

UNITED STATES PATENT OFFICE

2,676,153

METHOD OF PREPARING AN ALUMINUM-CAUSTIC SODA COMPOSITION

James Douglas MacMahon, Niagara Falls, N. Y.,
assignor to Mathieson Chemical Corporation,
a corporation of Virginia

No Drawing. Application April 13, 1950,
Serial No. 155,777

3 Claims. (Cl. 252-157)

1

My invention relates to a process for preparing an improved aluminum-caustic soda composition which is particularly valuable as applied in the cleaning of drain pipes and traps in plumbing systems.

It is old to prepare drain cleaning compounds by admixing caustic soda with aluminum metal in the form of granules, chips, or shavings or with aluminum dross, a material skimmed from aluminum melting pots. The effectiveness of these mixtures derives from the fact that in contact with water the caustic and aluminum react with production of heat and evolution of hydrogen gas which serves to provide agitation. Frequently, other materials are included in the mixture for some special purpose. Thus materials have been added to slow down the reaction or to reduce the quantity of aluminum necessary, or to make less offensive the fumes sometime resulting upon introduction of the mixture into drain pipes.

One disadvantage of the conventional mixture is the segregation of the components which seems prone to occur during transportation or from incidental handling during storage. It is quite common upon inspection of a carton of the present day product to find that the aluminum and caustic have segregated to a large extent. That this nonuniformity adversely influences the effectiveness of the material is believed obvious. Even in the absence of segregation of the components during transportation or storage the presently available drain cleaning compounds are disadvantageous in that in use the aluminum particles tend to settle toward the bottom of the drain or trap with the result that the desired intimate contact between the aluminum and caustic giving the maximum degree of reaction is not achieved.

Most sink drains are covered by a protective, perforated metal plate, brass, for instance, so that a material must be more or less finely divided to pass through this plate. Generally speaking, compositions that will pass through a 6-mesh sieve will satisfactorily flow through practically all sink plates used in this country. In any event, the portion remaining on the plate is easily washed through with a small amount of tap water. While a material passing through, for instance, a 4-mesh sieve may be forced into the drain by brushing a spoon, or some other similar convenient object, back and forth over the plate on which the mix has been poured, this practice is objectionable. Ordinarily the person who employs this type of product will attempt

2

to flush a substantial portion of the material through the drain plate which results in excessive water being present in the reaction. Thus it is advantageous to pass the cleaning mix into the drain first, then add water, since this procedure places the drain opening mix against the pocket of grease or other material to be removed from the pipe trap. As a result, I have found that a mixture that will pass through a 6-mesh sieve will be of maximum utility in this regard.

Unfortunately, to the best of my knowledge, there is no tableting equipment available which will make granules small enough to readily pass through a 6-mesh sieve. Conventional pelleting machines, for instance, make relatively large particles and since very few sinks have removable drain guards, materials so produced are not satisfactory. Further, it is difficult to handle large particles of this nature since, for instance, they tend to roll off a spoon, etc., and, when poured into a sink, they may roll and disperse undesirably.

I have found that thick castings even of aluminum granules dispersed in fused caustic soda tend, upon breaking, to crack from aluminum grain to aluminum grain so as to free a substantial portion of the aluminum as individual pieces. This separation, which may amount to 20% or more if coarse aluminum is employed in preparation, makes the material an undesirable mechanical admixture subject to the objections previously indicated. And when it is considered that the aluminum particles will settle very quickly after they are freed by such breaking the uneven nature of this composition and its unsatisfactory use in a non-flaked form will be appreciated.

In accordance with the present invention I provide a process for preparing a caustic soda-aluminum composition in which the caustic soda and aluminum are present in an intimately bound relation not permitting of the occurrence of segregation during shipment or storage and allowing for the near maximum possible reaction between the aluminum and caustic soda when the composition is brought into contact with water.

I have discovered that such improved drain-opening compositions can be prepared by dispersing finely-divided aluminum particles into fused caustic soda, cooling the mix as thin sheets or slabs, and then flaking or granulating the sheets into a useful product. I have found that certain process conditions and additive proportions are essential to the preparation of these improved compositions. The aluminum is added

3

in finely-divided form to fused caustic soda maintained at a temperature in the range approximating 625° to 700-800° F. The aluminum particles are preferably of a 20-mesh or finer screen size. The resulting mix is cooled as thin slabs or sheets, advantageously of a thickness less than about 0.050 inch. These thin sheets are then flaked or granulated into finely-divided form, preferably of a 6-mesh or finer size, for greatest utility. The granular aluminum is added in amounts of about 2 to 10% by weight on the caustic soda. And although diluent materials such as coloring or perfuming agents may be added as well as substances that will regulate the reaction of the final product, it should contain at least about 50% by weight of caustic soda.

By way of specific example, I particularly contemplate preparing an improved composition according to my invention by feeding fused caustic soda to the interface between two rotating drum surfaces, then evenly dispersing finely divided aluminum granules of 20-mesh or finer size into the fused caustic soda at the interface while the caustic soda is maintained at a temperature of about 650 to 750° F. Advantageously, the aluminum is added in amounts of about 3 to 8% by weight on the caustic soda and I particularly prefer additions of about 4 to 5% of aluminum. The aluminum-caustic soda mix is extruded as a thin sheet, advantageously of a thickness between about 0.040 to 0.050 inch. The sheet is then cooled or otherwise hardened whereupon it is finely divided or granulated, preferably so as to pass through a 6-mesh or finer screen.

The improved homogeneity and stability of the compositions prepared in accordance with my invention are dependent in large measure upon reactant proportions and the process conditions. However, I have found that other factors of consequence such as ultimate utility as governed by heat of reaction and hydrogen liberation also derive from these conditions and proportions. For instance approximately 2 to 10% by weight of the aluminum is added to the caustic soda. More than about ten per cent may result in objectionably violent reactions while less than two per cent is relatively ineffective. I prefer to add about 3 to 8% aluminum and about 4 to 5% will provide a product of maximum utility consistent with commercial considerations. Aluminum granules of a very small size are requisite to my process, such as those passing through a 20-mesh or finer sieve, since they are easily suspended in the fused caustic soda. In addition, aluminum particles of a generally homogeneous or similar size range are particularly preferred over, for instance, chips or shavings which may conform to size dimensions but which are not uniform in size. However, the aluminum need not be in pure form, for instance alloys of aluminum dross are applicable. Indeed, the attractiveness of my process is enhanced by the fact that impure aluminum may be and is usually employed. For instance, aluminum of about 90% purity may be advantageously used.

The caustic soda preferably should not contain more than about 1.5 to 2.0% water but a somewhat greater amount of water may be present if the aluminum is added slowly as it then tends to reduce the caustic soda water content. In this regard, I have found that it is advisable to avoid the use of caustic potash as a substitute for the soda since a less favorable composition is obtained. For instance, caustic potash is more difficult to dry and is more hygroscopic. How-

4

ever, caustic potash may be present in small amounts to take advantage of the fact that it lowers the melting point and will delay hardening of the sheet. But in any event, the proportion of caustic soda present in the final product should be at least 50% by weight, advantageously in considerably greater proportion, in order to obtain the highly useful and favorable product I prepare.

Other materials including inorganic compounds such as sodium borate, sodium chloride, caustic potash, sodium chlorite, sodium chromate, manganese sulfate, may be incorporated in the composition when desired, as may be perfuming agents, such as powdered spices, e. g. ginger, cinnamon, cloves, etc. If the material is stable in fused caustic soda in the presence of metallic aluminum, it is advantageous to add it to the melt; otherwise it may be incorporated following cooling and flaking of the caustic-aluminum mass by mechanical mixing. Of the materials specifically named sodium chlorite, for example, must be incorporated by the latter method. When adding this compound, which is desirable since it increases the heat produced in the reaction with water upon use of the composition, I ordinarily add from about 0.5 to about 5 parts for each part of aluminum present. Sodium chloride, sulfate and silicate are useful in the composition for controlling the intensity of the reaction with water, while the inclusion of alkali metal chromates, e. g. sodium dichromate, or manganese sulfate imparts a desirable color to the composition. Sodium monoxide serves to intensify the reaction and to keep the composition dry in storage. In any event, as I have already indicated, the amount of caustic soda present in the final composition should be at least 50% or more by weight.

The aluminum granules are advantageously added evenly by any suitable means, say by an electric vibrator. The fused caustic soda should be maintained at a temperature above that at which a skin will form on its surface, which will inhibit the free dispersion of the aluminum granules in the fused mass. This will generally require a temperature above about 625° F. On the other hand, the caustic soda temperature should be below the range in which it will react with the aluminum. Accordingly, I have found that an upper limit of about 700 to 800° F. is satisfactory. An addition temperature of about 650 to 750° F. is particularly advantageous. And although it is not necessary I prefer to effect mixture of the caustic soda with the aluminum in an inert atmosphere such as nitrogen or argon.

I have found it necessary to prepare the aluminum-caustic soda mix in the form of thin sheets or slabs if the mix is to be susceptible to granulation without separation of the aluminum. This is accomplished by sprinkling finely-divided aluminum into the fused or molten caustic soda, then cooling it into thin slab or sheet form. When so prepared, the proportion of the aluminum grains which are freed from the caustic soda flakes during any subsequent breaking or granulation treatment will be held as low as 5% of the total aluminum content. As a result, no substantial segregation takes place during handling, packaging, shipment and retailing, since 95% or more of the aluminum is present in the flakes all of which are substantially the same composition and density.

I prefer to cool the aluminum-caustic soda mix as thin sheets or slabs of a thickness less than

5

about 0.050 inch. Advantageously, a sheet thickness in the range of 0.040 to 0.050 provides an exceptionally useful form readily susceptible to granulation. The sheets are then granulated or flaked into fine particles of the final product. As I have previously stated, granulation to a more or less uniform product of a 6-mesh size or less will provide a product of considerable utility.

I have found that a highly advantageous aluminum-caustic soda composition may be prepared by pouring the molten or fused caustic soda between the interface of two rotating drum surfaces, sprinkling finely divided or granulated aluminum of a 20 mesh or finer size onto the surface of the caustic soda and then extruding the composition in the form of sheets of thickness in the range of 0.040 to 0.050 inch. Preferably, the caustic soda is maintained at a temperature between about 650 to 750° F. during the aluminum addition. The sheet thus formed is hardened and granulated. Upon granulation the fines formed may be screened out and charged to a subsequent melt so as to obtain an open, porous flake material. However, prior to granulation, I prefer to break the sheet into intermediate-size pieces, for example by passing the sheet through a breaker of the type generally employed in caustic soda flaking operations. However, when a sheet of caustic soda containing imbedded aluminum grains is satisfactorily granulated, say by rolling pieces of the sheet against and through a screen, the proportion of fines resulting is generally small.

Two rotating drums of identical or dissimilar size may be used in this practice of my invention. However, I prefer to employ drums of different size. The caustic soda is fused or melted and while in this state is poured into the pinch or interface between the rotating drums. The aluminum particles are then evenly sprinkled onto the surface of the molten caustic soda. The caustic soda is maintained at a temperature above about 625° F., since otherwise a "skin" may form, causing the aluminum particles to "float" on the surface of the caustic soda. As a result, the aluminum tends to separate out during the breaking and granulation operation. The sprinkling or dispersion of the aluminum in the caustic soda is advantageously accomplished by use of an electric vibrator so as to spread the particles evenly over the width of the rolls.

I prefer to set the rotating drum surfaces at a slight angle from the horizontal, for instance 15 to 30 degrees. Preferably, the lower drum is operated at a slightly lower temperature and at a slightly greater peripheral speed than the upper drum. Or this effect may be accomplished, for instance, by using one drum of a 10% greater diameter than the other and turning both at the same velocity. The rotating drums may differ either in size, peripheral speed, temperature of the drum surfaces or in relation to each other in height. When identical drums are employed, the sheet is advantageously cleanly extruded so as to not adhere to either of the rolls. Hardening is effected after extrusion by and during, for example, passage in a chute or feeder to a granulator or breaker. Generally speaking, though, satisfactory adjustment for operations with identical drums having their axes in the same horizontal plane so as to produce a satisfactory sheet is more difficult than with unlike drums.

The caustic soda is fed into the pinch in molten condition, the aluminum particles sprinkled on

6

the fused soda so as to settle into it, and the composition passed between said rolls to emerge as a single soft sheet. The sheet may adhere to the lower roll for a short period of time, for instance, about one half of a second, while stiffening, but is then removed and collected, allowed to harden, and finally granulated. After hardening, but prior to final granulation, the sheet may be broken into pieces of intermediate size and sorted or the sheets may be granulated directly to pass through, advantageously, a 6-mesh or finer sieve. Suitable granulating means are used, such as rotating or oscillating bars or rollers. Oversize particles are returned to the granulating means.

Hardening of the extruded sheet is facilitated by regulation of the composition of the fused material, such as by the addition of clay. The melting point can be lowered, for example, by addition of caustic potash to the caustic soda. Minor changes in the melting point and considerable alterations in the rate of hardening can be effected by the addition of, for instance, soda ash and sodium silicate to the melt. Further, this rate of hardening may be additionally varied by regulating the temperature of the lower drum, that is, the drum against which the sheet is held for a short period of time. The temperature regulation on the lower drum may be effected by pressure steam or water cooling and will depend upon the size of the installation and the speed at which the wheel turns. Ordinarily, the operational control is the temperature of the fused caustic soda feed.

The following examples are intended to more clearly illustrate my invention.

Example I

Ninety parts by weight of caustic soda were fused at 680 to 700° F. in a graphite crucible. Ten parts of 90% pure aluminum of a particle size less than 20 mesh were added to the fused caustic accompanied by stirring. The mix was poured onto a nickel plate to cool as a thin sheet. The cooled sheet was then crushed and sieved. Excellent results were obtained with this product.

Example II

A mixture by weight of 86.7 parts of caustic soda, 3 parts of sodium silicate and 0.3 part of sodium chromate was heated to a temperature of 750° F. The fusion was poured into the interface between two rotating drums, a "twin drum drier." Ten parts of about 90% pure aluminum of a particle size less than 20 mesh were evenly dispersed into the fusion. The mix was extruded as a thin sheet, was cooled and then granulated. The granulated product gave a very vigorous reaction with water.

Example III

A mixture by weight of 87.7 parts of caustic soda, 2 parts of borax and 0.3 part of potassium chromate was heated to a temperature of 700 to 750° F. The fusion was poured into the interface between two rotating drums, a "twin drum drier." Ten parts of about 90% pure aluminum of a particle size less than 20 mesh were evenly dispersed into the fusion. The mix was extruded as a thin sheet, was cooled and then granulated. The granulated product gave a very vigorous reaction with water.

Example IV

A mixture by weight of 93 parts of caustic soda and approximately 0.04 part of manganese sul-

7

fate was heated to a temperature of 690° F. The fusion was poured into the interface between 2 rotating drums, a "twin drum drier." Seven parts of 90% pure aluminum of a particle size less than 20 mesh were evenly dispersed into the fusion. The mix was extruded as a thin sheet, was cooled and granulated. The sheet was blue-green in color and the granulated product gave a very vigorous reaction with H₂O.

Example V

Three aluminum-caustic soda compositions were prepared in accordance with my invention by fusing caustic soda in air, adding 90% pure granular aluminum of less than 20 mesh size, cooling the mix as thin sheets and granulating the sheets. The only essential difference between each of the final products was the aluminum used in preparation. The first composition was prepared with 5% by weight of aluminum, the second with 10% and the third with 15%. A 50 part by weight sample of each was added to 350 parts of water in a calorimeter and the rate of temperature rise was measured. The results were as follows:

Time in minutes	Sample was prepared with—		
	5% Al	10% Al	15% Al
	Temperature in degrees Centigrade		
0 (Initial).....	19.5	19.5	5
1.....	40	42	33
2.....	49	54	38
4.....	59	63	42
6.....	62	70	47
8.....	65	78	52
10.....	68	86	59
12.....	70	88	68

It is interesting to note that the sample prepared with 15% aluminum (90% purity) did not provide as great a temperature rise as the sample from only 10%. This preparation, of course, contains aluminum in amount outside the range I have defined in my process.

8

In describing and claiming the process according to my invention I have consistently referred to finely-divided particles in terms of a certain mesh or screen size. By this terminology, e. g. "20-mesh size," "6-mesh screen" or simply "6-mesh," I mean to refer to the size of a particle that will pass through a sieve or screen with at least that many meshes per inch. And my reference is to the "Tyler" standard screen scale.

This application is a continuation-in-part of my co-pending application Serial Number 743,451, filed April 23, 1947, now abandoned.

I claim:

1. The method of preparing an improved drain opening composition of improved homogeneity and stability in which caustic soda and aluminum are present in intimately bound relation not permitting segregation which comprises uniformly dispersing into fused caustic soda maintained at a temperature in the range approximating 625° to 800° F., granules of metallic aluminum having a particle size passing a 20-mesh screen and in an amount of about 2 to 10 per cent based on the weight of the caustic soda, cooling and solidifying the mixture in thin sheets, and finely dividing the thin sheets.

2. The method of claim 1 wherein the thin sheets have a thickness not exceeding about 0.05 inch.

3. The method of claim 1 wherein the aluminum granular are uniformly dispersed into the fused caustic soda while the caustic soda is being fed into the interface between two rotating drum surfaces.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
934,036	Brindley	Sept. 14, 1909
2,353,026	Gilbert	July 4, 1944
2,357,723	Beecher et al.	Sept. 5, 1944
2,371,436	Gangloff	Mar. 13, 1945
2,403,157	Wegst et al.	July 2, 1946