AN INTRODUCTION TO THE MOVIE "MECHANISM OF MOISTURE MOVEMENT IN WOOD"

By G. L. Comstock

An understanding of the mechanism of moisture movement in wood is important from several standpoints. It is important in understanding why wood shrinks as it does and why drying stresses occur, but is probably most important because movement of moisture in wood is the factor that limits the drying process. If moisture moved freely through wood, drying would be an engineering problem of designing better equipment for rapid transfer of moisture from the wood. Because drying is limited by the rate at which moisture moves in wood, it is important for us to understand what the mechanism of movement is.

To have a clear understanding of how moisture moves presupposes some knowledge of wood structure and some basic wood moisture relations. A brief review of these areas should aid in understanding of the movie.

Wood is created each year in the living tree in the form of concentric cones, each year's growth being superimposed on the previous wood tissue. The individual cells formed in the early part of the growing season (earlywood or springwood) generally have a different size and configuration than the cells formed later in the growing season (latewood or summerwood). This is what permits us to differentiate one year's growth from the next and gives wood the grain characteristics that we see. Water or sap is the vital material that is essentially the lifeblood of the living tree. It transports nutrients from the soil to the growing parts of the tree and transports the products of photosynthesis to the growing or cambial cells where the wood is formed.

The coniferous or softwood species have markedly different wood characteristics than the broadleaf species. Coniferous wood consists primarily of tracheids, which are tubelike wood cells about 100 times as long as they are in diameter. These tracheids are tapered on each end and overlap adjacent tracheids to provide a continuous path for the movement of water. The openings that connect adjacent tracheids are called pits, and it is essentially these pits that regulate the flow of liquid water in wood. In sapwood these pits are very open and liquids flow freely, whereas in heartwood the pits are usually plugged with extractives and prevent or greatly retard the movement of liquid water.

Different species of wood contain varying amounts of water, but all of them contain an appreciable amount of water that must be removed. Most softwoods have a very high moisture content in the sapwood, and a somewhat lower moisture content in heartwood. The green moisture content of sugar pine sapwood, for example, is around 200 percent of the dry weight of the wood, and the heartwood has a moisture content of only about 100 percent.

The bulk of the water in wood occurs in two forms. It occurs as liquid water in the cell cavities and as bound water in the cell walls. Water vapor is present in the air spaces in the cell cavities, and although it adds only very little to the weight of water present in wood, it is very important in the movement of moisture by diffusion.

Basically, moisture moves in wood by two mechanisms and these are related to the type of water involved. Liquid water, sometimes called capillary or free water, may move in response to capillary tension forces. Bound water and water vapor can move by diffusion in response to a partial vapor pressure gradient.

A concept which is important in the movement of moisture is the fiber saturation point. This is defined as the moisture content at which the cell walls are saturated with water and no liquid water

is present in the cell cavity. This is important because this is the moisture content at which the mechanism of movement changes. Above the fiber saturation point, water may move as liquid in response to capillary tension forces and below it water may move by diffusion in response to a partial vapor pressure gradient.

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