

Microwave drying characteristics of wood

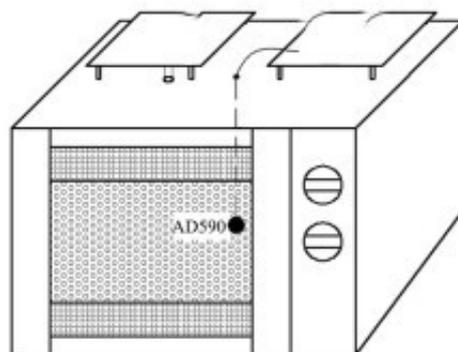
2.1 wood microwave drying process

[Microwave drying equipment](#) can be divided into 3 stages: acceleration stage (drying rate increases gradually), constant speed stage (drying rate keeps constant) and deceleration stage (drying rate decreases gradually). The microwave energy absorbed by wood can be roughly divided into two parts: one is used to evaporate moisture in wood, the other is used to raise the temperature of wet wood. In the acceleration stage, the heat provided by microwave radiation is mainly used to raise the temperature of wet wood, less energy is used to evaporate moisture; in the constant speed stage, the [wood microwave drying](#), the temperature in the wood is basically unchanged.

In microwave drying equipment, the heat of wood does not need to undergo a "long" process of convective heat transfer and heat conduction. Microwave energy penetrates directly into the wood in the form of electromagnetic waves. Through the direct interaction between electromagnetic fields and water molecules, wood polarization molecules (mainly hydroxyl groups), the electromagnetic energy can be instantaneously transferred. Heat is changed into heat, and the temperature of wet wood rises rapidly, and the moisture moves rapidly and evaporates.

Therefore, the proportion of the accelerating stage in the drying process is small, and the proportion of the constant-speed stage in the whole drying process is very large, which is in sharp contrast to the conventional drying in the proportion of the constant-speed stage is small, or even does not exist in the characteristics of the constant-speed drying section. In the late stage of drying, most of the free water in the wood has been removed, at this time, the radiation of microwave energy in addition to a small part of the evaporation of residual water in the wood, most of the energy is used to increase the temperature of the wood, drying rate gradually decreased.

In the process of microwave heating, the drying rate fluctuates a little. The reason may be that the microwave field is not fixed, but constantly changing. On the other hand, the wood moisture content and wood structure are not uniform, which will also lead to the change of moisture



Schematic diagram of microwave drying temperature control system

movement in wood.

2.2 temperature changes in wood during microwave drying

In the process of microwave drying, the change of wood temperature can be roughly divided into three stages: initial heating, isothermal and late heating. In the initial heating and isothermal stage, the temperature distribution in the wood is more uniform, and the temperature gradient from the center to the wood surface is not very obvious, but in the later stage of drying, the temperature difference in the wood tends to increase. The power is 200, 500, 800 W, respectively.

The central heating rates were 7.7, 14.0, 40.0 C min⁻¹, and the central heat preservation time of wood was 8.5, 6.0 and 110 C, respectively.

1.5 min. Therefore, it can be said that the microwave radiation power has a significant impact on the temperature characteristics of wood. The higher the power density, the faster the heating rate and the shorter the isothermal time.

2.3 distribution and variation of water content in wood during microwave drying process

In the process of microwave drying, the moisture distribution in wood is very different from that in conventional drying. In conventional drying, the internal moisture movement rate is usually less than the evaporation rate of wood surface, and the surface layer quickly reaches below the fiber saturation point, forming a large moisture gradient with the central part. In the process of microwave drying, the moisture content distribution in wood showed different laws: in the whole cross-section, the original moisture content gradient of wood was not increased, but was homogenized, and even in the drying process, the moisture content of wood surface increased. This result fully shows that in the microwave drying process, the inside of the wood is Moisture migration is not affected by water content gradient, but because microwave energy penetrates directly into the wood by radiation, and produces a large amount of heat rapidly, which makes water evaporate rapidly in the lumen of wood cells, and the pressure rises sharply. Moisture inside the wood "gushes" out quickly under the action of pressure difference inside and outside the wood. When the evaporation rate of moisture on the surface of the wood is less than the "gushes" out rate of moisture inside the wood, the moisture content "Accumulation" will occur on the surface of the wood, the surface moisture content of the wood will exceed its initial moisture content.

3 conclusion

The following conclusions can be drawn from the above experiments: (1) The continuous microwave drying process can be divided into three stages: acceleration stage, constant speed stage and deceleration stage, in which the constant speed stage accounts for a large proportion in the whole drying process. (2) The temperature changes during the microwave drying process can be roughly divided into three stages: heating stage, isothermal stage and late heating stage. In the heating and isothermal stages, the temperature distribution in wood is more uniform, and in the later stage of drying, the temperature difference has an increasing trend. (3) In the process of microwave drying, the original moisture gradient of wood was not increased in the whole cross-section, but was homogenized, and even the surface moisture content of wood was increased.