different sample of gas can be charged into the cylinder as free from contamination as is possible in the filling of a gas pipette. In regular operation upon city gas drawn directly from the service pipes, approximately 10 minutes is occupied in adjusting and reading the temperatures of the heaters and filling the gas cylinders. An additional length of time is used in burning out the gas volumes and reading the final temperatures.

I wish to acknowledge my indebtedness to Mr. N. W. Hill for the diligence and care exercised in deriving the data which accompanies this paper.

DISSOLVING CHEMICALS AND AGITATING SOLUTIONS: SOME PROBLEMS IN THE MANUFACTURE AND AGITATION OF SULPHIDE SOLUTIONS.

By OSKAR NAGEL, Ph.D.

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Sulphide of barium is produced by reduction of barytes by means of powdered coal in a reverberatory furnace. In a suitable installation of this kind about 90 per cent. of the barytes may be reduced.

The crude mass obtained by reduction is never used as such, as the impurities—coal dust, etc.—contained therein are rather undesirable for all uses which sulphide of barium is put to. In the majority of cases the sulphide has to be brought into solution by means of water, and for many uses, such as the manufacture of barium salts, lithopone, etc., the solution should be as concentrated as possible. Hence the dissolving appliances most fit for this purpose should be of great interest to the respective industries, the more so as in most factories manufacturing these products rather primitive methods are used.

In order to elute the material perfectly, care has to be taken that the water is sprayed uniformly over the entire batch. Provision must be made for conveniently charging the material and discharging residue. The water used should be warm. Furthermore, the sulphide solution first obtained should circulate and pass several times through one or more batches of solid material, if possible, according to the countercurrent principle, in order to yield a somewhat concentrated solution.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

An installation in which all these points are considered is shown (in one unit) in Fig. 1; *L* is the vessel holding the material to be eluted. The material is charged at the top and discharged through a door or manhole. The water reaches the material through a spray, whereby a uniform elution is effected. The solid material is preferably supported by coarse filter cloth or perforated screens and the solution flows finally into tank *H*. The water is pumped to *L* by means of a steam-jet siphon, *E*, whereby the water or other liquid passing through the siphon is heated simultaneously. For starting up, tank *H* is partly filled with water and the steam valve opened. The steam issuing from a nozzle carries along the liquid to be transported, a considerable part of the momentum of the steam being utilized for conveying the liquid. After a short time tank *H* will contain a solution of sulphide, whereupon it may be again, by means of the same siphon, lifted and passed through *L*, which process, if only a single unit is at hand, may be repeated until the solution is obtained in the desired strength. Then the liquid can be removed from *H* and replaced by fresh water, which may be passed once through the solid (if the latter is not yet perfectly extracted); now *L* can be discharged, charged with fresh material and the process continued.

The manipulation will be considerably simplified if two tanks, *H*, or two vessels, *L*, are provided. It is readily understood that such an installation would be somewhat more elastic. An installation built along these lines is shown in Fig. 2. It shows the installation of a siphon, *L*, for lifting alternately from tanks *A* and *B*. *C* are the cocks, *T* the overhead tanks. The ideal way would be to have two, or preferably four, vessels, *L*, and two, or preferably four, tanks, *H*, as by such an installation if suitable "cross-wise" pipe connections are provided an absolutely elastic system is obtained which presents no difficulties to the use of the countercurrent principle.

The outside view of a siphon with flanged ends is shown in Fig. 3. The steam pressure to be used in connection with these siphons depends upon the height of lift and should equal in pounds the total elevation in feet. The minimum steam pressure is 20 pounds. This will pump to a height of 20 feet. The Schutte & Koerting Company, of Philadelphia, manufacture these siphons up to maximum suction of 24 feet. Water, when flowing to the siphon, may have a maximum temperature of 140° F.

The proportion of the steam to the water (or any other liquid of the same specific gravity) which is discharged varies according to the height of lift from (weight) 1.84 to 1.42. The increase of temperature of the liquid also changes accordingly from 15° to 32° F. The capacity of these siphons in gallons of water per hour is from 200 to 30,000.

For liquids of higher specific gravity the capacity is correspondingly lower.

In the manufacture of sulphides and other chemicals it is sometimes desirable to agitate liquids without causing any contact with air. Direct steam would always be satisfactory, but the immense steam consumption of the plain steam agitator prevents the use of this apparatus; the application of the ordinary steam jet blower, which furnishes a mixture of air and steam, is not permissible with substances that are oxidized by air. Hence the proper thing to use would be a steam-jet blower, which is connected to a supply of an indifferent gas. This, however, is too expensive, and the only solution of this problem that I know of is the one shown in Fig. 4. The tank *C* which contains the liquid to be agitated is provided with an air-tight cover, the space between liquid and cover being filled out by an indifferent gas. A so-called duplex steam-jet agitator is connected to the top of the tank. The steam passes through *S*, and the steam-jet issuing through nozzles provided in the body of the agitator draws in (at *C*) the indifferent gas; the mixture of gas and steam travels through *A* and passes through the perforations of the bottom pipe as shown in the figure, acting as an agitator of the liquid. The indifferent gas is always used over again, and is continuously circulated. This is evidently the most economical way to effect agitation without the admission of air.

A ROTATING GRAPHITE ANODE.¹

By J. W. TURRENTINE.

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Mention has already been made of designs of a rotating graphite anode which was to accompany the graphite cathode dish.² This piece of apparatus has now been made and is in use. Its serviceableness when employed in connection with the platinum Classen dish, as well as with the graphite cathode dish, is such that, although the anode is not yet perfected, this preliminary account of it is deemed warranted.

The graphite anode, it is hoped, may be found capable of supplanting the vastly more expensive platinum anode in electrochemical analysis and other electrochemical processes where the rotating anode is used. As has been pointed out, many of the beautiful and time-saving methods of electro-analysis and of electrochemical operation might fail of adoption because of the expense of the platinum apparatus involved. When graphite is employed the expense is minimized.

Little attention has been paid heretofore to special forms of anodes in electro-analysis. The efforts of

¹ A paper presented at the Seventeenth General Meeting of the American Electrochemical Society, at Pittsburg, Pa., May 5-7, 1910.

² Turrentine, *J. Phys. Chem.*, **13**, 438 (1909). *Trans. Am. Electrochem. Soc.*, **15**, 505 (1909). *Chem. Abstr.*, **4**, 691 (1910).