

## THE USE OF BOILER COMPOUNDS.\*

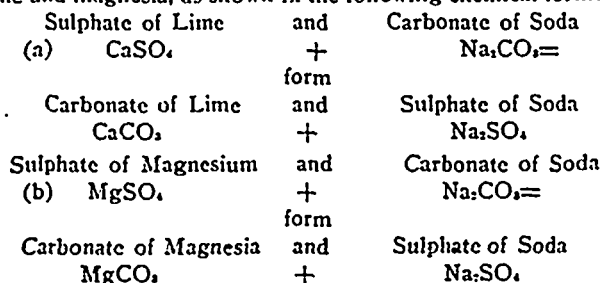
BY ALBERT A. CARY.

To the majority of steam users, anything that is put into a boiler to lessen troubles due to the formation of scale, is a "boiler compound;" and the fact that these various so-called compounds act differently in their endeavor to accomplish their purpose is not as generally understood as it should be by those who persist in their use. Such nostrums may be divided into three classes:

First—Those attacking the scale-producing material chemically, and acting as re-agents, combine with the matter precipitated from the feed water, forming a third substance different from either the original precipitated solids or the "re-agent," the theory being that the new substance will not form into a hard, resisting scale, and therefore can be more easily removed by blowing off or by the cleaning tools used after the boiler is "opened up." Second—Those acting mechanically upon the precipitated crystals of scale-making matter soon after they are formed. Such "compounds" are of a glutinous, starchy or oily nature, and become attached to the surface of the newly formed crystals (precipitated from the water) surrounding them, as the skin does an orange; and when these crystals fall together they are thus robbed of their cement-like action, which frequently occurs when they are allowed to come in immediate contact. Third—Those acting both mechanically (as just described) and also as a solvent, the latter action partially dissolving scale already formed, and by this "rotting" effect (as it is often called), preparing the scale for easy removal.

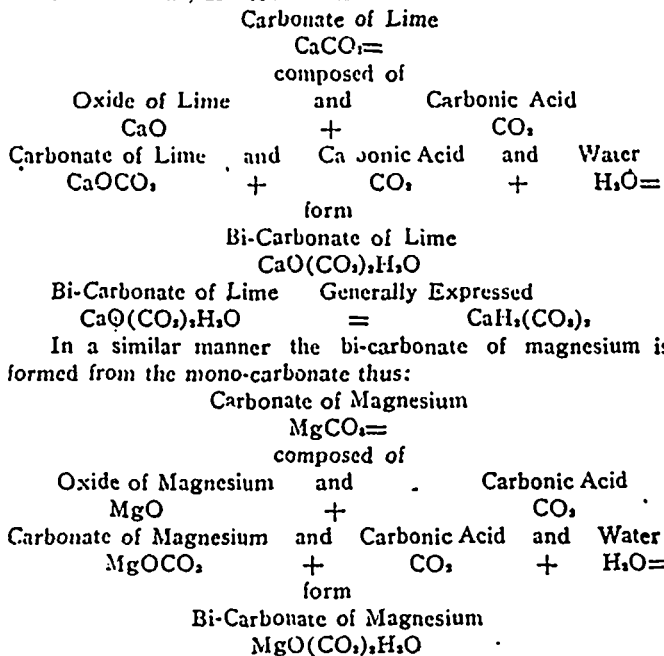
The "compounds" under the first division (which act chemically upon the scale-forming matter) also frequently accomplish this same rotting effect upon scale formed previous to their use. Still other divisions or subdivisions might possibly be made, but the above will suffice for a good general idea of the subject. Taking up our first division of this subject, we find that the principal ingredients used in such "compounds" are soda ash (or carbonate of soda) and tannin matters, while we sometimes find caustic soda, sal soda, acetic acid and numerous other active agents which are generally less efficient in their action on the scale-forming matter and more harmful to the boiler and its fittings. In order to disguise these very cheap chemicals and help the "compound" vendor get prices for his powder or liquid, whichever, it may be, there are often added other substances which generally render the active agents less efficient, and they frequently fall unchanged to the bottom of the boiler with the scale, thus increasing the deposit and aggravating the trouble. Such added substances include clay, chalk, sand, etc., and sometimes merely coloring matter is used to disguise the original chemicals, such as tobacco juice, iron scraps, lamp black, spent tan, etc.

The principal scale-making impurities precipitated in boilers are carbonate of lime ( $\text{CaCO}_3$ ), carbonate of magnesium ( $\text{MgCO}_3$ ), sulphate of lime ( $\text{CaSO}_4$ ) and sulphate of magnesium ( $\text{MgSO}_4$ ), and, although there are generally other precipitates, notice of these alone will be sufficient for the present consideration. The chemical action taking place when some of the above named active agents are used may be traced as follows: Soda ash is a dry impure carbonate of soda, from which the pure alkali is afterwards made. The carbonate of soda ( $\text{Na}_2\text{CO}_3$ ) is used to act upon the sulphate of lime and magnesium, as shown in the following chemical formulæ:



Leaving this treatment for a moment, it would be well to note that both the carbonate of lime and carbonate of magnesia are held in solution through the presence of carbonic acid gas dissolved in the water, which unites with them and changes the

mono-carbonates into bi-carbonates (which are only known to exist in solution), as shown thus:



The mono-carbonates (or single carbonates) of lime and magnesia are but slightly soluble in water, whereas the bi-carbonates, or double carbonates) are very soluble in cold water, and this fact will account for the presence of the large quantities of lime and magnesia in boiler waters as carbonates.

When waters containing the bi-carbonates are heated, the rise in temperature drives off the extra carbonic acid gas and leaves behind the practically insoluble mono-carbonates, which are precipitated.

When a temperature of 180 degrees Fahr. is reached, a considerable percentage of the bi-carbonates is precipitated (as insoluble mono-carbonates), and at 290 degrees Fahr. (a temperature corresponding to 43 pounds gauge pressure) the precipitation is nearly completed, after a thorough boiling.

Scale formed from the mono-carbonate of lime is seldom very troublesome, if not allowed to accumulate in too large a quantity, nor allowed to remain in the boiler for a long time; while the precipitated mono-carbonate of magnesia gives slightly more trouble, due to the fact that it seldom is found in scale as a mono-carbonate. All the contained carbonic acid ( $\text{CO}_2$ ) is generally lost from the bi-carbonate of magnesia ( $\text{MgO}(\text{CO}_2)_2\text{H}_2\text{O}$ ) by the time it forms a crust, leaving behind the hydrate of magnesia ( $\text{MgO} + \text{H}_2\text{O} = \text{MgOH}_2$ ), which acts as a cement and binds closely together (though not very strongly) whatever precipitated matter it may come in contact with. This hydrate of magnesia is very fine and light when precipitated and requires a comparatively long time to settle.

(To be continued).

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J. GEORGE HODGINS.

Hon. Treas. of the British Red Cross Society, Canadian Branch,  
Toronto, February 28th, 1900.

Collingwood, Ont., will vote on May 30th on a grant of \$115,000 bonus to Chas. Cramp, Philadelphia, the well-known shipbuilder, to establish a smelter, capacity of 200 tons a day, in that town. There is to be an open hearth steel plant of three Wellman furnaces, and a rolling mill capable of making armor plates.

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