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Development of A New Type of Insulating Material for Overhead Power Lines

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Abstract: *The article describes the current problems of insulation of overhead power transmission lines and a specific solution to how to increase the operation of the power supply system. Since the article discusses a new type of insulating mineral material called Wollastonite mineral. According to laboratory studies, we have determined the specific physicochemical properties in general.*

Keywords: Wollastonite mineral, ultrabasic, skars, artificial, molar mass, USA, United Kingdom, generators, voltage, emissions, hydroelectric power stations, synthetic silicate of calcium, alternates.

Introduction

There are currently no wollastonite deposits in Russia that are in high demand for use and production [1]. Such large enterprises include the Altai Territory. In the south of Russia there is an industrial zone (especially enterprises Kemerovo region), in the territory of the former Soviet Union all previously explored deposits of wollastonite were found in the Republic of Kazakhstan, Central Asia (Bosagin, Koytash, Kuruk-Tegerek, and other.) and the Caucasus (Tyrnyauz). The largest producers of wollastonite in the world are China, the United States, India and Finland. China ranks first in the world in terms of exports, availability and production of domestic consumption resources, and has great potential for industrial development [2-3]. The introduction of industry and large-scale exports will be carried out with a new policy of reforms in the country and openness to the world economy. The production of wollastonite in China has reached 250,000 tons per year for 80 years until 1994, and the demand for it is increasing by 11-15% annually. By 2003, the total consumption of Chinese wollastonite was 0.5-1.0 million tons per year.

The role of vollastonite in the contribution of special materials from the best cement, paints, varnishes, ceramics, household and technical, mold materials, brakes in vehicles, plastics, electromagnetic radiation, medicine and other composite materials is great. In the United States, the United Kingdom, and China, Wollastonite is listed as a strategic raw material.

Wollastonite deposits are divided into 4 groups according to production:

1. Skars.
2. In metamorphic complexes of archeological sites.
3. In metamorphic complexes of skarnoids.
4. Ultrabasic – in complex arrays of hydroxide rocks.

Materials and methods

The wollastonite element is easily converted to xenotyl and calcium quartz aggregates when applied in low-temperature mixtures with a colorless, powdery white appearance, white angles, and a change of lustrous glassy mineral. Types: Ferrovollastonite is formed by the hypotonic combination of the mineral FeSiO3 to wollastonite. This mineral is difficult to meet in nature and create in the laboratory. Natural ferrovollastonite, i.e. ferrous wollastonite, makes up 25% of the wollastonite content. Artificial ferrovollastonite is a mineral with a 76% admixture of wollastonite that was first cracked in Sky (Scotland). According to its origin, it can be found in Central Asia, mainly in gold mines of Uzbekistan. In the mountainous regions of Chatkal and Peskim, the places where lead spirits appear. Almalyk ore field (Napkay, Qatrangi, Lead mining) are areas of tungsten molybdenum formation. The places of occurrence of anchor, Koytash, lead-spirit mineral are in the western Jangalik regions. The most common sites of vollastonite and Piraxon-vollastonite are Mingbulak, Qumbel, Chimkent, Chol-ota, Oltin tapgan, Kara-tepa, Karasay, Mayhor, Aksay, Karasay-2 and other places of origin. The use of wollastonite mineral in decorations and fine arts is not high, but it is noteworthy. Collection views are made of fine and needle aggregates. Solid and crystal copies are used in jewelry. Practical application — the widespread use and extraction of the wollastonite mineral began in the 1940s with the emergence of large sites in WILSBORO (NEW YORK, USA). Vollastonite (calcium silicate, CaSiOS) is a multifunctional material that is in constant demand. Quality wollastonite minerals could not be obtained in sufficient quantities in pure form. More than 10 phosphogypsum deposits are accumulating in the country. In the coming years, industrial enterprises plan to extract synthetic calcium silicate (wollastonite) minerals from these deposits. Fig.1.

Fig.1. Wollastonite mineral (synthetic silicate of calcium)

Especially using to the wall and roof panels, in colored mineral wool (as a thermal insulator). Used in the manufacture of sanitary porcelain and tiles, electrical insulation porcelain. As filler it is added to papers, paints, rubbers. The use of vollastonite vollaconium in rubbers increases the strength of elastic rubber. The use of wollastonite mineral in waxed ceramics protects against deformations and cracks in cold weather.

Result and discussion

Construction materials with the addition of wollastonite mineral are characterized by high resistance to pressure, bending and bending. Therefore, in high-voltage overhead lines, lighting masts, radio antenna, etc., cements with a mixture of wollastonite are used. It is very easy to use wollastonite material instead of unnecessary asbestos in the construction system. Slabs, pipes, slabs used between walls have a higher quality than asbestos when using wollastonite. Melted and boiled wollastonite is widely used in ferrous and nonferrous metallurgy. The use of molten wollastonite mineral in furnaces is used in the collection and disposal of metal slag. The use of wollastonite mineral from highly engineering devices protects the equipment from moisture penetration and corrosion (corrosion). The mixture of wollastonite mineral in colors absorbs and attenuates electromagnetic radio waves in the visible spectrum. The colors are also resistant to biological waste. The top of the painted layer will never be moldy. Therefore, wollastonites mixed colors are used in manufacturing and military equipment. It is not clear to many how the trucks used in production suddenly fail and become unusable. This is due to the fact that in trucks (BelAZ, CAT) often do not withstand high pressures and temperatures of rubber pipes that transfer fuel to the internal combustion engine. It is recommended to add as filler to the rubber pipes of such vehicles. The use of wollastonite mineral in the composition of high and low voltage overhead line insulators is of all-round quality from existing insulators. Because it absorbs and reduces electromagnetic and radio waves in the invisible spectrum. In addition, the addition of the mineral wollastonite in the composition of bulletproof bullets in armored vehicles used in the military field is distinguished by its transparency and durability. Mechanical properties of wollastonite mineral: hardness - 4.5-5; density - 2800-2900 kg / m3; ferrovollastonite - 3120 kg / m3.

An initial spectral analysis of the mineral composition of wollastonite was studied. Fig.2.

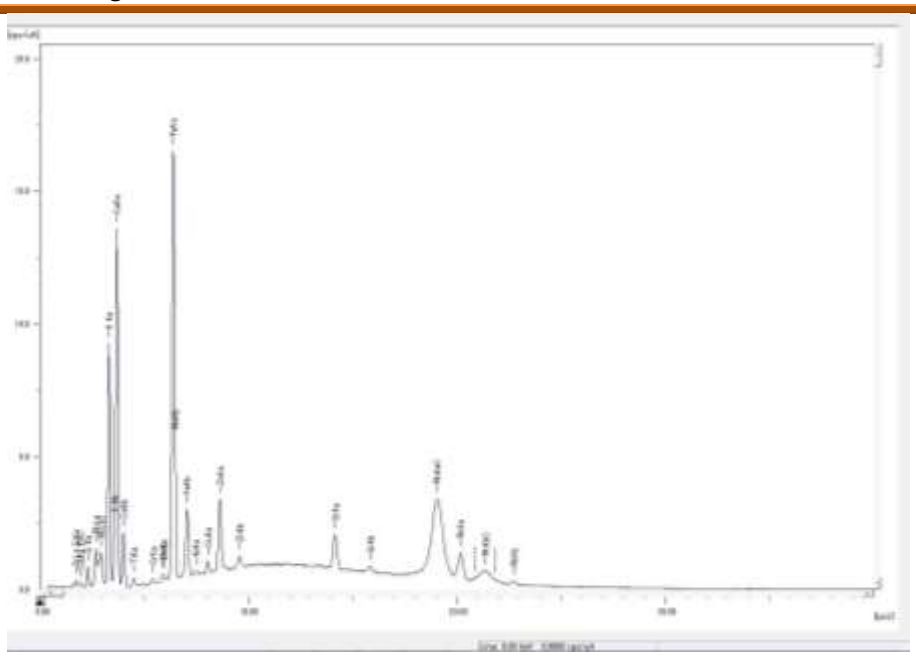

Fig.2. Spectral analysis of vollastonite

The synthetic calcium silicate (Vollastonite) industry is carried out at high temperatures of at least 100 ° C and normal atmospheric pressure. It can be isolated from phosphogypsum (a large-scale waste of chemical plants) using a low-temperature hydrothermal synthesis process. The product is dried and crystallized at a temperature of 350-1000 ° C. One of the raw materials used is calcium-containing materials, silicon mixture, alkali (KOH or NaOH - industrial waste, in the form of NH3OH - an aqueous mixture of ammonia) is used in the technical water used for cooling. The energy carriers used are: gas, electricity, thermal fuel, fuel oil, fuel oil, vegetable oil. Consequently, the mechanical properties were improved.

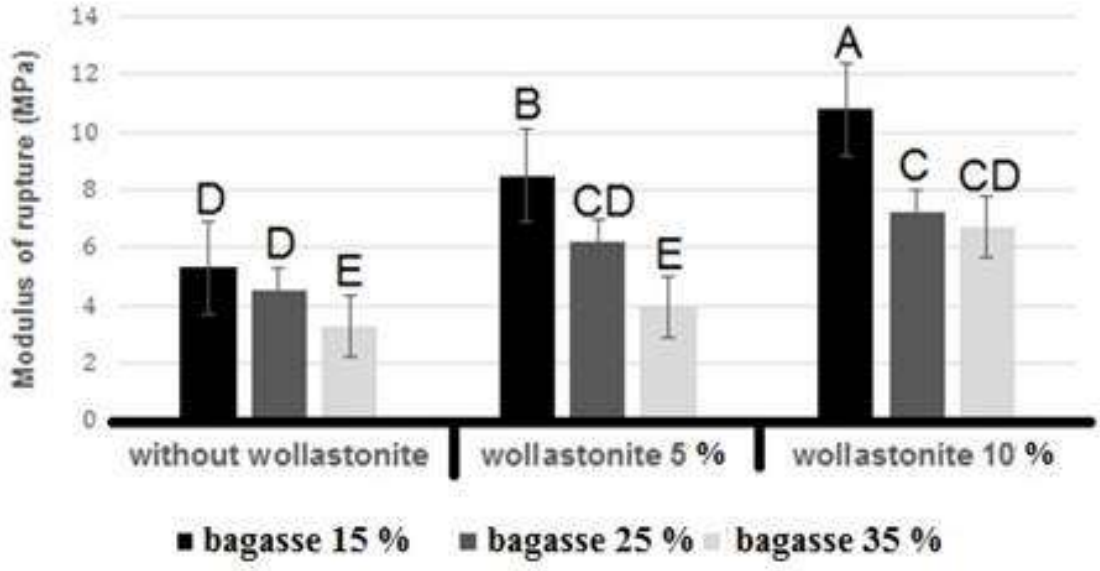

Fig. 3. Effect of varying levels of nano wollastonite on the MOR of composites composed of different percentages of bagasse; letters on each column indicate Duncan's grouping at the 99 % level of confidence.

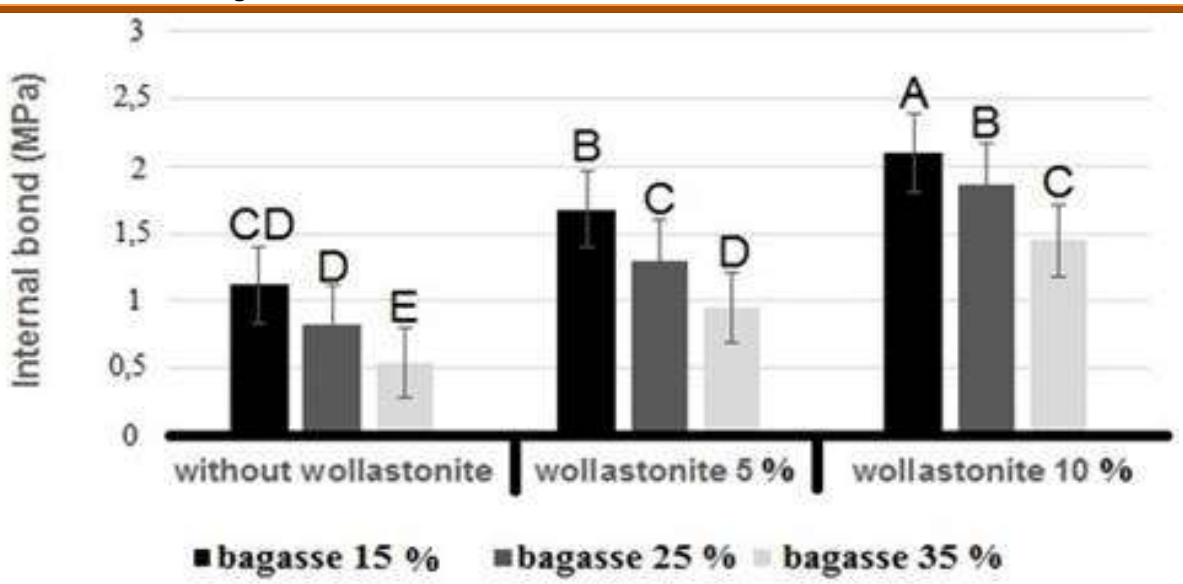

Fig. 4. Effect of varying levels of nano wollastonite on the MOE of composites composed of different percentages of bagasse; letters on each column indicate Duncan's grouping at the 99 % level of confidence.

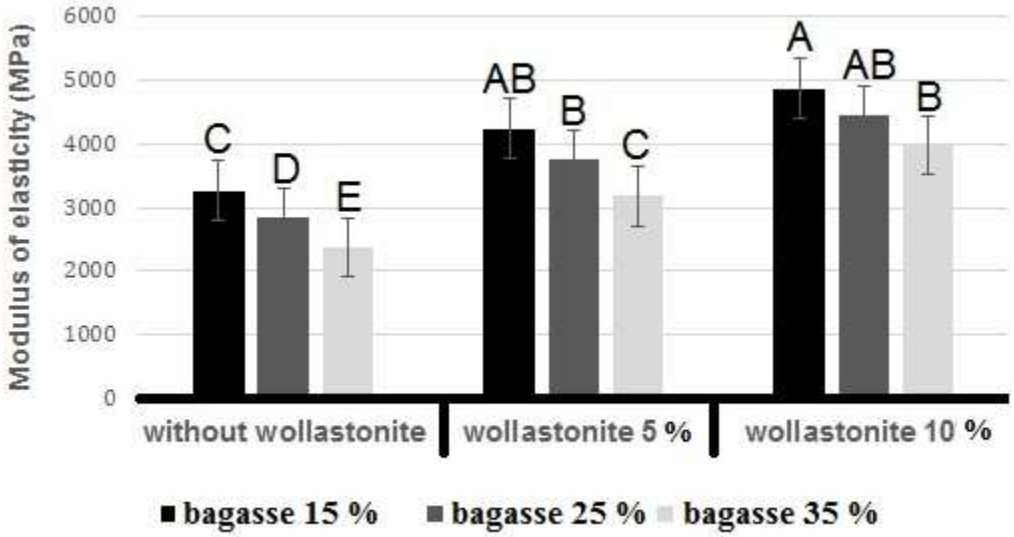

Figure 7: Effect of varying levels of nano wollastonite on the IB of composites composed of different percentages of bagasse; letters on each column indicate duncan's grouping at the 99 % level of confidence.

The following products can be made from synthetic wollastonite:
• White pigment for complete replacement of titanium dioxide imported from Russia;
• Color composite pigments in the required amount of organic and inorganic dyes;
• Water-based paints;
• Plastic polymers (with the introduction of 75-80% wollastonite);
• Electrical insulators (with mechanical and strong dielectric properties);
• Reusable filters for industrial plants;
• Asbestos-free materials (brake pads);
• Equipment used for cleaning and washing woolen fabrics. Due to the chemical properties of wollastonite, this synthetic product is calcium silicate. Such a chemical bond is very convenient for use in cement, silica, dry building materials and other construction industries.

Conclusion

The wollastonite mineral we are talking about can also serve as a raw material for products that can meet the above requirements and standards. It is used in the building materials industry for the production of tiles, porcelain materials, facing bricks, asbestos, gypsum, cement admixtures for wall tiles, additives that provide its gloss and quality in the preparation of building paints, auxiliary and filler additives for road construction, mineral fertilizers in agriculture and electrical engineering. Insulators with low power dissipation, porcelain for radio engineering and sanitary products in many other fields are the main raw materials for various cleaners. The calcium element wollastonite is found in iron, magnesium and sometimes manganese. It is known that there are 3 types of metasilicate, high-temperature - wollastonite and the second low-temperature - parawollastonite and vollastonite. Wollastonite inversion - pseudowollastonite is formed at a temperature of 1120 degrees Celsius. The state of the aggregate is leaf-like, radial, fibrous, white, gray, glossy, glassy, and transparent. Hardness 4.5-5. Molar mass 2.9. The ordinary mineral is added with thermal metamorphic limestone and skarns. Occasionally metamorphic limestone and a number of silty rocks occur in the region. It is mainly used in the ceramic industry in the form of special cement for special high frequency radio ceramics, tile, and porcelain, insulators with low dielectric loss, sanitary ware, wall tiles, facing bricks, gypsum, ceramics and grinding materials. It is also used as an additive and pre-filler coating for paint, varnish, glass, asbestos, paper, asphalt slabs. Wollastonite is used to make fertilizers, special filters, mineral wool, various cleaners and more. Large wollastonite complexes according to the next known genetic type: scars, regional - metamorphic crystalline rocks, complex ultra-basic intrusions, shale demons. The largest of them are regional - metamorphic crystalline rocks (mostly the United States, CIS countries, India). The largest deposits of wollastonite are located in Willsboro (New York, USA), Langar, Koytash, Tetyukhe and other regions of the CIS.

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