ACETYLENE IN SOLUTION.

As well known, acetylene in burning gives a flame that is much more luminous than that of coal gas. On another hand, the discovery of calcium carbide by M. Moissan has permitted of obtaining this gas at a very low figure. It suffices to cause water to react upon the carbide in order to obtain an abundant disengagement of acetylene; but, unfortunately, the manipulation is dangerous, and numerous accidents have given a bad reputation to lighting with this agent. Such accidents have almost always been caused by an excessive production of the gas, which, with the atmospheric air, forms an eminently explosive mixture. Moreover, acetylene is an "endothermic" compound; that is to say, it is apt, under certain circumstances, to decompose with a disengagement of heat. Hence it follows that such decomposition is accompanied with a great increase in volume or a great increase in pressure. Acetylene is, in fact, an explosive body. This fact is of a nature to render the accumulation of the gas under a slight pressure very dangerous.

Nevertheless, there now exist numerous apparatus that permit of regulating the production of acetylene and of burning it in perfect safety. In certain localities where there is neither gas nor electricity, there have been established lighting installations that are operating in an absolutely satisfactory manner; but these are stationary and have to be submitted to a regular surveillance, which, however, is rendered easy by the fixed character of the apparatus.

An interesting problem to be solved was that of rendering acetylene portable. In the first place, an endeavor was made to compress it at a high pressure, or even to liquefy it (since it easily liquefies in very strong receptacles); but such processes had to be abandoned on account of dangers of explosion that the endothermic properties of acetylene always rendered imminent. In 1896 MM. Claude and Hess, two French engineers, conceived the idea of utilizing for the same object a solution of acetylene in an appropriate liquid, and, after some researches, selected acetone as the solvent. Acetone, which is comparatively cheap and not very volatile, boils at 56 deg. C. and does not freeze. The quantity of acetylene that it is capable of dissolving is 24 volumes per atmosphere at a temperature of 15 deg. C. Thus, a quart of acetone at a medium pressure of 10 atmospheres dissolves 8.5 cubic feet of acetylene, while its volume increases by about 13.6 fluid ounces. This solution presents the remarkable property of being incombustible, as has been shown by MM. Berthelot and Vieille. If, into a vessel containing acetylene dissolved under a pressure of 10 atmospheres, we insert a wire heated to redness, or if a percussion cap be made to explode in the vessel, all that will occur will be an explosion of the small quantity of gas that exists above the solution, without the latter being influenced in the least; while if the vessel were filled with liquefied gas there would occur a formidable explosion capable of developing pressures of from 5,000 to 6,000 atmospheres.

It results from the experiments of the two above named chemists that the stability of the solution is maintained up to the neighborhood of a pressure of 20 atmospheres. So the use of this solution presents a remarkable character of safety, since nothing but an explosion of the small quantity of gas that exists above the liquid in the receptacle need ever be feared. Nevertheless, as slight as is the danger of this small

ceeded in devising the necessary apparatus and in rendering the ingenious idea of the first inventors truly practical and industrial. Such a result is obtained by the use of "porous materials." After several tentatives the company has succeeded in producing a ceramic material—a peculiar porous brick of a specific weight of 0.5, which possesses extremely fine pores. The receptacle is exactly filled with this substance, and then the liquid and afterward the gas under pressure is introduced. The liquid, retained by capillarity, can no longer escape, even though the vessel containing it should get broken.

The duration of the process of solution is considerably abridged, and the discharge at the moment of decompression is rendered perfectly regular, since all the phenomena of supersaturation are suppressed. Finally, and this is the important point, there exists no empty space in the apparatus, other than the pores of the brick, and all dangers of an explosion, however slight it may be, are absolutely prevented. We know, in fact, that an explosive wave cannot propagate

FIG. 1.—2-QUART TUBE CONTAINING 7 CUBIC FEET OF GAS.

itself through very fine tubes; and it is still less capable of transmitting itself through the pores of the brick. So, even though the liquid should not entirely fill the pores and should leave a space for free gas, the latter would not in any manner explode. The experiments that have been made on this subject have even shown that it would be possible, without any danger, much to exceed the pressure starting from which the free solution ceases to be perfectly stable. At 25 atmospheres, for example, the free solution is an explosive liquid, while this same solution incorporated in the porous brick constitutes, under the same pressure, an absolutely inert body. Such high pressures as these, however, are never employed in the industries. The utilization of the gas coming from the receptacle requires a few simple precautions. It is necessary to bring the pressure of 10 atmospheres to that of a few inches of water. This is the rôle of the expander. There is a mercurial safety valve, too, for permitting the gas to escape in cases in which, in consequence of damage, the pressure might tend to rise beyond measure in the pipes. Finally the gas passes through a meter of the dry type, and a pressure gage that communicates with the receptacle permits, through the lowering of the pressure, of recognizing the moment at which the receptacle is about to become empty, and at which it is necessary to replace it. As all these apparatus are unaffected by frost, they can be placed out of doors, and this further adds to the safety.

The types of receptacles most usually employed are: 1. A 2-quart tube of an internal diameter of 2.5 inches and of a length of 30. It contains 7 cubic feet of dissolved gas and is mounted upon a board carrying the accessory

of automobile carriages. Two of the tubes suffice to assure a light for thirteen or fourteen hours, with a fully adequate consumption of 1 cubic foot an hour.

2. An 11-quart tube 6 inches in diameter and 42 inches long. This receptacle, which contains 42 cubic feet of gas, is applied to the lighting of street railway cars. Upon the Belleville line such a tube supplies the two lamps of a car for four or five hours without being renewed. This tube, in connection with a powerful reflector, was used also for the lighting of the Bois de Vincennes during the Exposition of 1900 (Fig. 2). It is capable of furnishing a light of 150 candle power for 10 hours, and, through the use of incandescence, gives the elevated figure of 500 candles.

3. A 23-gallon receptacle formed of a tube 16 inches in diameter and 36 in length entirely enveloped by staves, which renders the manipulation easy and protects the receptacle against shocks and the heat of the sun (Fig. 3). This apparatus contains 350 cubic meters of acetylene and stores up 13,000 candle-hours. It is adapted for stationary installations.

4. A wagon of 35 cubic feet carrying four large cylindrical reservoirs 24 inches in diameter and 6.5 feet in length, each having a capacity of 225 quarts (Fig. 4). It contains 3,500 cubic feet of acetylene capable of furnishing 3,000 candle power for fifty hours, or of supplying 1,000 30-candle burners for five hours. In default of extensive gas and electric mains, such a lighting could be obtained by no other process than by the aid of large and costly installations. This wagon has already been used for the illumination of fêtes and the lighting of country theaters.—For the above information and the engravings we are indebted to La Nature.

PROCESS FOR THE TREATMENT OF SULPHURET-ED ORES AND MINING PRODUCTS IN THE ELECTRIC FURNACE.

By M. DIEFFENBACH.

In this process, heating the ores in the electric furnace is recommended as an important feature. Various inconveniences are thus avoided. With the elevated temperature secured by this furnace, a very liquid scum is formed, even in the presence of a great excess of coal, while the zinc vapors are simply mixed with carbon oxide, with variable quantities of sulphurous acid.

With the electric furnace, ferric oxide can be replaced by other oxidizing substances with the same success. If, for example, blende is mixed with lime and coal, calcium sulphite is obtained in the state of liquid scoria, while the zinc is distilled. A similar result follows the employment of alumina, magnesia, silica, and other oxidants. Many natural rocks, as feldspar, can be substituted.

If the blende contains many oxygenized compounds some other addition than coal may be needful for setting the zinc at liberty.

If an ore of oxidized zinc is added to the blende both are reduced at the same time in the furnace. If the blende is heated with such products as mentioned above, without the coal, or if this contains suitable gangue, a conversion to zinc oxide takes place under the influence of oxygenized combinations. After the separation of the scoria by metallurgical, chemical, or electro-chemical processes, the zinc oxide may be treated for obtaining metallic zinc or zinc-bearing derivatives.

FIG. 2.—11-QUART TUBE CONTAINING 42 CUBIC FEET OF GAS DISSOLVED IN ACETONE.

FIG. 3.—23-GALLON CASK CONTAINING 350 CUBIC METERS OF ACETYLENE DISSOLVED IN ACETONE.

FIG. 4.—A WAGON OF 35 CUBIC FEET CONTAINING 3,500 CUBIC FEET OF ACETYLENE DISSOLVED IN ACETONE.

explosion, it is yet incompatible with the exigencies of practice, which demands absolute safety. Moreover, in certain applications, such, for example, as the lighting of public carriages, the presence of a mass of an eminently combustible liquid capable, in case of accident, of spreading in flames outside of its receptacle is entirely inadmissible. Finally, the solution of acetylene in acetone takes place but slowly, and, inversely, the disengagement of the gas is quite irregular because of very marked phenomena of supersaturation.

New studies, therefore, became necessary, and these were undertaken by the Compagnie Française de l'Acetylene Dissous. This company has finally suc-

cessfully devised the necessary apparatus and in rendering the ingenious idea of the first inventors truly practical and industrial. Such a result is obtained by the use of "porous materials." After several tentatives the company has succeeded in producing a ceramic material—a peculiar porous brick of a specific weight of 0.5, which possesses extremely fine pores. The receptacle is exactly filled with this substance, and then the liquid and afterward the gas under pressure is introduced. The liquid, retained by capillarity, can no longer escape, even though the vessel containing it should get broken.

In certain cases the scoriae may be rendered useful. Thus, those containing ferric sulphide may serve for the preparation of sulphurous acid or of ferric sulphate; those which contain calcium sulphite may serve for the preparation of hyposulphites.

This treatment of blende is applicable equally to sulphureted ores or to mixtures of ores.

The type of the electric furnace may vary. The fusion may be effected by the arc itself, or by heating with resistance, whether the matter to be decomposed itself constitutes the resistance or whether a special resistance is intercalated. In fact, recourse can be had to any mode of heating.—Translated from La Revue des Produits Chimiques.