A method that simulates the natural darkening of wood with age has been developed from experiments at the Forest Products Laboratory and is briefly described below for those who may be interested in the subject as it applies to the finishing of interior paneling. The darkening produced is in the soft brown shades that protected woodwork takes on after long periods of time rather than the gray weathered appearance of woodwork exposed to the weather. The distinguishing feature is that the treatment brings out the shades of color latent in the wood rather than imparting a color and of the figure and the lights and darks of the grain without the exaggeration that frequently occurs in the staining of open grain wood. These features are due to the fact that it is a gas treatment rather than a liquid stain. 1

The depth of the color produced is largely dependent upon the kind of wood. It is also dependent upon the temperature, pressure, and duration of the treatment. Woods such as oak and chestnut as a rule react more readily than do such woods as maple, birch, pine, and spruce. As a general rule, heartwood reacts much more readily than sapwood of the same species. For this reason the process can not be relied upon to equalize the color of heartwood and sapwood. In fact, the differences will be intensified more than by natural aging. One important exception to this rule is red gum. A high temperature process has been developed for this species which practically obliterates color differences between the sapwood and the heartwood. With this exception the principal usefulness of the process may be said to lie in the treatment of the heartwood. Thoroughly satisfactory results have been secured on chestnut and oak paneling by treatment at a atmospheric pressure and temperature. The heartwood of soft pine lumber, which is particularly important from the standpoint of paneling, has been successfully treated at temperatures and pressures well above normal atmospheric.

The description that follows is confined to methods for the small job and such as may be followed by any reasonably skilled person.

1 A gas stain has one further advantage over a liquid stain in that the entire piece is treated prior to assembly rather than simply the face after assembly. This means that lines of unstained wood that commonly show up in woodwork after it shrinks during use are entirely eliminated. It is to be understood, of course, that this process does not take the place of thorough seasoning of the wood by proper kiln drying and that it is entirely supplementary to the seasoning process.
at any place and with small outlay. The application of the process on a commercial or quantity basis would be considerably different,

In brief, the treatment involves subjecting the finished woodwork to ammonia gas at atmospheric pressure and temperature. To avoid excessive loss of the gas during treatment a reasonably air-tight enclosure or compartment must be provided. The individual pieces must be separated by thin crossers to permit uniform diffusion through the pile, the crossers being as near one-half inch in width as possible and not over 1 inch in width so as to avoid undue coverage of the surfaces to be colored.

The most satisfactory source of ammonia gas is the cylinder container in which ammonia is ordinarily handled for use in commercial refrigerating plants. Such a cylinder commonly contains from 50 to 200 pounds of ammonia, technically known as anhydrous ammonia, selling at 15¢ to 18¢ per pound. Ordinarily only from 5 to 15 pounds are needed for treating a thousand feet of lumber, so only a part of a standard commercial cylinder is needed. In most towns, even the smaller ones, arrangements can probably be made with a local refrigerating plant or meat market to obtain the use of an ammonia cylinder, preferably one that is nearly empty because it is lighter and easier to handle. The gas is noninflammable and nonexplosive, but, of course, is extremely penetrating and irritating to the eyes.

A reasonably air-tight compartment can be made by nailing heavy building or roofing paper over and around the lumber after it has been piled as compactly as possible. The joints in the paper should be well lapped and nailed down smoothly and tightly to minimize the leakage of gas. A light frame may need to be built to permit of the proper fitting and fastening of the paper covering, particularly at the ends of the pile.

The connections between the ammonia supply and the treating compartment should be made of black iron pipe, rubber, or glass. Brass pipe and fittings are not suitable for continuous use with ammonia though they may be used for a few weeks or longer without serious deterioration. Where considerable treating is to be done it will be found very convenient to screw a three-eighths inch high pressure ammonia needle valve directly into the ammonia cylinder outlet, using an extra heavy iron nipple or short length of pipe for this purpose. The regular cylinder valve may then be opened wide and the flow of gas regulated by means of the needle valve. If the lumber to be treated is 8 feet long or more the gas should be admitted into the compartment through the top at three points -- near the ends and middle. Spacing the inlets in this way is to facilitate uniform distribution of the gas. In a really tight chamber the diffusion of gas will take place automatically but in the chamber as described there will be leakage for which the proper distribution of the inlets will help to compensate. The treating compartment should be built in an outbuilding which is not occupied either by humans or animals.
No definite rules can be laid down as to the length of treatment required to produce different degrees of aging in different kinds of wood. Some preliminary tests should be made in each individual case to determine approximately whether a mild or prolonged treatment is necessary to meet the requirements. In any case instead of turning on the gas for one prolonged treatment the process should be carried out in two or more stages until the desired color is obtained. A very slow infiltration of gas for one-half hour followed by a couple of hours of inactivity to permit diffusion and penetration is a logical unit of treatment that may well be used until the rate of coloration is gauged for the particular set of conditions at hand. This involves, of course, some provision for opening the compartment sufficiently to gauge the progress of the treatment.

The chestnut paneling illustrated in the article which appeared in the April, 1932, issue of "Good Housekeeping" was treated for varying periods of time, averaging about 30 hours. During this period gas was admitted on an average of about 10 times for a 3-minute period each time, the needle valve being open only part of one turn. Had the compartment been carefully constructed, the amount of gas used could have been very materially reduced.

As pointed out previously, methods of treatment on a commercial basis would be entirely different from those suggested here. A very definite schedule and method of treatment could be arrived at after some experimenting and a permanent air-tight chamber easily designed. The moisture content of the mood and temperature of the air are known to have a marked effect on the rapidity, depth of penetration, and shade of coloring. These are factors which must be taken into special account in commercial treatments. With proper equipment and methods a thorough and through penetration can be easily obtained, which means that in some species at least the process can be carried out on the rough lumber, rather than on the finished product, to some commercial advantage.

Forest Products Laboratory
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