

vents the heat of the flames and gases being imparted to the water with the result that the boiler plates may become red hot. With feed-water containing salts which are easily soluble scale may be prevented to some extent by frequently blowing off.

Carbonates in the water may be partially removed by boiling, but the more effective method is to treat the feed-water with caustic soda. Sulphates form the most troublesome compounds, and the only really satisfactory method of dealing with such is to pass the feed-water through a water softening plant; though the incrustations may be softened and the removal rendered easier by the addition of carbonate of soda. Accumulated scale should be carefully removed, and any scale chipped off should not be allowed to remain in the boiler.

After a boiler has been cleaned and the brickwork rebuilt, all openings for the admission of air, except through the fire, must be carefully stopped, as this is often a cause of waste.

If a boiler is not required for some time it should be emptied and thoroughly dried; if this is impracticable, it should be filled with water to which has been added a quantity of common soda. Care should be taken if the water is salt or acid in nature that no galvanic action takes place where copper or brass fittings are attached to the boiler. It may be easily prevented by placing metallic zinc or a little lime in the boiler. Particular attention should be observed that the exterior of the boiler is not attacked with.

Should the boiler remain idle in frosty weather the water should be withdrawn and the boiler thoroughly dried. The siphon of the pressure-gauge and the connections of the water-gauge should be drained and examined to make sure that their passages are clear. After the fire has been started under the boiler the steam pressure should not be raised too quickly or the joints and plates will become strained and leakages occur. When the boiler is under pressure the loss of heat by radiation is considerable, and great economy is effected by having the boiler and its connecting steam pipes covered with non-conducting material. The non-conductivity of any material depends largely upon its cellular structure, air—a bad conductor of heat—being confined within the cells of the material. The materials generally used in the manufacture of non-conducting covers are asbestos, magnesia and slag wool. Any substances used to prevent the escape of heat of the steam should be at least one inch thick. Thus, a brief summary of the essentials of a boiler are as follows:

- (1) Greatest care and management with regard to firing.
- (2) Prevention of overheating of plates due to low water.
- (3) Prevention of incrustation, internal and external corrosion.
- (4) Good material and construction.
- (5) To guard against working a boiler beyond its strength.

Apart from what has been said above, the best measure is to insure the boiler with a reliable insurance firm. The firm will thoroughly inspect the boiler periodically and report upon its condition and efficiency, calling attention to any defect or source of danger. A responsible man who thoroughly understands his duties should be placed in charge of the boiler and its firing. A good fireman keeps the water-level uniform and maintains a regular feed; keeps the fire in a uniform condition, and avoids sudden and excessive variations of temperatures; suits the air supply to the requirements of the fire; aims at uniform generation of steam to avoid waste by over-pressure, and delay by insufficient pressure.

## THE MINERAL PAINT INDUSTRY.

By Dr. F. Mollwo Perkin.\*

The production of white lead has been much studied, and several ingenious methods have been suggested. Bleeker Tibbits places lead electrodes in a bath consisting of sodium nitrate and ammonium carbonate or sodium nitrate and ammonium nitrate. Carbon dioxide is blown through the bath, causing the formation of lead carbonate. Ferranti and Noad used lead anodes in a bath of ammonium acetate. Ammonium bicarbonate is fixed with the lead acetate thus formed to produce white lead. Browne and Chaplain electrolyze a solution of 10° Beaumé sodium nitrate in a divided cell. The anodes are of lead and the cathodes of copper. Lead nitrate and caustic soda are formed, and the two solutions are mixed to produce lead hydroxide and sodium nitrate. The lead hydroxide is filtered off and the sodium nitrate returned to the electrolyzer. The hydroxide is then stirred up with a solution of sodium carbonate to produce white lead and sodium hydroxide.

All the processes mentioned above, with the exception of that of Luckow's, require the use of diaphragms, and these are difficult to obtain. Further, secondary reactions take place at the electrodes, white basic lead compounds form at the anode, and these, of course, lessen the yield. Much care and experimenting is, therefore, necessary in carrying out successfully an electrolytic white lead process, if it is to be commercially successful.

Zinc white can be prepared in a somewhat similar manner. A warm solution of sodium sulphate or other alkali salt, the corresponding zinc salt of which is soluble, is electrolyzed. Zinc plates are used as electrodes, and the zinc sulphate formed is precipitated by the sodium hydroxide as zinc hydroxide. Tibbits produced colored white lead by using another metal—as copper—along with the zinc anode. The depth of the color depends on the relative area of the lead-copper anodes. By a similar method chrome yellow can be prepared, using sodium or potassium chromate instead of sodium carbonate.

Browne and Chaplain made lead chromate by first producing lead nitrate or acetate in a diaphragm cell with lead electrodes, and an electrolyte of alkali nitrate or acetate. The caustic alkali produced gradually overflows, and can be continuously collected. In another vessel a solution of chrome alum is treated with caustic alkali. The precipitate is filtered and washed, and then dissolved in excess of caustic alkali. This solution is then electrolyzed, after being mixed with sodium chloride in the anode compartment of a cell, and thus converted into chromate. At the end of the operation the lead solution and the chromate solution are mixed. Potassium or sodium chromate can be produced by electrolyzing in a solution of potassium or sodium hydroxide with anodes of high grade ferro chrome.

To obtain metallic hydroxides a metal anode and carbon cathode is used. In such a case partial disintegration invariably takes place, and particles of the metal fall to the bottom of the electrolyzing cell, thus contaminating the electrolyte; the anode should be wrapped in a piece of cloth or parchment. It is an advantage to keep the solution well agitated by causing the anode or cathode to rotate by blowing air rapidly through the solution.

Metallic sulphides can be obtained in a manner analogous to that in which metallic hydroxides are prepared. Copper

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