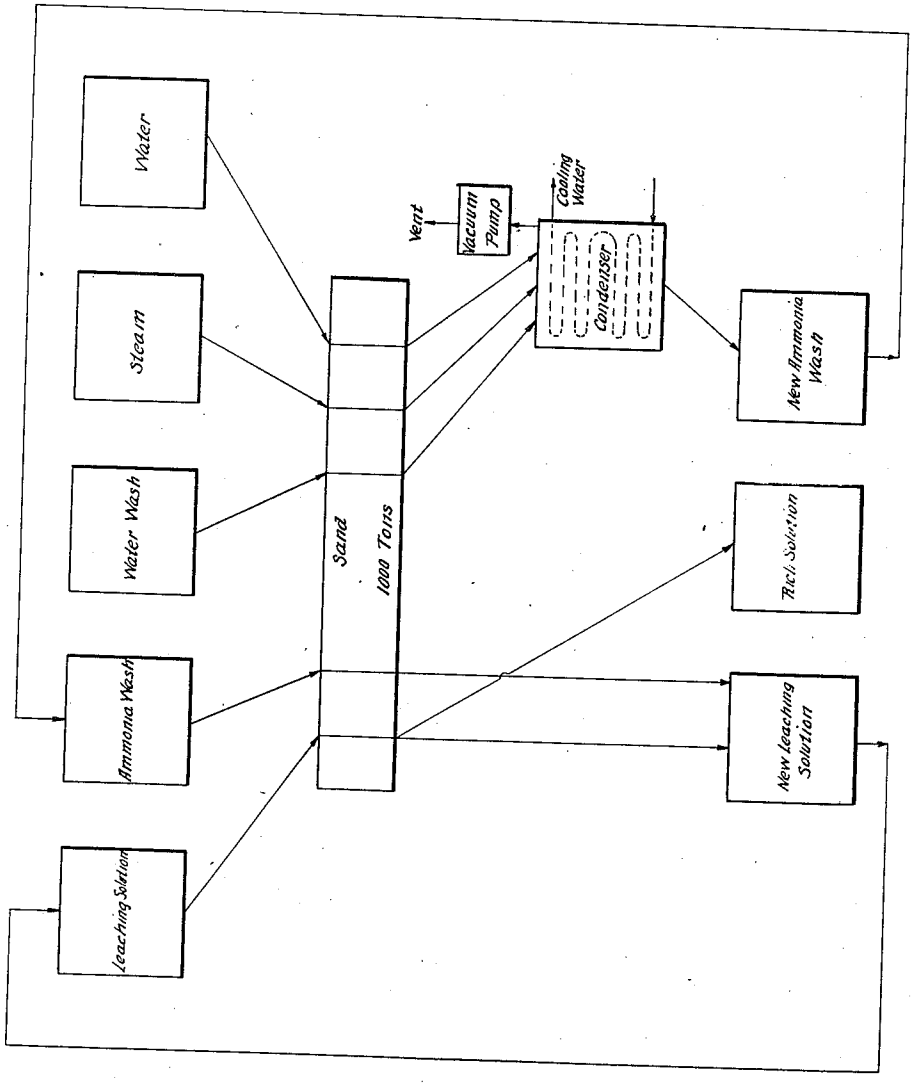
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PROCESS OF TREATING COPPER BEARING SANDS.

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1,335,474.

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UNITED STATES PATENT OFFICE.

CENTENNIAL HARRY BENEDICT AND HERMAN C. KENNY, OF LAKE LINDEN, MICHIGAN.

PROCESS OF TREATING COPPER-BEARING SANDS.

1,335,474. Specification of Letters Patent. Patented Mar. 30, 1920.

Application filed October 7, 1919. Serial No. 329,179.

To all whom it may concern:

Be it known that we, (1) CENTENNIAL HARRY BENEDICT and (2) HERMAN C. KENNY, citizens of the United States, residing at (1) Lake Linden, (2) Lake Linden, in the county of (1) Houghton, (2) Houghton, and State of (1) Michigan, (2) Michigan, have invented certain new and useful Improvements in Processes of Treating Copper-Bearing Sands, of which the following is a specification.

It is well known that in the leaching of copper-bearing sands or the like with solutions containing ammonia, usually employed in conjunction with cupric salts, material losses of ammonia are encountered owing to the tendency of the sands to occlude or adsorb ammonia, the quantity of ammonia so adsorbed being in general approximately proportionate to the concentration of the ammoniacal solutions. The adsorbed ammonia cannot be completely recovered by simple washing with water either at normal or higher temperatures. A better recovery may be secured by passing a current of steam through the bed of leached sands, using a sufficient pressure of steam to secure the desired rate of flow, and condensing the effluent vapors so long as they carry sufficient ammonia to warrant this recovery; but this is an expensive procedure in a large operation, in which it is not unusual to leach the sands in successive batches of about 1000 tons each. Not only is a large quantity of steam required for heating the sand to the temperature at which substantial condensation ceases and an efflux of ammonia-bearing vapors begins, but highly expensive pressure-apparatus is required in order to avoid loss of ammonia while introducing the steam at the super-atmospheric pressure necessary for obtaining the desired flow through the sand.

According to the present invention we overcome the above difficulties in the following manner: After the completion of the leaching operation proper, and a preliminary washing or washings so conducted as to eliminate the dissolved copper as far as practicable, we partially exhaust the air from beneath the sand bed, and allow the bed to drain. Thereby the dilute copper-bearing solution remaining in the interstices of the sand is withdrawn, and the sand bed is left in a relatively permeable state. We then admit steam at substantially atmospheric pressure above the surface of the bed and allow it to flow downwardly therethrough, the partial vacuum being meanwhile maintained beneath the bed. There is some incidental condensation of such steam, and we withdraw such condensate and preferably utilize the same, on account of its ammonia content, as a wash in the treatment of fresh batches of ore. Meantime the temperature of the sand rises progressively to approximately the temperature of the steam, and eventually steam appears at the effluent surface of the bed. This application of steam is continued, with condensation of the effluent vapors, until the ammonia content of the condensate falls to a predetermined minimum. We then cut off the direct supply of steam and add water, which is preferably hot, and is distributed as uniformly as possible over the upper surface of the sand bed. The partial vacuum being maintained, the water vaporizes rapidly at the diminished pressure as it percolates through the heated sand, and the resulting steam entrains the last recoverable traces of adsorbed ammonia. The heat necessary for this vaporization is supplied by the sand which therefore progressively falls in temperature and is eventually run to waste.

This procedure involves certain economic advantages among which are the following:

1. The steam is admitted above the sand bed at substantially atmosphereic pressure, and its downward flow is regulated and controlled by the suction applied beneath the bed. This renders it possible to simplify very greatly the type and the construction of the apparatus used, for the reason that the pressure is substantially equal on the inside and outside of the tank covers, and the latter may therefore be of light construction, may be simply set in a water-seal to avoid losses of ammonia, and are readily removable for the purpose of filling and emptying the tanks.

2. The residual heat of the sand is used, under diminished pressure, to generate the steam by which the last recoverable portions of adsorbed ammonia are eliminated, thereby avoiding in large measure the heavy losses of heat which are incurred when the highly heated steamed sand is run directly to waste.

Our invention is not limited to the treat-

ment of copper sands, since it may be applied to the treatment of zinc or other ores or metallurgical products or residues which are to be subjected to an ammoniacal solvent. It is especially applicable however to a process of the general type described in U. S. Patent 1,131,986, patented March 16, 1915 to C. H. Benedict, and will be particularly described in conjunction with such process. The operation contemplated herein may be carried out in apparatus of the same general type as described in the said patent. The procedure relating to filling the tanks with sand and discharging the leached tailings will be substantially unchanged. The solutions may be led onto the sand in the same general way, and the leaching solutions may be of the same general nature and applied in the same order. The operation of washing the sands may however be materially simplified and curtailed, since the final elimination of ammonia is effected by means of steam. Accordingly, we may use one or more leaching solutions as described in the earlier patent, but a more limited volume of wash. Also, the concentration of the leaching solutions may if desired be somewhat higher than those described as preferable in said patent.

A preferred leaching cycle will now be described, it being understood, as stated above, that the procedure of filling the tanks and of flushing out the leached sand differs in no essential respect from that described in the earlier patent. After the sand has been subjected to the action of one or possibly two leaching solutions of cupric ammonium carbonate with the result that substantially all of the copper of the ore has passed into solution, the wash solution containing free ammonia and preferably obtained from the steaming of a previous tank is applied. This wash will displace the greater part of the copper-bearing solution, and is recovered in the ordinary way by permitting the sand to drain. This wash is followed by water, the purpose of which, as described below, is to eliminate the copper to such extent that its re-precipitation under the action of steam need not be apprehended. After the draining, suction is applied at the bottom of the tank under the filter, and under the influence of the vacuum any residue of copper-bearing solution is removed. The sand now contains only ammonia wash and water with some adsorbed ammonia, that is to say ammonia adherent to the surface of the sand and so strongly held by it that it cannot be washed out or displaced in the ordinary way. It is in order to recover this adherent or adsorbed ammonia that the modified steaming process herein described is used. Steam at substantially atmospheric pressure is led into the tank above the sand, a partial vacuum, equivalent for example to about 20" of mercury, being still maintained beneath the sand bed.

The first portions of the steam flowing into the sand by reason of the diminished pressure beneath the bed are of course condensed by the cooler sand. After a while, however, the sand becomes thoroughly heated and the steaming is continued until finally steam containing ammonia vapor issues from the bottom of the tank. This is condensed and recovered, and the operation is continued until the condensate contains a predetermined percentage of ammonia, for example about $\frac{2}{10}$%. The supply of steam is then discontinued, the partial vacuum being however still maintained, and water, preferably hot, is admitted at the surface of the sand. As this water is drawn downward through the heated sand it becomes vaporized under the action of the heat at the reduced pressure, and the flow of ammonia and water vapor continues until practically all of the ammonia contained in and adhering to the sand has been removed. The solution produced during the operating stage in which a vacuum is maintained beneath the bed is relatively high in ammonia, and is for this reason advantageously used as a wash for a subsequent cycle. The operation is thus completed and the tank is flushed out in the normal way.

The purpose of the wash which immediately follows the leaching solutions is to remove as much as possible of the copper-bearing solution from the interstices of the sand. Accordingly this wash should contain sufficient free ammonia to prevent precipitation of copper from its existing solutions. If steam were admitted directly after the leaching solutions, without an intermediate wash, it would be effective for the removal of ammonia but would re-precipitate the copper as oxid. Similarly, if the water wash were used directly following the leaching solutions, there would be a liability to the precipitation of a part of the copper in the form of a basic carbonate. In practice we have found it advisable to apply, after the leaching solutions, first a dilute ammonia wash, and second a certain amount of a water wash, both of these washings preceding the application of steam. It will be understood from the foregoing that the primary purpose of these washes is to eliminate dissolved copper and to prevent its re-precipitation in the sands.

Certain of the advantages of this process may be summarized as follows:

1. The advantage to be derived from the use of large tanks with removable covers and with a single said distributer for a row of tanks because of the fact that inasmuch as there is no pressure in the tank above atmospheric there is accordingly no necessity for a tight joint between the cover and

the tank other than that obtainable by means of a water-seal.

2. The economy of steam resulting from the use of water following the steaming of the sand, the vapor resulting from the action of the water on the heated sand under reduced pressure removing the last traces of ammonia.

3. The employment of the ammonia-bearing condensate recovered in a previous cycle from a body of sand subjected to the action of steam for the recovery of its contained ammonia, as an ammonia-wash in a subsequent cycle to prevent precipitation of copper under the action of steam.

The accompanying drawing is a diagrammatic flow sheet of the process in its preferred embodiment.

We claim:—

1. Process of treating copper-bearing sands or the like, comprising disposing the sand in the form of a bed or layer, extracting copper therefrom by an ammoniacal solvent, steaming the bed to heat the same, and then vaporizing water in the heated bed under less than atmospheric pressure to recover adsorbed ammonia.

2. In a process of treating copper-bearing sands or the like with an ammoniacal solvent, the steps comprising heating the leached sands, and then vaporizing water in the heated sand bed under less than atmospheric pressure to recover adsorbed ammonia.

3. In a process of treating copper-bearing sands or the like with an ammoniacal solvent, the steps comprising admitting steam at substantially atmospheric pressure above the bed of leached sand and establishing a flow of steam downwardly through the bed by means of suction applied beneath the same, thereby heating the bed and extracting ammonia therefrom.

4. In a process of treating copper-bearing sands or the like with an ammoniacal solvent, the steps comprising admitting steam at substantially atmospheric pressure above the bed of leached sand and establishing a flow of steam downwardly through the bed by means of suction applied beneath the same, thereby heating the bed, and then vaporizing water in the heated bed under less than atmospheric pressure to recover adsorbed ammonia.

In testimony whereof, we affix our signatures.

CENTENNIAL HARRY BENEDICT.
HERMAN C. KENNY.