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SELF-HARDENING GRAPHITE LEAD FOR
PENCILS

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This invention relates to a self-hardening graphite "lead" or marking material for pencils and to the process of making the same.

One of the objects of this invention is to provide a self-hardening graphite lead which, by reason of its characteristics, may be made into coils or rolls of any desired lengths, enabling various novel methods of pencil manufacture to be employed which are impractical where the ordinary hardened lead in relatively short lengths is used. A further object of the invention is to avoid the warping and breakage which frequently occurs with the ordinary hardened graphite lead.

Graphite lead as manufactured at the present time consists of a combination of graphite, clay and wax. The graphite and clay are mixed in varied proportions according to the degree of hardness required in the lead and this mixture is then formed into relatively short lengths which are dried and later calcined to harden the mixture. After the calcining operation, the leads are waxed to improve their writing qualities, and are then ready for insertion in the pencil sheaths. The drying and heating operations employed in the conventional process of making hardened graphite leads often causes warping of the leads which either break when an attempt is made to insert them in a pencil sheath, or else are so badly warped as to render them unfit for use. Consequently, the manufacture of the ordinary hardened graphite lead involves considerable waste.

This invention comprehends the production of a self-hardening graphite lead, some of the advantages of which are these: Such a lead or marking material may be of great length (that is, of indefinitely greater length than the usual hardened lead); it may be conveniently maintained in coiled or rolled condition for a reasonable period of time until ready for use, and in combination with a plastic sheath or covering it may be employed to form pencils speedily and inexpensively. The warping and breakage so characteristic of the ordinary or hardened graphite lead is avoided with resultant saving in the cost of manufacture of the pencils.

There are several ways in which a self-hardening graphite lead or marking material may be made in accordance with this invention. One method involves the mixing and grinding together of clay, graphite and water, with or without the addition of such carbonaceous substances as lamp black or pyrographitic acid; the drying of the ground mixture in small masses or lumps;

the burning or heating of these dried lumps; the impregnation of the clay, graphite and carbonaceous substance (if used) by wax; the grinding of the lumps into a powdered mass and the mixing of the powder with suitable ingredients to form a plastic mass which is dried to the desired plasticity and extruded into a round, flexible rod of indefinite length.

In carrying out the process thus briefly described, stock is prepared by grinding a mass composed of a mixture of water, graphite and clay, to which the carbonaceous substance such as lamp black or pyrographitic acid may be added if a very black lead is required. The mass so formed is then divided into smaller portions or lumps to facilitate drying, the drying being performed by exposing the lumps to the action of air, or by any of the other drying processes common to this art. When dried, the lumps are heated or calcined, which greatly adds to their porosity. These calcined lumps are then immersed in molten wax for a period of time sufficient to cause the wax to penetrate the pores of the mixture and surround and adhere to the graphite particles therein and to the particles of the carbonaceous substance, if used. Six or seven hours is usually sufficient to cause a thorough penetration of the wax into the pores of the mixture and a coating of the graphite and carbonaceous substance particles by the wax. The lumps now composed of a mixture of calcined clay, graphite and possibly the carbonaceous material and wax are then reduced to a powder by grinding. The ground or powdered mass is then mixed with a water-soluble organic compound which serves as a binder, or a bonding element. I have found a water-soluble cellulose compound, such as an alkyl derivative of cellulose, very satisfactory for the purpose. These alkyl cellulose compounds are at the present time, available in the open market and are water-soluble binding agents advantageously used in my composition. They may be prepared, for instance, in the manner described in the patents to Lilienfeld Nos. 1,188,376 and 1,505,043 and numerous others. However, it is more convenient to purchase the alkyl cellulose binding agent from a manufacturer thereof. When employed as herein set forth three to twenty per cent by volume is used in the mixture. The more alkyl cellulose binder employed the harder will be the mixture. Instead of alkyl cellulose binder, gum tragacanth may be employed in the same proportions, although its use is not particularly

recommended due to its tendency to ferment readily.

In addition to alkyl cellulose binder, an inorganic material such as bentonite may be mixed with the calcined clay, graphite and carbonaceous material (if used) and wax. Bentonite is a plasticizing agent and serves to render the mixture plastic. Two to five per cent by volume, of bentonite, and about eighteen to twenty per cent water is used. The resultant plastic mass consists of graphite, a carbonaceous material (if used), calcined clay, wax, alkyl cellulose binder, bentonite and water. This mass is dried in any suitable way, such as by passing it through a screen which acts to break the mass up and facilitate drying it. By making suitable tests during the drying operation it can be easily ascertained when the mixture is in its proper condition for extrusion to form the lead. Tests indicate that the mass is satisfactory for extrusion when it contains approximately twelve to twenty per cent water. When the drying has progressed to the required extent, the extrusion is performed which converts the mass into a lengthy, flexible, rod-like section of lead. Since it is soft, the lead section can be formed into a roll or coil and can be kept from hardening for a reasonable period of time, such as from two to three weeks by storing it in an airtight container.

Another satisfactory method of making the improved self-hardening graphite lead is substantially as follows:—

Graphite is ground to the proper degree of fineness in water. To this graphite and water mixture is added chlorinated naphthalene and a wax. Since the chlorinated naphthalene is later removed from the mixture by distillation the amount employed is relatively unimportant. The amount of wax employed is from five to ten per cent by volume of graphite.

The mixture, consisting of graphite, chlorinated naphthalene and wax is agitated, the chlorinated naphthalene cleaning and purifying the graphite so as to cause the wax to intimately coat or adhere to the graphite particles.

Instead of using chlorinated naphthalene in the mixture, it is entirely feasible to use a volatile oil mixing it with wax and a benzol compound, such as xylol, with satisfactory results.

When the mixture has been prepared the water therein, containing the impurities cleansed from the graphite by the action of the chlorinated naphthalene, is removed by decantation and then the chlorinated naphthalene (or oil and xylol, if used) is removed by distillation. This leaves a powdered mixture of wax-coated graphite to which may be added, if desired, a carbonaceous material, such as lamp black or pyrographitic acid, in such quantity as necessary to produce a lead of required black-

ness. This mixture is then mixed with alkyl cellulose binder, bentonite and water, as previously described in connection with the first method of carrying out this invention. The resultant mass is dried to the required extent and is extruded to form it into a soft, self-hardening lead in the form of a continuous flexible rod of indefinite length which will retain its flexibility, when kept in an airtight container, for several weeks. Such lead, since sheathed while soft, does not crack or break and consequently losses from waste are small. This self-hardening lead can be handled in very lengthy form since it can be conveniently rolled or coiled, and it enables pencils, and particularly those which have a sheath composed of a plastic material, to be made by an extrusion method not possible when hard, short-length leads are used.

What I claim is:—

1. A marking material for pencils containing a comminuted wax-saturated calcined graphite and a water-soluble binder.

2. A self-hardening lead material for pencils containing a comminuted wax-saturated calcined graphite, and a binder composed of a water-soluble cellulose material.

3. A self-hardening lead comprising graphite and clay, calcined together, wax-saturated and comminuted, a water-soluble organic compound forming a binder and an inorganic plasticizing agent.

4. A self-hardening lead comprising a comminuted mixture of calcined and wax-saturated graphite and clay, a water-soluble cellulose material, a plasticizing agent and water.

5. A self-hardening lead comprising a comminuted mixture of calcined and wax-saturated graphite and clay, alkyl cellulose, bentonite and water.

6. A self-hardening lead comprising comminuted wax-coated calcined graphite, a water-soluble binder and a plasticizing agent.

7. The method of making a self-hardening graphite lead consisting in calcining a mixture containing clay and graphite, in impregnating the mixture with wax, in reducing the wax-impregnated mixture to powder form, in mixing a water-soluble binder with the powder mass, in adding a plasticizing agent thereto, in drying the mixture and forming it into lengths.

8. A plastic mass yielding a self hardening pencil lead and capable of being extruded into lengthy, rod-like sections having a diameter of the order of pencil lead and which can be coiled into rolls for storage prior to use, said mass containing a homogeneous mixture of wax-saturated calcined graphite, clay and a binder composed of an aqueous solution of a water soluble binding agent.

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