panies such as railroads, which demand a very large and fairly constant supply of structural timber, comparatively resistant to the entrance of the preservative. It is not to be understood that this non-pressure process is to replace in any manner the older and more firmly established pressure processes for all timbers and conditions.

What was needed was a process by which the more porous lumber of different kinds and for different conditions could be treated efficiently and cheaply in a plant inexpensive to install and simple to operate. The record of attempts to meet this need is the history of the non-pressure process. This type of plant generally has a treating cylinder 6 feet in diameter and about 50 to 60 feet long, and a capacity of about 500 ties per day. It may be completely installed for from six to eight thousand dollars.

For the butt treatment of telephone and telegraph poles an ordinary open tank, either rectangular or round, about 9 feet in diameter by 9 feet deep, and fitted with steam coils, is used. A storage tank of small capacity for holding a supply of the preservative, and a jib crane for handling the poles in and out of the treating tank, complete the equipment. Such a plant can be installed for eight or ten hundred dollars.

A full cell treatment or process occurs when the wood cells and intercellular spaces of the timber are completely filled with the preservative. The portion of the timber treated in this case is made to take as much of the preservative as the cells are capable of containing.

On account of the expense involved in a treatment of this kind, with a preservative as costly as creosote, means have been sought to remove from the timber a portion of the preservative injected. In this manner the same penetration is secured with a much less amount of the preservative, and the cost of the treatment is consequently decreased. In treatments of this kind the preservative contained in the cells proper is withdrawn, and the cell walls left simply coated or painted with the preservative. This process is used largely in treating railroad ties with creosote, where mechanical wear destroys them before the increased life to be derived from a full cell treatment can be obtained.

Length of Life.

The length of life of treated timber, like the treatment, depends on a variety of conditions. The kind of wood, kind of preservative used, the kind of treatment given, and the conditions under which the treated timber is used; all have an important bearing on the length of life. In the Southern States, Louisiana and Texas particularly, a loblolly pine tie untreated will last little more than a year. Ties treated with zinc chloride and placed in a track in the same locality have been removed in three years on account of decay. The life of the same species of timber in one section of the country will not be the same when exposed to the climatic conditions in another section. The use of zinc chloride as a preservative does not give as long life as creosote. Ties properly treated with this can, however, be made to give an average life of about 12 years. In the Central West, hemlock and tamarack ties treated by the Wellhouse process have shown a life of twelve to fourteen years, while untreated ties under the same conditions have to be removed at the end of four years on account of decay. Properly creosoted ties can be made to last until destroyed by mechanical wear, and if protected against this wear can be made to give 20 to 30 years' service. With the proper kind of treatment, a pile can be made to last from twenty to twenty-five years. The L. & N. R. R. Company in 1882 used large quantities of creosoted piles, stringers, and caps in the construction of trestles and docks in the vicinity of Pensacola, Fla. All of this material gave a service of over twenty-five years. The New Orleans and North Eastern Railway Company's bridge across Lake Pontchartrain is another notable example of the efficient service to be expected from a good treatment. This bridge was built in 1876 on creosoted piling, most of which to-day is in a good state of preservation. Most of the timber used in these instances was southern pine which, if untreated, would be destroyed by marine borers in 3 years or less. At Girardville, Pa., in the Reading Coal Company's mine, treated timbers have given 12 years' service where ordinarily they would be removed in 2 years.

The Forest Service has estimated that proper preservative treatment will increase the life of ties over 200 per cent., poles 100 per cent., posts 300 per cent., piles 700 per cent., mine props 400 per cent., and lumber 300 per cent. These figures are made up of the average estimates of treated and untreated life for the various forms all through the country and under all conditions, so they naturally give merely an indication of the results of treatment which, in specific instances, may be much more or less than the general average.

Economic Considerations.

It has been clearly demonstrated that the life of timber in many situations has been increased at least two-fold by the use of preservatives, and often the increased life is very much greater. Suppose, for example, that certain timbers put to a certain use will last 5 years without treatment. Disregarding interest charges, it is therefore true that the cost of treatment must be less than the additional cost of new timbers 5 years later, plus the cost of their setting in order to effect a saving. In treating on a large scale the additional cost of any treatment now practised does not usually exceed the present purchase price of the timber. Therefore, the saving means at the least the cost of resetting the timbers, plus the advance in price of the timber, over a period of 5 years. For example, the popular grade of mine timber in the West has increased some 40 to 50 per cent. in price within the last 5 years, and it is reasonable to suppose that a corresponding, if not greater, increase will occur within the next 5 years. Therefore, the financial saving from a treatment, which will double the life of the timber, will be equal to the cost of replacement, naturally a variable quantity, plus 50 per cent. of the present cost of timber. More frequently a good treatment will triple and quadruple the life, and the financial saving is correspondingly greater. Another factor entering into the economic value of the treatment is that often replacement of timber is an expensive undertaking. It means in some cases a shutting down of work on hand during the period of replacement, with the consequent more or less serious financial loss. For instance, the replacement of the timber in a mine shaft will often partially, if not wholly, stop all the work through that section during the period of replacement, with a corresponding financial loss to the company. Since by treatment these replacements may be easily reduced by one-half and oftener to a greater extent, it can be seen that this element bears an important relation to the financial saving growing out of preservative treatments.

With railroad ties a wide field for the betterment of conditions exists in the more general introduction of preservative treatment. Formerly, white oak was the most popular and widely used species for this purpose, but in the past 10 years the cost of the oak tie has more than doubled, and railroads have consequently been turning their attention to other species. Thus, loblolly and shortleaf pine in the South, hemlock and tamarack in the Lake States, lodgepole pine and

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