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SODIUM BARIUM ALUMINATE AND PROCESS OF MAKING THE SAME

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This invention relates generally to a compound of barium and a process by which such a compound may be produced. The invention relates particularly to the production of a compound comprising the oxides of sodium, barium and aluminum or any soluble barium salt, and a process of producing the same from insoluble barium salts.

An object of this invention, generally stated, is to provide a soluble barium salt.

Another object of this invention is to provide a process for making a soluble salt from an insoluble barium salt.

Another object of this invention is to provide a process for making sodium barium aluminate.

A further object of this invention is to provide a barium compound from which barium hydrate or barium oxide may be readily obtained.

A further object of this invention is to provide a barium salt containing sodium and aluminum which may be used in its original state in all processes in which barium oxide or barium hydrate have heretofore been used and under circumstances in which it is desirable to add a small quantity of sodium and aluminum, such as in glazing processes in the ceramic industry. Other objects will become apparent to those skilled in the art when the following description is read:

In accordance with this invention, a soluble barium salt, such as, for instance, one including the oxides of barium, sodium and aluminum is produced from insoluble barium salt and a suitable salt of sodium with the addition of some alumina. This mixture is preferably heated at a sufficient temperature either with or without a reducing agent to drive off the acidic content of the barium and sodium salts and thereby produce a compound which is a true mixture of sodium aluminate and tri-barium aluminumate. After such a roasting process has been completed and all the acidic content driven off, a soluble barium salt sodium barium aluminate

\[ 3\text{BaO}\cdot\text{Al}_2\text{O}_3 \] (Na\text{O}\cdot\text{Al}_2\text{O}_3)

will remain.

The roasting process in which the acidic content of the barium and sodium salts is driven off may be conveniently carried out in any suitable type furnace, such as, for instance, the well-known long brick-lined rotary type furnace or any other type which is suitable for withstanding high temperatures, such as for instance, 1300\(^\circ\) to 1500\(^\circ\) C. The specific dimensions of the furnace are, of course, optional, but when it is desired to produce the compound by continuous operation and when a substantially large output is desired, a furnace approximating 100 feet has been found preferable. With the use of such a furnace, the time required for converting a batch of the sodium and barium salts with alumina into sodium barium aluminate in accordance with this invention is generally from three to four hours. It is to be understood that the roasting process can be carried out with any type of fuel, such as, for instance, gas, coal or oil, and it is preferable under all circumstances to maintain the flame of the reducing character. Under some conditions of operation, it is preferable also to employ a reducing agent, such as, for instance, coke or powdered coal, but under ordinary operation the process may be satisfactorily carried out without the presence of such a reducing agent.

As an illustrative embodiment of the process for producing a soluble salt, such as, for instance, sodium barium aluminate, an insoluble barium salt, such as, for instance, barium sulphate, which may be in the form of baryte ore, is preferably ground to a fineness of not less than 100 mesh. Similarly, a quantity of any suitable sodium salt, such as, for instance, sodium chloride is ground to the desired fineness. Likewise, a quantity of alumina is ground to the desired fineness and the three materials, alumina (\(\text{Al}_2\text{O}_3\)), barium sulphate (\(\text{BaSO}_4\)) and sodium chloride (\(\text{NaCl}\)) are mixed together in molecular proportions and the mixture then heated in the furnace as set forth above. Under most circumstances it is preferable to add a trace of carbon for expediting the reaction. During the time in which the various materials are being roasted in the furnace, the sodium chloride is broken down by virtue of the presence of carbon monoxide and the chlorine is liberated so that the sodium is oxidized and remains as sodium oxide. The sodium oxide, however, is immediately broken down, the sodium replacing barium in the barium sulphate present so that a mixture of sodium sulphate and barium oxide is now present in the furnace. As the heating is continued, the sodium sulphate, by virtue of the carbon present, will be broken down into sodium sulphide, sodium oxide and sulphur dioxide, but since the sodium sulphide is unstable, the sulphur thereof readily be replaced by oxygen and the sulphur liberated as either the dioxide or trioxide. It is apparent, therefore, that the gases which are liberated during the roasting process are a mixture of chlorine, sulphur dioxide and sulphur trioxide, and are effective to carry with them the many various impurities which may be present in the raw ma-
terial, such as baryte ore. When the liberation of gases or acidic radicals has been completed, the material remaining in the furnace in the form of a clinker is a complex salt, comprising, barium oxide, sodium oxide and alumina. It has not been definitely determined whether or not the alumina undergoes any chemical change or action during the sintering process, but it is apparent that the resultant complex salt is a mixture of tribarium aluminate (3BaO·Al₂O₃) and sodium aluminate (Na₂O·Al₂O₃).

It is important that the temperature of the furnace be accurately controlled during the sintering process since it has been discovered that the barium content of the soluble salt is rendered, to an extent, insoluble, if the material is subjected to high temperatures for a substantial period of time. It is difficult to pre-determine the proper temperature for production of high solubility barium content, and it is necessary to determine the proper temperature more or less by experience. It may be pointed out, however, that the proper temperature for production of high solubility barium content is dependent to a great extent upon the portion of sodium salt present. For instance, it has been discovered that if the percentage of sodium chloride present be increased by 10%, the criterion temperature for production of high solubility barium content is reduced from 50° C. to 100° C. It may be pointed out that the process in this invention is adaptable to the production of such a complex salt as has been hereinbefore described with the use of barium carbonate or wetherite ore as a raw material. Moreover sodium carbonate may be used in lieu of the sodium chloride with more or less equal results. The use of wetherite ore as a raw material and the use of sodium carbonate, it may be pointed out, however, that different temperature conditions and longer periods of roasting are often necessary.

From the foregoing description it is apparent that a process has been described for producing a soluble barium salt, such as, sodium barium aluminate, from insoluble barium salt, such as, barium sulphate or barium carbonate, which may be continuously employed in a single furnace operation for the production of the soluble barium salt, which may be employed in commerce either in solution or in the dry phase.

It is apparent that the process hereinbefore described and the resultant compound are susceptible of many modifications without departing from the spirit of this invention. Accordingly, it is to be distinctly understood that the foregoing description and the various terms employed therein set forth merely one illustrative embodiment, and it is apparent that many individual features are of utility without reference to other features, so that it is to be distinctly understood that such modifications and the use of such features as do not depart from the spirit of this invention, are, although not specifically described herein, contemplated by and within the scope of the appended claims.

Having thus described the invention, what is claimed is:

1. In the art of making soluble barium compounds, the process comprising, mixing barium sulphate, sodium carbonate, and alumina, and heating the mixture to a temperature sufficient to drive off the acid radical of the barium salt.

2. In the art of making soluble barium compounds, the process comprising, mixing barium carbonate and sodium carbonate and alumina, and heating the mixture to a temperature sufficient to drive off the acid radical of the barium salt.

3. In the art of making soluble barium compounds, the process comprising, mixing barium carbonate and sodium chloride and alumina, and heating the mixture to a temperature sufficient to drive off the acid radical of the barium salt.

4. In the art of making soluble barium compounds, the process comprising, mixing barium carbonate and sodium carbonate and alumina, and heating the mixture to a temperature sufficient to drive off the acid radical of the barium salt.

5. A composition which has been fused comprising, tribarium aluminate and sodium aluminate.

6. A composition which has been fused comprising, a barium aluminate and sodium aluminate in intimate association resulting from concurrent production.

7. In the art of making soluble barium compounds, the process comprising, mixing a barium salt with a sodium salt, and alumina substantially in molecular proportions such as to yield a product having the formula (3BaO·Al₂O₃) and a product having the formula (Na₂O·Al₂O₃), and heating the mixture to expel the acid radicals from the salts and concurrently produce said products in intimate mixture.

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