UNITED STATES PATENT OFFICE.

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PRODUCTION OF ALUMINATES FROM ALUNITE.

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To all whom it may concern:

Be it known that we, PAUL R. HERSHMAN and RAYMOND D. COOKE, both residing in Chicago, county of Cook, State of Illinois, and whose post-office addresses are care of Armour Fertilizer Works, Union Stock Yards, Chicago, Illinois, have invented certain new and useful Improvements in Production of Aluminates from Alunite; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to the treatment of alunite and to the recovery therefrom of potassium aluminate and of alumina in an alkali-soluble form.

The invention is based upon the discovery that by calcining alunite in admixture with coal or coke or other suitable carbonaceous material, under appropriate reducing conditions, the alunite can be freed or substantially freed from sulfur and sulfur compounds, and the reduction can be effected at temperatures sufficiently low to prevent any appreciable loss of potash by volatilization and to prevent the conversion of the alumina to any considerable extent into an alkali-insoluble form. The reduction can be carried out in various types of furnaces, both externally and internally fired, in which the conditions are reducing in the sense that the desired reduction of the sulfates takes place, although the conditions may be oxidizing in the sense that active combustion of carbonaceous material may take place and may thus insure all or part of the necessary heat for the calcination. The reduction can be further facilitated by the use of a reducing gas such as producer gas, or by passing steam into contact with the charge, or by the use of various mixtures of gases, etc.

In the preferred practice of the invention, the alunite is formed into porous bodies with the carbonaceous material and an appropriate binder, and is calcined in a shaft furnace. The binder may itself be of a carbonaceous material and may form in part or in whole, the carbonaceous portion of the charge. Briquets may thus be formed by the use of tar or pitch as a binder or by the use of waste sulfite liquors, etc., with which small amounts of coal or coke or other solid carbonaceous material may also be incorporated. Petroleum residues, asphalt, heavy coal tar, and the like, are also available as carbonaceous materials.

The desired reduction can be effected at temperatures as low as 700° C., but higher temperatures can also be used, for example, from 700 to 900° C., and even higher temperatures, although in general the temperature should not be raised sufficiently high to cause any material volatilization of potash or to convert the alumina of the calcined product into an alkali-insoluble form. The furnace can be fired by a gas flame, or by the use of powdered coal or by the combustion of hydrocarbon oils, etc. During the calcination, an excess of a reducing gas, such as producer gas, or of a current of steam, or various mixtures of gases, can be introduced into the furnace. In general, admixtures of from 5 to 10% of the carbonaceous material with the alunite will be sufficient, but the amount may be increased with advantage where the conditions are such as permit combustion of the carbonaceous material within the furnace. Where a reducing gas, such as producer gas, is passed through the charge, less carbonaceous material is required to be admixed with the alunite than when such reducing gases are not used. At temperatures of from 700 to 900° C., the reduction is completed in about one-half hour to an hour. Where the calcination has been effected by heating the alunite mixed with 5 to 10% of coal in the presence of producer gas at a temperature of 800° C. for about thirty minutes, steam may then be admitted and the heating continued for a further period of about 15 minutes in order to complete the reduction of any sulfids or sulfates remaining and also to complete the removal of the remaining carbon. The resulting product will then be free from carbon and sulfur compounds and will consist principally of potassium aluminate and of alkali-soluble alumina.

Instead of admitting the steam subsequent to the admission of the reducing gas, it may be admitted simultaneously therewith. Thus, the finely ground alunite may be intimately mixed with say 5% to 10% (preferably about 6%) by weight of powdered coke or charcoal, and heated in an atmosphere of steam and a reducing gas as,

for instance, producer gas or illuminating gas. The treating may be carried on at 700° C. for thirty minutes, or at 900° C. for from five to ten minutes, or the temperature may be gradually raised from 700° C. to 900° C. during thirty to forty minutes.

From the product of the calcination, the potash and part of the alumina can be directly recovered as aluminate by extraction with water; and alumina and potash salts can be recovered from the potassium aluminate in any suitable or preferred manner, for example, by precipitation of the alumina with carbon dioxid and recovery of the potash by evaporation. The alumina contained in the residue, after extraction of the aluminate, is for the most part soluble in alkali, and can be recovered in solution by digestion therewith. Yields of alumina ranging from 93% upward have been thus obtained.

The process of the present invention, can, however, be carried out under conditions which are not uniformly reducing and which will give smaller yields of alkali-soluble alumina, while still giving the potash and part of the alumina in the form of potassium aluminate.

Instead of recovering only that part of the alumina as aluminate which will combine with the potash normally present in the alunite, increased yields of aluminate can be directly obtained by incorporating added amounts of alkali compounds in the furnace charge. Thus, if sufficient potassium carbonate or other potassium compounds are added to the charge, substantially all of the alumina can be recovered directly from the product of calcination in the form of potassium aluminate by extraction with water.

What we claim is:

1. The method of producing potassium aluminate from alunite, which comprises calcining the alunite in the presence of carbonaceous material; substantially as described.

2. The method of producing potassium aluminate from alunite, which comprises calcining the alunite in the presence of carbonaceous material under non-oxidizing conditions and at a temperature sufficiently low to leave the alumina present in an alkali-soluble condition, and recovering the potassium aluminate and the alkali-soluble alumina from the resulting product; substantially as described.

3. The method of producing potassium aluminate from alunite, which comprises calcining the alunite in the presence of carbonaceous material, and maintaining reducing conditions during the calcination; substantially as described.

4. The method of producing potassium aluminate from alunite, which comprises calcining the alunite in the presence of carbonaceous material and of a reducing gas; substantially as described.

5. The method of producing potassium aluminate from alunite, which comprises calcining the alunite, in the presence of carbonaceous material and of steam; substantially as described.

6. The method of producing potassium aluminate from alunite, which comprises calcining the alunite, in the presence of carbonaceous material, steam and a reducing gas; substantially as described.

7. The method of producing potassium aluminate, which comprises calcining the alunite in the presence of carbonaceous material and of added alkali compounds, and recovering the potassium aluminate and the alkali aluminate corresponding to the added alkali from the resulting product; substantially as described.

8. The method of producing potassium aluminate from alunite, which comprises forming porous bodies of the alunite together with carbonaceous material, and calcining under non-oxidizing conditions; substantially as described.

9. The method of producing potassium aluminate from alunite, which comprises briqueting the alunite with carbonaceous material and calcining a charge of the briqueted material in a shaft furnace and under non-oxidizing conditions; substantially as described.

In testimony whereof we affix our signatures.

PAUL R. HERSHMAN.
RAYMOND D. COOKE.

Witnesses:
O. LAAGE, Jr.,
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