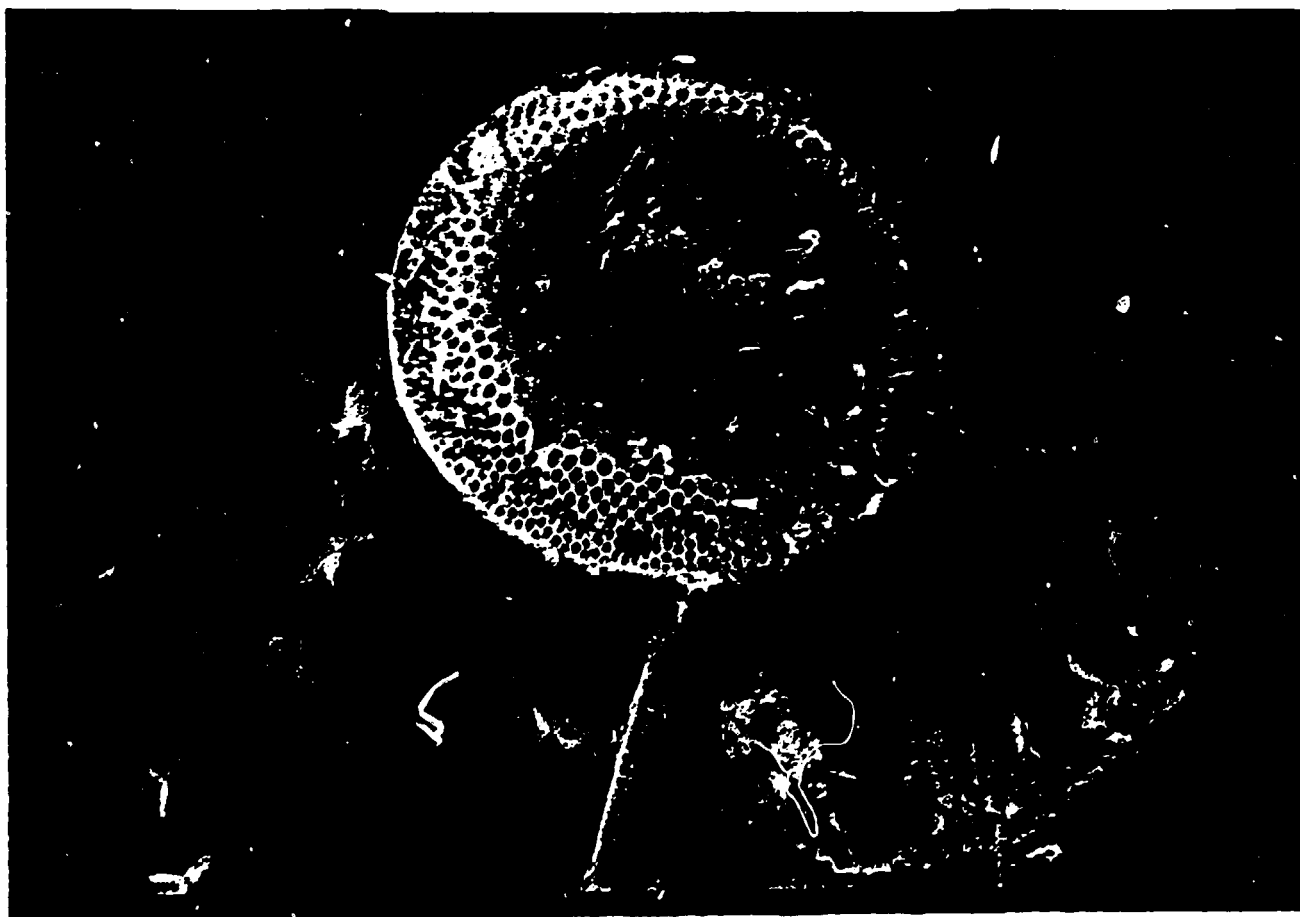
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VII. PICTURES OF DIATOMACEOUS EARTH

Pictures 1 and 2 with a low content of clay substance.  
Pictures 3 and 4 with a high content of clay substance.

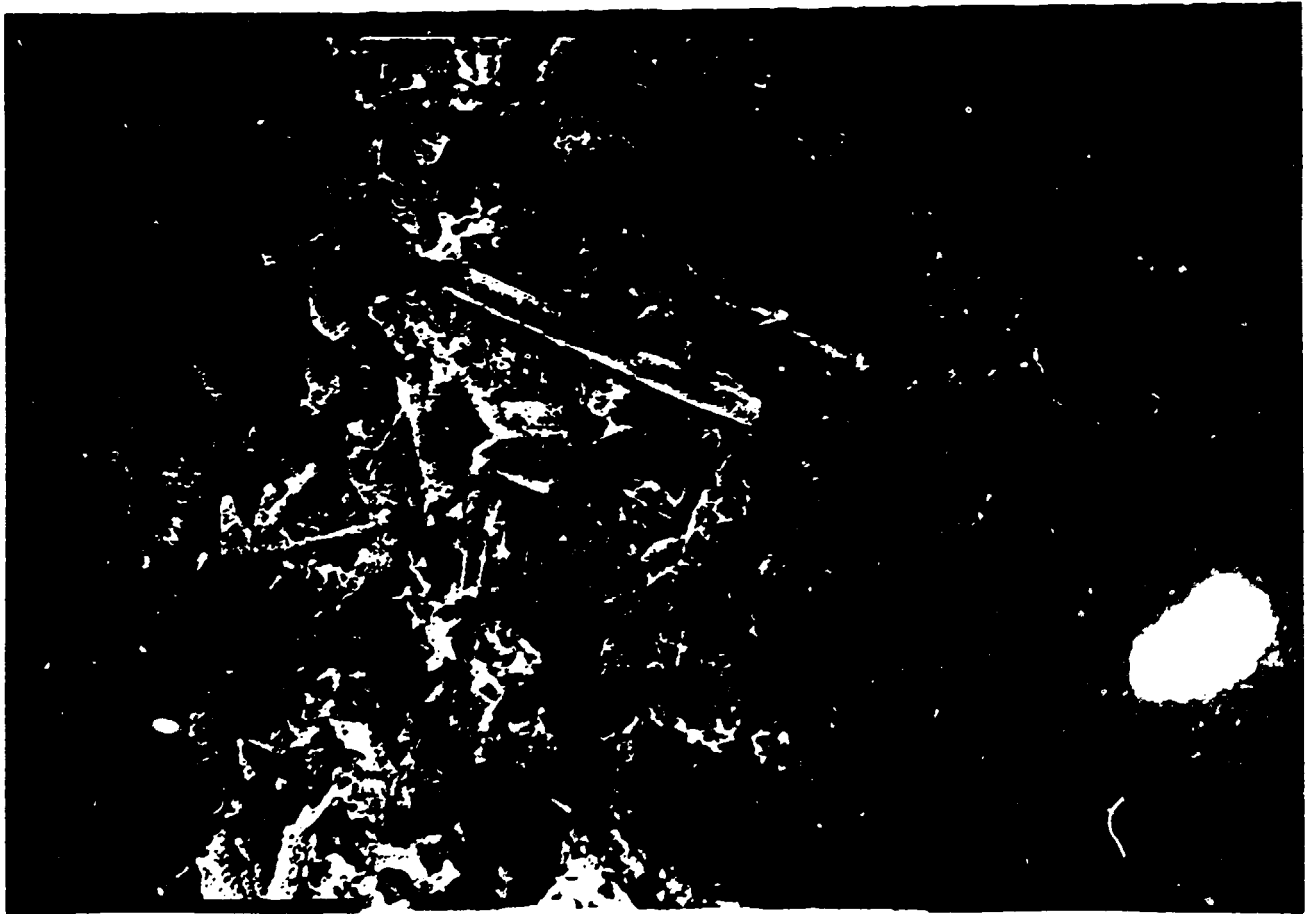
Picture 1

Magnification 16 000 x



Picture 2

Magnification 6 000 x



Picture 3

Magnification 6 000 x



Picture 4

Magnification 6 000 x

