4.0 Conclusions and Recommendations

4.1 Conclusions

4.1.1 Comparing the four techniques for measuring the moisture gradients

1. Moisture distribution measured by the four techniques was significantly different based on the ANOVA test under the green condition, but the results obtained from the two newly developed techniques----flaking and razor blade slicing technique, were not significantly different from each other based on the statistical t-test.
2. During the kiln drying of red oak, the moisture gradients measured by the bandsaw slicing technique were the lowest among the four techniques. This was because the high temperature from the saw blade and the environment humidity decreased the moisture content of each slice.
3. The moisture gradients measured by the Forstner bit layering technique were the highest among the four techniques and the variance in the results was also the highest. This was because of the material loss during drilling each layer and oven drying the sawdust of each layer.
4. Since the results obtained from the flaking and razor blade slicing technique were between the results obtained from the bandsaw slicing technique and Forstner bit layering technique, and the two new techniques were developed to overcome the disadvantages of the two existing techniques----moisture loss and material loss, so the moisture gradients measured by the two new techniques were more close to the true value than those measured by the two existing techniques.
5. The razor blade slicing technique is a fast and easy method. It is useful in the practical wood drying industry. The flaking technique can obtain more detailed moisture profiles. It provide more information for the study of drying stress and strain.

4.1.2 Testing the thickness effect on measuring the moisture gradients

1. Under the green condition, there is no strong correlation between the moisture contents and positions in the wood.
2. For the relatively wet samples, the thinner the slices cut for measuring the moisture gradients in the samples, the more the variances would be in the moisture gradient profiles obtained.
3. There is no significant slice thickness effect on measuring the moisture gradients after 4 days drying for both the flaking technique and razor blade slicing technique.
4. While there is no slice thickness effect on the moisture gradients measured, the 0.6mm flake thickness and 3mm slice thickness are optimum for the flaking and razor blade slicing technique, respectively, considering their different purpose used in the different areas as concluded by the first test. 3mm-thick razor blade slicing is better for the practical industry quick-obtaining-result purpose. 0.6mm-thick flaking is better for the research study detailed-knowledge purpose.
5. The flaking technique is becoming better than the razor blade slicing technique for measuring the moisture gradients with the samples becoming dried based on investigation of slice cutting procedure and correlation coefficients of the moisture profiles with these two techniques after 6 days kiln drying.

4.1.3 Comparing the moisture gradients in the radial and tangential directions.

1. While kiln drying the red oak block, differences of moisture gradients between the radial and tangential directions are not significant based on the statistical conditional error test, except for the 4-days-drying test. Moisture gradient in the radial direction

measured on the 4 days drying is lower than that in the tangential direction, which can be concluded that moisture moves a little faster in the radial direction than in the tangential direction on the 4 days drying of red oak under the certain drying condition.

2. Moisture gradients in the tangential direction are steeper than those in the radial direction, which may result in a higher drying stress in the tangential direction.

4.2 Recommendations for the future research

- The flaking technique was concluded as the best technique for measuring the moisture gradients in wood by this study because the flaking machine can cut thin flakes with smooth surface. But tests were only made on red oak, more species will need to be tested for the flaking technique, such as softwood species.
- More tests with the flaking technique for measuring moisture gradients will be needed when the wood becomes drier. Since the drier the wood block, the more difficult the flakes were to cut, the worse the surfaces of the flake.
- In this study, all the techniques for measuring the moisture gradients are the destructive methods. The environmental effects during the cutting and weighing procedure can not be completely eliminated. So finding a non-destructive technique for measuring moisture gradients would be a help for obtaining more accurate moisture profiles during the wood drying.