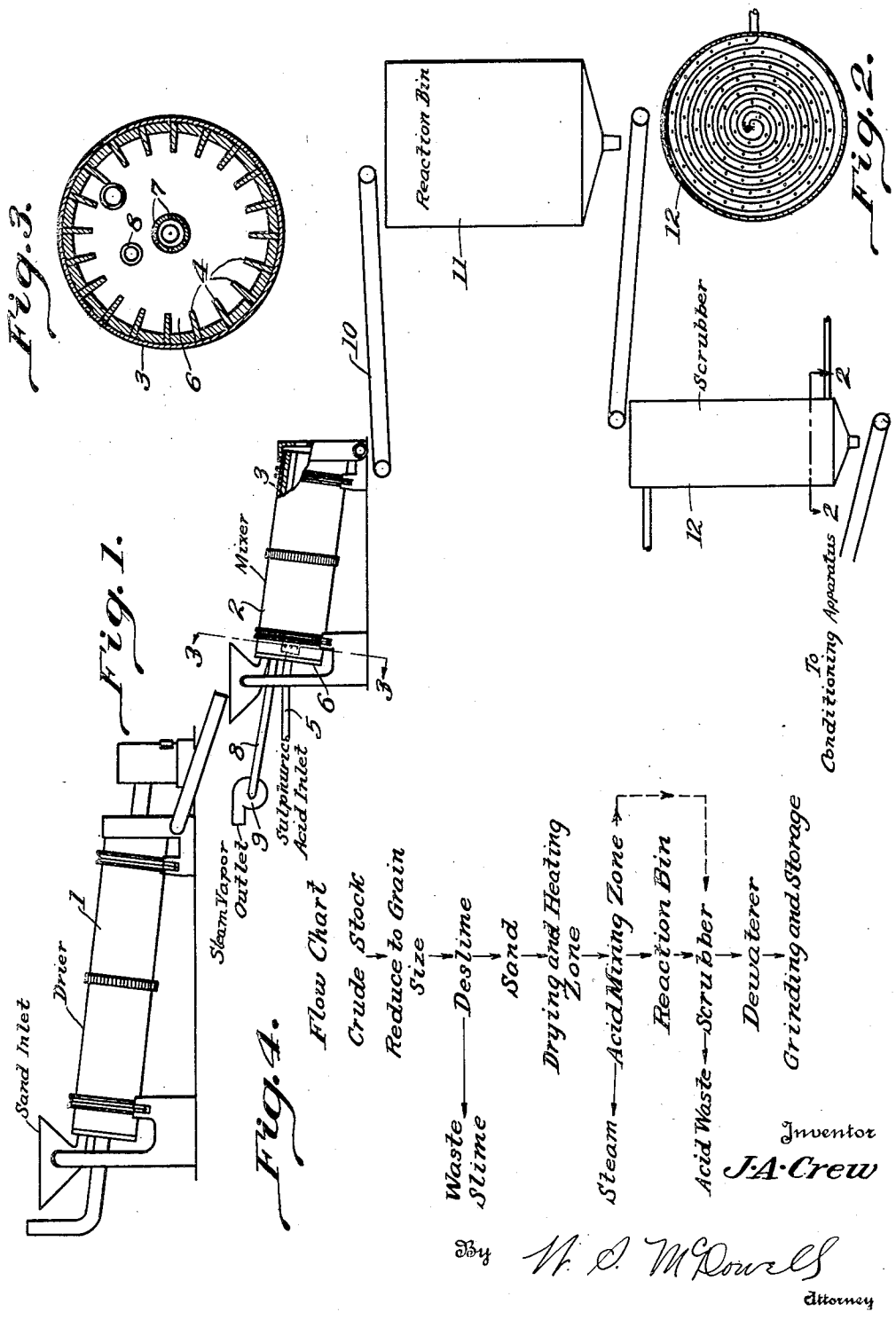
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PROCESS FOR TREATING SAND

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PROCESS FOR TREATING SAND

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This invention relates to an improved process for treating silica sands for the purpose of obtaining in an economical and efficient manner, unusually highly purified and decolorized sand which is readily adapted for use, among other fields, in the ceramic and glass manufacturing industries.

It has been proposed heretofore to leach natural sands to remove impurities or other undesired compounds therefrom of a discoloring character by intimately mixing such natural sands with dilute sulphuric acid and then passing the sand through a heating zone possessing a temperature sufficiently high to evaporate the moisture or water content of the sand to leave the grains of the latter coated with concentrated sulphuric acid, whereby to permit the sulphuric acid to react with iron oxide compounds contained in the sand so that when the latter is finally washed or scrubbed, the impurities will be removed with the sulphuric acid, leaving the sand in a purified and bleached state. I have observed that when the sand is thus treated and is placed in the heating zone and otherwise handled, it is necessary to employ special corrosion resisting materials since the dilute sulphuric acid readily attacks ordinary metals to produce damaging corrosion.

It is an object of the present invention to provide a process wherein the sand is first heated to a relatively dry state and to a temperature above the boiling point of water immediately prior to the step of adding a reagent usually in the form of an acid solution to the sand, for the purpose of assisting in the spreading of the acid over the whole surface of each grain by capillarity and surface tension, providing a much easier and surer operation than the replacement of water by, for example, dilute sulphuric acid through diffusion, as is required in the former method of soaking the same in a bath or vat containing dilute sulphuric acid. Again, my improved process avoids entirely the transportation of the sand when mixed with dilute sulphuric acid solutions. Since concentrated sulphuric acid, when applied in the form of a thin film on the sand grains, is not highly corrosive, it may be handled by ordinary conveyor mechanism of standard design without premature destruction of metal parts through corrosion.

For a further understanding of the invention, reference is to be had to the following description and the accompanying drawing, wherein:

Fig. 1 is a diagrammatic view in side elevation disclosing apparatus employed in carrying the present invention into effect;

Fig. 2 is a horizontal sectional view on the line 2—2 of Fig. 1;

Fig. 3 is a vertical transverse sectional view on the line 3—3 of Fig. 1, disclosing the inlet portion of the mixer; and

Fig. 4 is a chart disclosing the sequence of operations used in carrying out the present invention.

My process is practiced by first taking natural sand and bringing the same down to grain size, cleaning off as much as possible of included impure matter by customary treating operations. I then take the sand and pass the same through an unlined rotary drier of the type indicated at 1, wherein heat is passed through the drier from a suitable heat generator in a direction countercurrent to the passage of the sand through the drier. This operation serves to greatly reduce the normal moisture content of the sand and heats it to a desired operating temperature, normally, 400° F. which is sufficient to drive off all appreciable moisture. However, the temperature of the heated sand may vary between 200° F. to whatever upward limit is considered desirable.

Following this initial heating of the sand in the drier 1, I immediately transfer, through a belt or other convenient means, the heated sand to a brick lined mixer, indicated at 2. This mixer may be of approximately the same form, only shorter than the drier 1, in that it involves a rotating drum set on a slight angle with respect to the horizontal. The drum of the mixer is indicated at 3 and the interior of the drum is preferably brick lined and may be provided with lifters 4 by which turbulence is imparted to the sand as the drum 3 rotates. The drum 3 may or may not be additionally heated, usually the sensible heat of the sand is sufficient to carry out my operation. A pipe line 5 is mounted in the stationary end wall 6 of the drum 3 adjacent to the point of entrance of the heated sand into said drum, and the pipe line terminates in a closed end provided with radial ports 7 by which the sulphuric acid solution or other reagent is introduced into said drum and into contact with the heated sand. This reagent may consist of sulphuric acid or other suitable chemicals in varying proportions. When the acid solution strikes the sand, steam is liberated in copious quantities and is preferably immediately withdrawn from the mixer by way of an outlet conduit 8 connected with the stationary end wall 6, the conduit being equipped with a suction fan

or its equivalent 9 whereby to effect a positive withdrawal of the steam almost immediately upon its liberation.

Since the sand, prior to its delivery to the mixing drum, is in a substantially dry and heated state before the reagent is added, the result is to secure the spreading of the reagent over the whole surface of the sand grains, this being assisted by capillarity and surface tension, enabling the reagent to enter the fine crevices of sand grain and thoroughly coat the surface of each grain with a film of the reagent. This film, in effect, comprises a highly concentrated form of the reagent since the water content of the solution is quickly evaporated and almost instantaneously removed by the operation of the suction fan in withdrawing the steam from the mixer drum.

This film of concentrated reagent readily reacts on the surface impurities of the sand such as the iron oxide compounds. Since reagents such as concentrated sulphuric acid when in film form on the sand grains do not readily attack metal, the sand upon discharge from the mixer may be readily handled in ordinary conveying apparatus without involving the use of special corrosion resisting materials.

Upon discharge from the mixer, the acid coated sand, which is practically dry to the touch, is transferred by means of a conveyor 10 of standard construction to a bin 11, in which the sand is permitted to stand for a period of several hours in order to insure thorough and complete reaction between impurities in the sand and the sulphuric acid. Following the retention of the sand within the bin for a desired period of time, the sand is then transferred to one of a plurality of scrubbers 12. Water is percolated upwardly through the sand contained in each scrubber to wash away the sulphuric acid and the impurities combined therewith, the percolation continuing until the liquid discharged from the top of each bin is negative to acid tests.

If desired, the sands may be again washed with a caustic if an extremely white appearance is desired. After being washed to a negative acid condition, the sand will be flushed to a drag washer and conveyed to a drain bin, thence to a standard steam drier and finally subjected to a grinding mill operation, whereby it is reduced to its desired state of fineness.

The advantages resulting from this method of operation have been set forth above but, in addition, it may be pointed out that it permits of the employment of an unlined drier, as at 1, whereby to provide for quick firing and good temperature control for the succeeding mixing step. Preferably, the sand introduced into the drier will be preliminarily treated by standard apparatus so that it does not possess a moisture content materially in excess of 5 to 6%. This moisture content consists of water only, no acid being present in the drier. Since no acid is present when the sand is being heated in the drier, there is no likelihood of decomposition of the sulphates or the darkening of the sand. By having the sand in a dry heated condition when brought into contact with the dilute sulphuric acid solution, the sand grains readily take up the sulphuric acid present to provide over each grain of sand a film or deposit of concentrated sulphuric acid, since the water in the solution is practically instantly driven off or evaporated in the form of steam and removed from the mixer by way of the outlet conduit 8. This conduit as well as the fan may be formed from corrosion resisting materials if necessary.

I prefer to employ the bin 11 whereby to secure the desired period of time to effect complete reaction between the acid and the sand impurities although, of course, there are certain operations wherein this bin may be omitted since I have found that the reaction is more than 75% complete by the time the sand is discharged from the mixer. Thorough washing of the sand and removal of acid and impurities can be effected by the upward percolation of water through the sand delivered to the scrubbers 12. The temperatures specified are subject to variation and a considerable degree of control both in the drier 1 and the mixer 2. Ordinarily, in the drier, the sand is heated to a temperature of substantially 370° F. to 430° F. and is then removed from the drier. At the time of introduction into the mixer, the sand may possess a temperature of approximately 350° F., which is well above the boiling point of water so that the heat stored in the sand may be used to drive off the water content of a dilute acid solution.

The conditions which exist in the drum 3 and the reactions desired may be readily controlled by governing the strength of the acid solution, by varying the rate of feed of the sand into the drier and/or by varying the temperature of the sand when introduced into the drum. Lifters 4 in said drum serve to stir the same and effect its intimate contact with the acid. By the explosive action of the evolved steam at the feed end of the mixer, a very thorough agitation or turbulence of the sand is obtained, the steam expands rapidly with a considerable degree of violence so that an effective intermixture takes place between the sand and the acid reagent. While in the bin 11, the sand may be maintained at a temperature varying between 160° F. and 230° F. and may be held at this temperature for several hours before washing.

What is claimed is:

1. The process of treating sand, which comprises heating sand to a drying temperature, introducing into the dry sand while the latter is in a heated state an acid reagent in aqueous solution, whereby the heat of the sand serves to evaporate substantially the water content of the reagent leaving the grains of the sand covered by the reagent in a highly concentrated form, withdrawing water vapor from the sand substantially immediately upon its evolution by contact with the heated sand, and then following the desired period of reaction between the concentrated reagent and the sand, subjecting the sand to a washing action to remove the reagent and impurities combined therewith.

2. The process of treating sand which comprises heating the sand in the absence of an acid to a drying temperature in excess of 200° F., then introducing into the sand while the latter is in a heated state and during agitation thereof an aqueous solution of sulphuric acid, and substantially immediately removing the liberated water vapor to produce a film of concentrated sulphuric acid on the sand particles.

3. The method of treating sand to remove impurities therefrom which consists in continuously passing a body of sand through a heated drying zone wherein the sand attains a temperature in excess of 200° F., passing the sand while in a heated state from the drying zone to a mixing zone and continuously passing the same in an agitated state through said mixing zone, and in-

troducing into contact with the sand during its passage through the mixing zone an aqueous acid solution, whereby to coat the sand particles with an acid film of a concentrated character, the liquid carrier medium of the acid being quickly liberated as a vapor by initial contact with the heated sand.

4. The method of treating sand to remove impurities therefrom which consists in reducing the sand to a substantially dry state by continuous passage through a drier wherein said sand is heated in the absence of an acid to a temperature of from between 200° F. to 500° F., continually removing the heated sand from the drier and immediately transferring the same to a mixer through which the sand is continuously passed and agitated, introducing into the mixer an aqueous solution of sulphuric acid, whereby to coat the sand grains with a film composed of a highly concentrated solution of sulphuric acid, the liquid carrier agent being substantially immediately vaporized by the temperature of the sand and removed from the drier, and then water washing the acid coated sand, following removal from said mixer to remove the acid and combined impurities from the treated sand.

5. The method of treating sand to remove impurities therefrom which consists in reducing the sand to a substantially dry state by continuous passage through a drier wherein said sand is heated in the absence of an acid to a temperature of from between 200° F. to 500° F., continually removing the heated sand from the drier and immediately transferring the same to a mixer through which the sand is continuously passed and agitated, introducing into the mixer a weak aqueous solution of sulphuric acid, whereby to coat the sand grains with a film composed of a highly concentrated solution of sulphuric acid, the liquid carrier agent being vaporized by the temperature of the sand and removed from the drier, maintaining the said film on the sand grains for a desired period of time to secure chemical reaction between the sulphuric acid and the iron oxide content of the sand, and then water washing the acid coated sand, following removal from said mixer to remove the acid and combined impurities from the treated sand.

6. In a process of treating sands to remove ferrous impurities, the steps which comprise heating the same under substantially atmospheric pressure conditions to a temperature above 200° F. in the absence of an acid, and then introducing into the sand while the latter is in the heated state specified an acid in aqueous solution, the temperature of the sand and the presence of normal pressures thereon effecting a substantially immediate evaporation of the water content of said acid solution, and immediately removing the liberated water vapor at the time of its formation to produce on the sand grains a film of acid in a concentrated form.

7. In a process of treating silica sand to remove ferrous impurities, the steps which comprise preheating the sand in the absence of an acid, and then introducing into the sand a quantity of sulphuric acid to produce on the sand grains a film of acid in concentrated form.

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