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METHOD OF PREPARING THIOTETRAPHOSPHATES AND PRODUCT THEREOF

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Our invention relates particularly to the production of thiotetraphosphates and the product thereof, but has relation especially to the production of trithiotetraphosphates of the alkali metals.

The object of our invention is to provide a process and product thereof by means of which thiotetraphosphates of the alkali metals may be produced. A further object is to carry out the process by the use merely of materials which are inexpensive and readily obtainable in large quantities.

While our invention is capable of embodiment in many different forms, we have described only certain ways of carrying out the same herein-after.

For example, in carrying out our invention, the equivalent of 2 molecules of phosphorus pentoxide, P_2O_5 , the same being preferably finely ground, is mixed with the equivalent of 3 molecules of a sulphide of a metal, for instance sodium sulphide, Na_2S , or what is known commercially as sodium sulphide, or the corresponding salt of potassium or any other metal, preferably also in a fine state of subdivision as a result of having been finely ground. Where commercial compounds are used an allowance will be made, of course, for the possible impurities present in calculating the weights used. These materials, after they have been thoroughly mixed together, are melted, preferably at an incandescent temperature. When the heat is thus applied, after the melting, although fusion is not absolutely necessary, a sintering or solidification takes place, thus obtaining a material which is hard at these same temperatures, of maximum effectiveness and strength which is a physically and chemically homogeneous compound, the product being obtained probably in accordance with the following equation,—



the product being trithiotetraphosphate of sodium, and which is a sodium salt of the tetraphosphoric acid, the constitution of which is given by Roscoe and Schorlemmer in their Treatise on Chemistry, vol. 1, 1905, page 636, and in which three of the oxygen atoms have been substituted by sulphur.

The ordinary commercial sodium sulphide is dark red in color, whereas the resulting sodium trithiotetraphosphate is of a greenish color before fusion and of a glassy colorless appearance when cooled, which is freely soluble in water and, as in the case of thiophosphates generally, gradually gives a slightly milky precipitate of sulphur

with a slight evolution of hydrogen sulphide, H_2S , upon being dissolved in water. However, this slight reaction in the presence of water does not at all interfere with the various uses of the material to which it may be effectively and advantageously applied. There are many advantageous uses to which these compounds may be applied, as, for instances,—

As a water softener by keeping the alkali earth bases in a soluble condition.

In laundries as to save soap by combining with the alkali earth bases in the washing water.

In deliming leather as in the tanning industry.

In dissolving the lime compounds which may occur in soiled textiles.

To prevent deposits of alkali earth salts forming in hot water systems.

To prevent deposits of alkali earth compounds in steam boilers and their feed lines.

To prevent deposits of alkali earth compounds in automobile water cooling systems.

To prevent the formation of alkali earth bases as precipitates in the water to be frozen in artificial ice machines.

To prevent the formation of alkali earth precipitates on the outside of cans from the cooling water of the canning industry.

To prevent streaky dyeing in textiles by keeping any alkali earth compounds in a condition of solubility.

Preventing the formation of soap spots on the cloth in dyeing.

To clean cement or brick walls from lime deposits.

As a softener for water in washing living animals or in baths for human beings.

For cleaning or washing dishes.

For softening water in which anything may be washed and thus saving soap.

Washing rayon, for instance.

Scouring wool.

Kier boiling in bleacheries.

Boiling off silk.

Causing increased penetration of dye in textiles by cleaning off traces of alkali earth compounds.

While we have described our invention above in detail we wish it to be understood that many changes may be made therein without departing from the spirit of the same.

We claim:

1. A process which comprises reacting, by mixing and heating together phosphorus pentoxide with an alkali metal sulphide in substantially their theoretical proportions to produce an alkali metal thiotetraphosphate.

2. A process which comprises reacting, by mixing and heating together phosphorus pentoxide with sodium sulphide in substantially their theoretical proportions to produce a thiotetraphosphate.
- 5 3. A process which comprises reacting, by mixing and heating together phosphorus pentoxide with an alkali metal sulphide in substantially their theoretical proportions to produce an alkali metal trithiotetraphosphate.
- 10 4. A process which comprises reacting, by mixing and heating together phosphorus pentoxide with sodium sulphide in substantially their theoretical proportions to produce a trithiotetraphosphate.
- 15 5. A process which comprises reacting, by mixing and heating together phosphorus pentoxide with an alkali metal sulphide in substantially their theoretical proportions, both in powdered form, to produce an alkali metal trithiotetraphosphate by sintering.
6. A process which comprises reacting, by mixing and heating together phosphorus pentoxide with sodium sulphide in substantially their theoretical proportions, both in powdered form, to produce a trithiotetraphosphate by sintering.
7. A trithiotetraphosphate of an alkali metal.
8. A trithiotetraphosphate of sodium.
9. A trithiotetraphosphate of sodium of glassy colorless appearance.
10. A trithiotetraphosphate of sodium of glassy colorless appearance freely soluble in water with the formation of a slight milky precipitate.
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