PROFESSOR CHANDLER ON BOILER INCRUSTATIONS.

(Continued from page 7.)

THE FORMATION OF INCRUSTATIONS.

The analyses presented in the tables already published show that the incrustations consist chiefly of the carbonates of lime and magnesia and the sulphate of lime. The two carbonates are insoluble in pure water, and owe their presence in the waters of springs and rivers to free carbonic acid, which forms with them soluble bicarbonates.

When such waters are boiled this carbonic acid is expelled, and the carbonates of lime and magnesia separate in thef orm of insoluble powders, portions of which adhere to the sides of the vessel containing the water.

The carbonic acid acting as a solvent is so loosely combined with the carbonates, that exposure to the air is sufficient to cause the separation of a portion of it, an equivalent quantity of the insoluble carbonates separating as a deposit, as already mentioned in connection with the Weedsport waters.

The more slowly the carbonates are precipitated from their solution in carbonic acid, the more compact are the deposits, and the more firmly do they adhere to the surface with which they come in contact. In caverns, by slow evaporation, hard stony stalactites and stalagmites are formed, while in boilers, unless sulphate of lime be present in considerable quantity, the deposits consist usually of a fine loose powder or mud.

Various alkaline substances, by appropriating this carbonic acid, cause the precipitation of the insoluble carbonates. Potash, soda, and ammonia, as well as their carbonates, produce this effect, as does also lime water. In the latter case, the lime added, unless an excess be used, is also deposited as carbonate; consequently no alkaline salts are substituted for the carbonate removed, as in the case when the other substances are employed.

It is seen from the above that the carbonates may be removed without decomposition, by simply depriving them of their solvent, the carbonic acid.

The sulphate of lime is soluble in water, one part of the sulphate requiring about 400 parts of water for its solution. One gallon of water is capable of holding about 150 grains of sulphate of lime. The solubility of sulphate of lime in water is modified by the presence of other substances. The chlorides of calcium and magnesium, alcohol, etc., and even a high temperature diminish, while the chlorides of sodium and ammonium, sugar and various other organic substances, somewhat increase in solubility. Hyposulphite of soda is said to increase its solubility ten fold. Above 212° F. the solubility rapidly diminishes as the temperature increases. At 255° F., equivalent to a pressure of 30 pounds, its solubility is diminished nearly three-fourths; at 272° F., equivalent to a pressure of 45 lbs., nineteen-twentieths, and at a temperature of 280° to 300°, it may be said to be totally insoluble.

The following analyses of waters taken from boilers are interesting in this connection:—

	1. No. 101.	2. No. 106.	3. No. 113.	4. Stationary Machine Shop, Syracuse.
Distance run	700 miles.	416 miles.	416 miles.	
Road	direct.	Auburn.	Auburn.	
Preventive used	bran.	bran, two buckets.	nothing.	Potatoes, one peck.
Reaction	neutral.	neutral.	neutral.	alkaline.
Sulphate of lime	17·88 grs.*	9·53 grs.*	39·89 grs.*	49·82 grs.*
Carbonates of lime and magnesia	trace.	trace.	trace.	trace.
Chlorides, etc.	56·76 "	19·38 "	52·95 "	37·42 "
Organic matter	9·33 "	8·86 "	13·99 "	12·59 "
Nitrates	trace.		trace.	faint trace.
Total per gallon	83·97 grs.	37·77 grs.	106·83 grs.	99·83 grs.

* These figures are probably too high, as they are calculated from the sulphuric acid, a portion of which probably exists in the form of alkaline sulphates.

No. 106 had run for eight months, and was very clean. The water from the stationary was turbid, depositing on standing, a sediment containing sulphate of lime, carbonates of lime and magnesia, oxide of iron, clay, etc. The small quantities of sulphate of lime and of the carbonates of lime and magnesia contained in these waters, confirm the statements already made with regard to the effect of heat on the solubility of these substances.

Sulphate of lime does not therefore require the presence of carbonic acid for its solution. It is deposited in boilers on account of the high temperature and its limited solubility, and forms, in the absence of the carbonates, as in marine boilers, a hard crystalline scale, sometimes an inch or more in thickness. When the carbonates of lime and magnesia are present the deposits vary from a loose powder to a hard crystalline incrustation, according to the relative proportions of the three substances.

In practice sulphate of lime can only be removed from water by undergoing decomposition; for example, by carbonate of soda, which forms carbonate of lime, which is deposited as a powder, and sulphate of of soda, which remains in solution. It has been stated, that as much as thirteen hundred pounds of incrustation has been taken from a single boiler at one time. It may seem impossible for so large a quantity of earthy matter to be deposited from waters which average only seventeen grains of incrusting constituents per gallon. When it is recollected, however, what vast quantities of water pass into a locomotive boiler, the possibility will be fully conceded. It was stated by a master mechanic on the road, that a locomotive in running 40 miles will take in 1800 gallons of water, equivalent to 45 gallons per mile, a quantity which seems incredible.

Accepting this statement as a basis for calculation, we have 765 grains, or more than an ounce and a half of earthy matter as a possible average of the quantity which enters the boiler per mile. Multiplying this by 1988, the average number of miles run on this section of the road by each of 56 locomotives, in one month (Dec.), we have 217 pounds of incrusting matter entering a boiler per month, or 2604 lbs. per year. Nor is this necessarily a maximum, as some boilers receive the larger part of their water form stations furnishing water much below the average in purity.

THE EFFECT OF INCRUSTATIONS.

The injurious action of the incrustations is threefold:—

1. Being very poor conductors of heat, and occupying a position between the boiler plates and the water, they cause a great loss of heat and consequent waste of fuel. This waste is estimated at 20 per cent., and in some cases as high as even 47 per cent. of the fuel used. Nor does this waste require a very thick incrustation, a very small fraction of an inch of scale being sufficient to exert a decided influence on the quantity of fuel necessary to produce the required power. This loss of heat involves, of course, a corresponding loss of power.

2. For the same reason they cause an over-heating of the boiler plates, which often become red hot, though only separated from the water by a thin scale. Such over-heating is sure to cause a rapid burning out of the metal, and may result it an explosion of the boiler, should the expansion of the boiler plates loosen and detach the scale so as to expose the over-heated surface of the water.

3. The corrosion of the metal occurs most rapidly in those parts of the boiler upon which the deposits are most liable to accumulate.

[To be continued.]

RECENT AMERICAN PATENTS.

The following are some of the most important improvements for which Letters Patent were issued from the United States Patent Office last week; the claims may be found in the official list:—

Hoisting Tackle.—This invention consists, first, in casting a block with suitable recesses to receive a wrought-iron or steel hook and eye connection or swivel, in such a manner that a cheap and durable block is obtained, the hook or eye of which is not liable to give way before any of the other parts; second, in providing said wrought-iron or steel eye with a suitable recess or recesses, or with a head whereby the same, when cast into the block, is perfectly engrafted therein, and a spontaneous detaching of the same from the block is rendered impossible; also, in casting in the single block a seat composed of two holes and arranged to receive a rope or other suitable becket in such a manner that the hoisting rope can be secured as close as possible to the shears, and the largest possible amount of hoisting room is obtained; finally, in the arrangement of ribs acting in combination with the bosses on the shanks of the eye so as to relieve the center pin partially or wholly of the strain to which the eye is exposed. J. W. Norcross, of Middletown, Conn., is the inventor.

Fire-arm.—The object of this invention is to produce a repeating rifle which will not need to be recocked by the hand for every shot. An arm of this sort will be of great advantage in deer hunting, as it will allow the hunter to keep sight on the running deer, while the gun discharges the contents of its cylinders in a successive series, automatically. It will also be of great service in hunting other game, and for military uses. Ordinary revolvers or repeating fire-arms cannot accomplish like results with this arm in hunting swift-running animals, as they take too much time to be got ready for each succeeding discharge, and the hunter has to lose sight in the act of cocking the piece. In shooting water fowl at a great distance, a rifle barrel for "0" sized shot, arranged after this invention, would do great execution, as a many-chambered breech for that size of shot might be made to hold ten to fifteen charges without being too bulky, and two shot might be loaded in each chamber, and the whole discharged in about two seconds, having greater range than a shot-gun, and being made to scatter by the hunter in moving his aim along the line of the object, whether the same be stationary or running game, or a flock of birds in flight. This plan may also be used for smooth-bored guns, giving the hunter six shots through one barrel (where a cylinder with six chambers is used), which he might discharge singly or in rapid succession. George C. Bunsen, of Belleville, Ill., is the inventor.

Turbine Water Wheel.—Water wheels which are fitted within scrolls, helixes, or cylindrical water guides or boxes, all leak, in a greater or less degree, at the joint or junction of the wheel with the scroll, helix, or box, in consequence of a tight joint not being formed in order to avoid friction. This leakage, of course, serves to diminish the efficiency of the wheel, and the object of this invention is to obtain a tight joint without causing friction, and to this end a flange is attached to the inner edges of the scroll, helix, or box, either at the top or bottom, or both; said flange being of such a shape as to form annular boxes in which water, when the wheel is at work or in motion, is retained directly over the joints by centrifugal force generated by the rotation of the wheel, and loose joints admitted which will not cause any friction and at the same time prevent the escape or leakage of water therefrom. George Talcott, of New York City, is the inventor.

Process for Cleaning Cotton Seed.—Many attempts have been made to plant cotton seed by a machine, but none have hitherto succeeded, the fine lint which adheres to the seed causing the latter to adhere together, and preventing them from being properly distributed or discharged from a seed box or hopper. The object of this invention is to obtain a simple and inexpensive means for depriving the seed of its lint, so that the former will have a perfectly smooth exterior, and be capable of being planted with a machine in equally as perfect a manner as corn or other seed. To this end a perforated revolving cylinder is used in which the cotton seed is placed with small pebbles, stones, or other hard material, a trifle larger than the seed, the attrition produced by the action of the seed and hard substances against each other, as the cylinder rotates, effectually depriving the seed of its lint. John G. Page, of Rockford, Ill., is the inventor.

Blind Fastener.—This invention consists in the use of a short lever latch attached to the bottom of the blind, with an arm at the outer end, bearing catches for keeping the blind open or shut, and a knob at the other end to operate the lever. The fastenings at present in use are placed either so near the hinge as to cause the blind to surge and get loose, or so far from it as to necessitate the reaching of the arm, and sometimes the head, far out of the window to loose the fastenings from the staple. This invention obviates these difficulties. The catch is far enough out to be always secure and in good working order, and at the same time may be loosened from the staple by simply pressing on the knob a few inches from the hinge. Rev. B. S. Huntington, No. 255 East Thirtieth street, New York, is the inventor. Patented November 28, 1865.

A ROD of iron 846 inches in length, has its length increased one inch by being heated from the freezing to the boiling point of water.