WATER IN WOOD STUDIED BY TIME - DOMAIN NMR

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INTRODUCTION

- **Problem**

Traditional methods cannot solve the relation between wood and water in micro-scale.

- **Question**

1. Is there a special way to probe wood and water relationships without destruction and how?

2. Is that possible to study water molecular dynamics in wood and thereafter to explain water transportation during sorption process in molecular level?

INTRODUCTION

- **Objectives**

1. The water content in wood investigated quantitatively through the difference of proton sensor's concentration.

2. The water states in wood according to relaxation time.

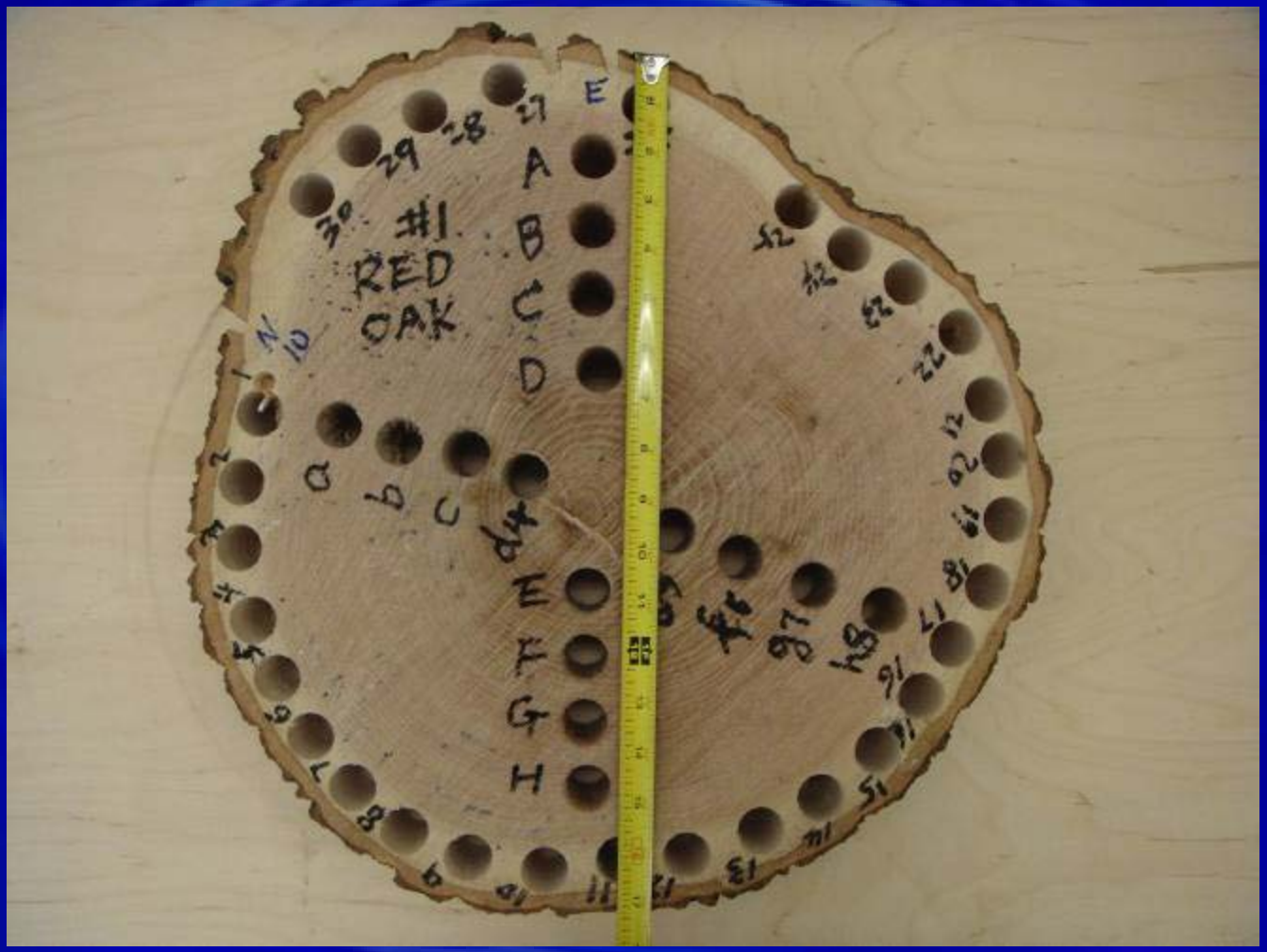
3. Water transportation process in wood during drying and its mathematical model .

METHODOLOGY

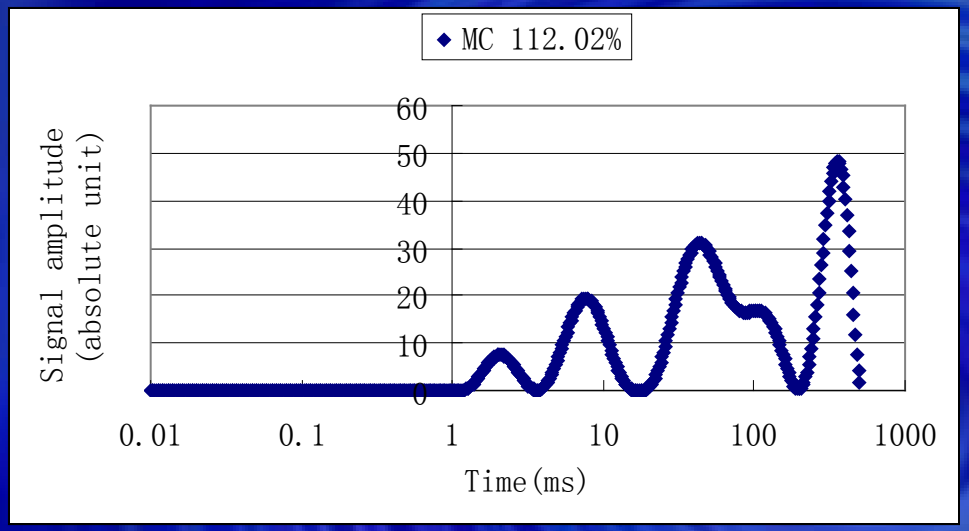
1. **Samples are from fresh cut trees: Ash, Red oak, Walnut and Poplar.**

2. Insert sample into bench top NMR for time relaxation and FID measurement.

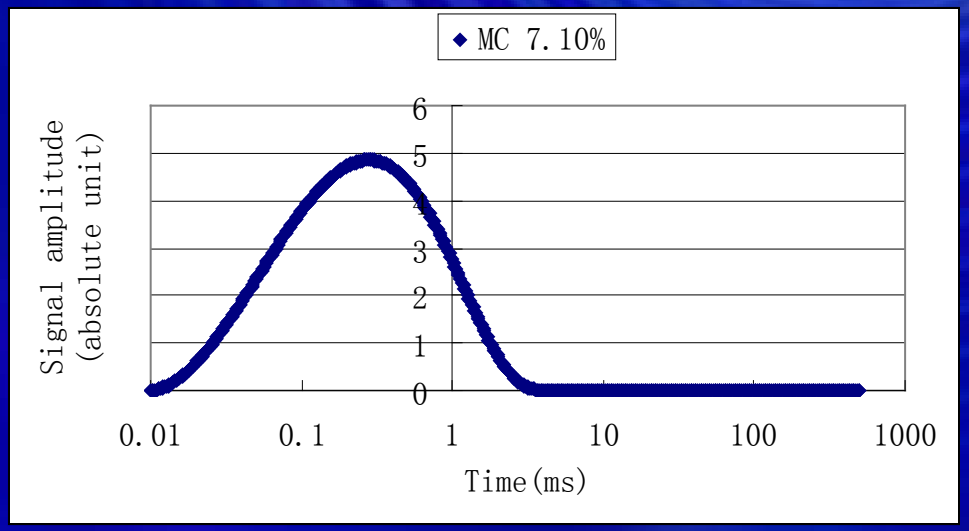
Samples Positions from Wood Disk



RESULTS & DISCUSSION

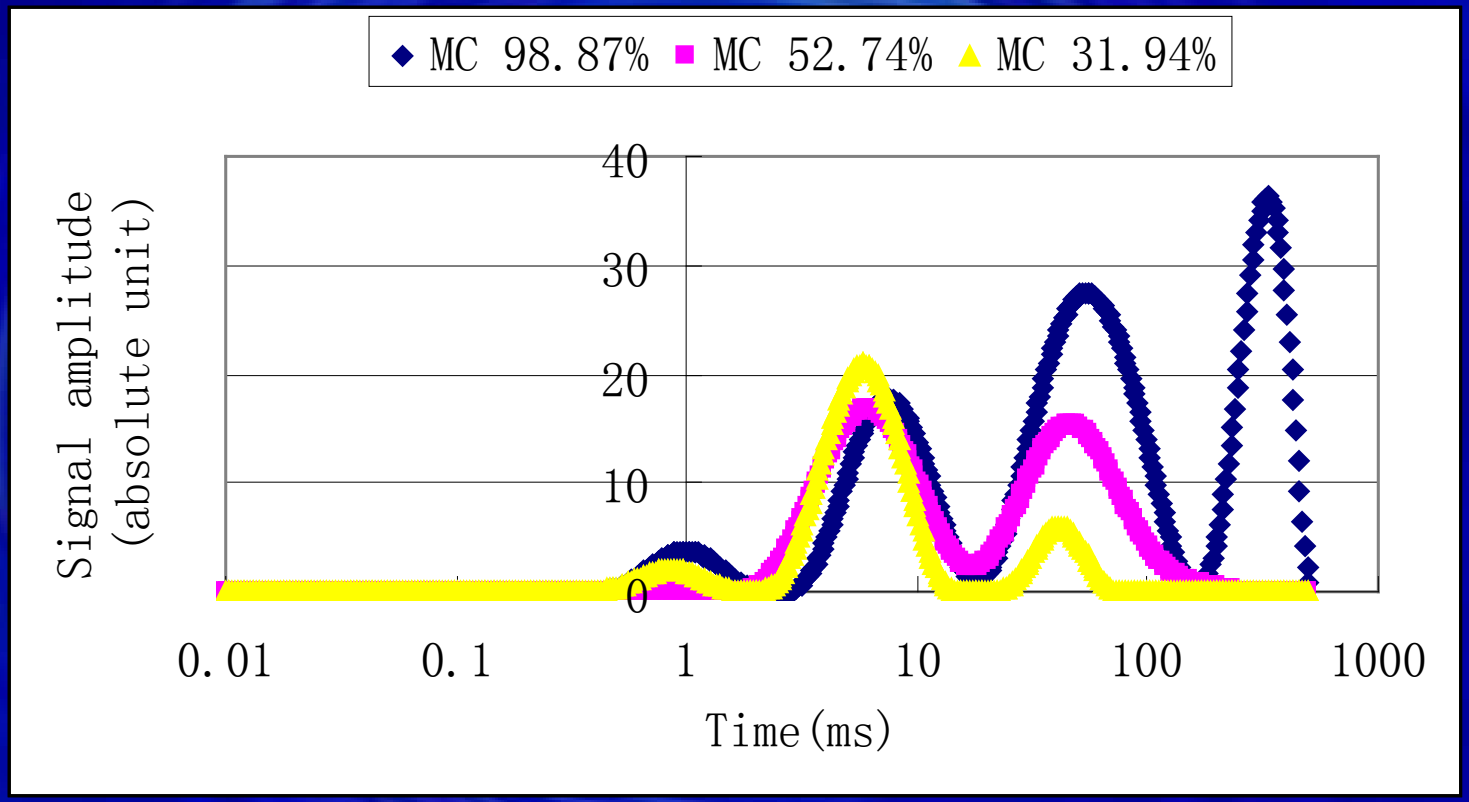


T2 relaxation profile during Yellow poplar drying at MC112.02%



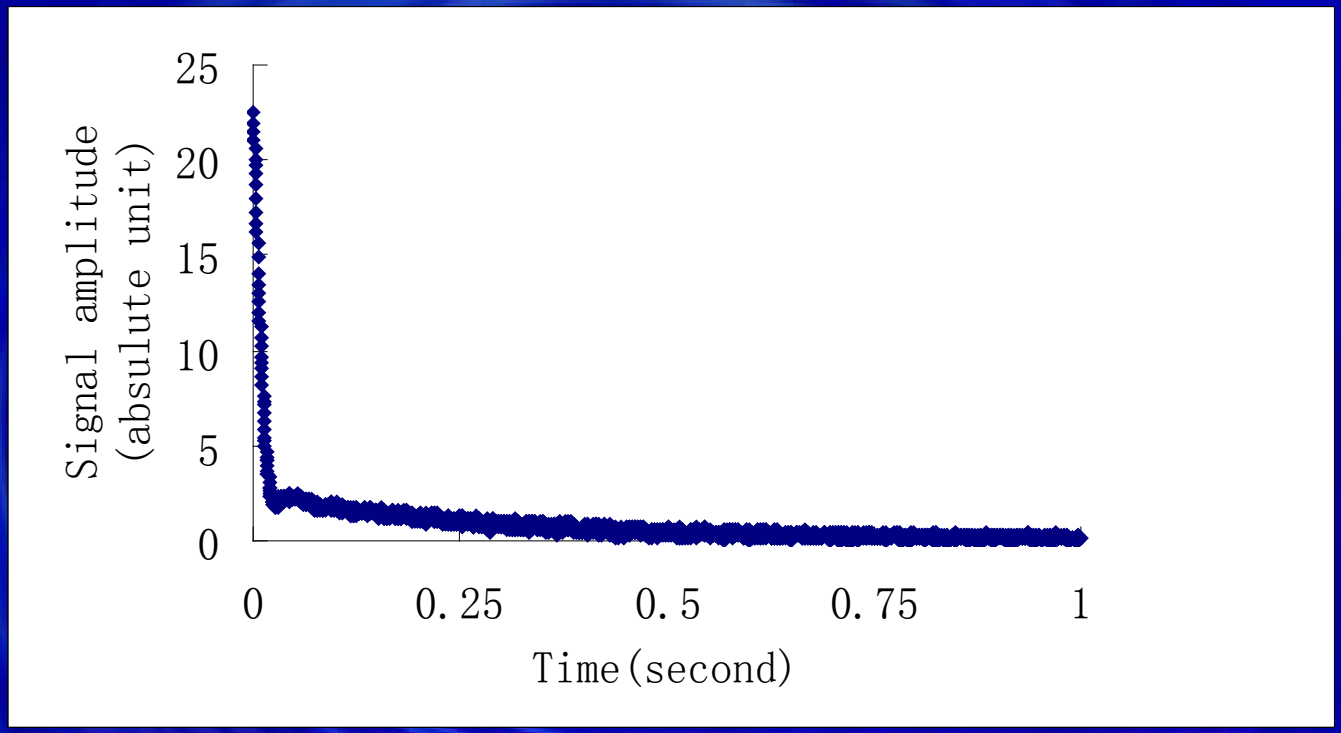
T2 relaxation profile during Yellow poplar drying at MC 7.10%

Spin-spin relaxation time for different moisture content of yellow poplar.



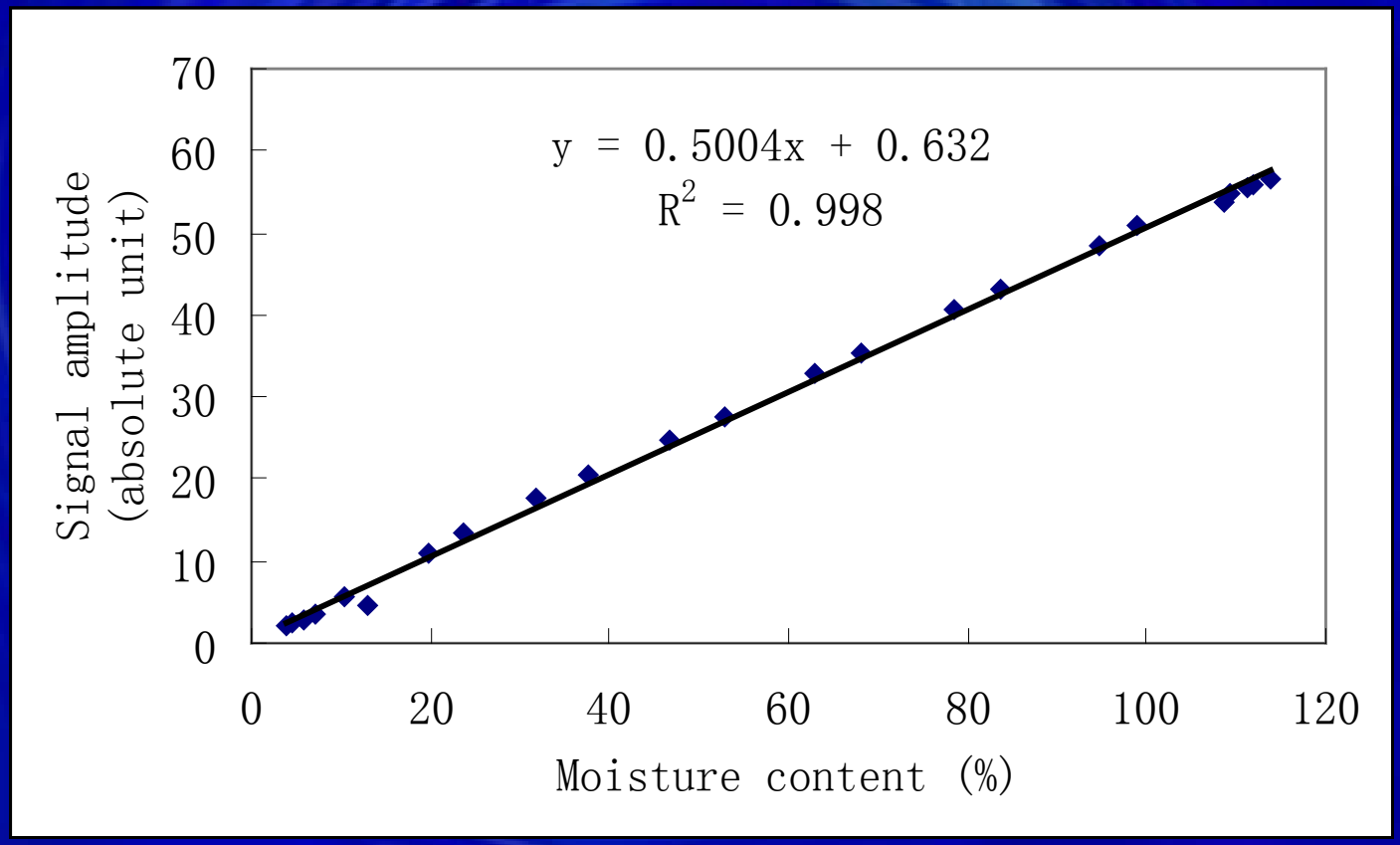
T2 relaxation profile during drying at different MC

A typical FID curve for the yellow poplar with MC = 4.03%

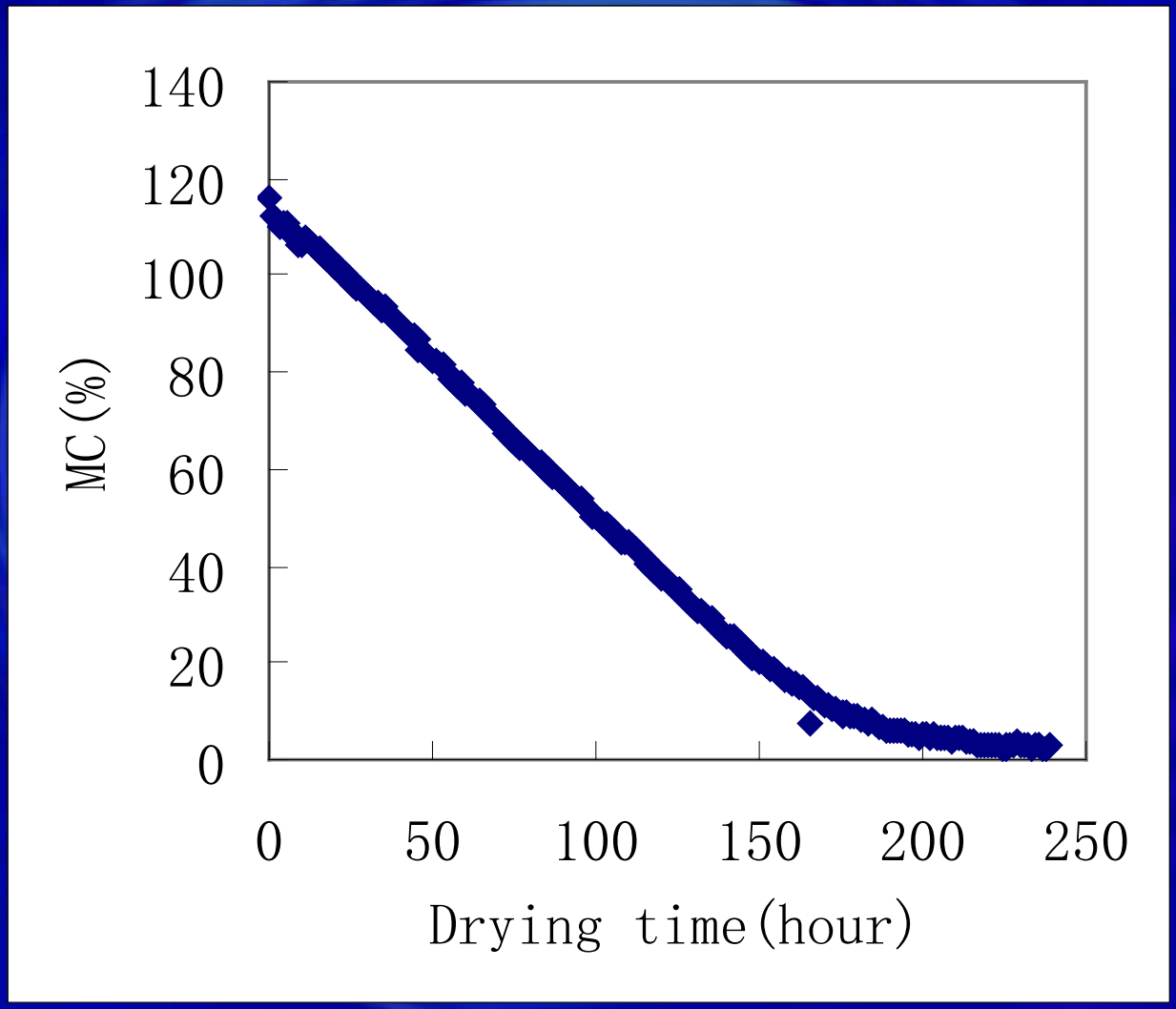


A. The first part of signal (intensity) is directly related to the number of nuclei in the sample (more NMR signal means more nuclei in the sample);
B. The rate of decay (T_2) is related to mobility of molecules (liquids have longer decay time than solids).

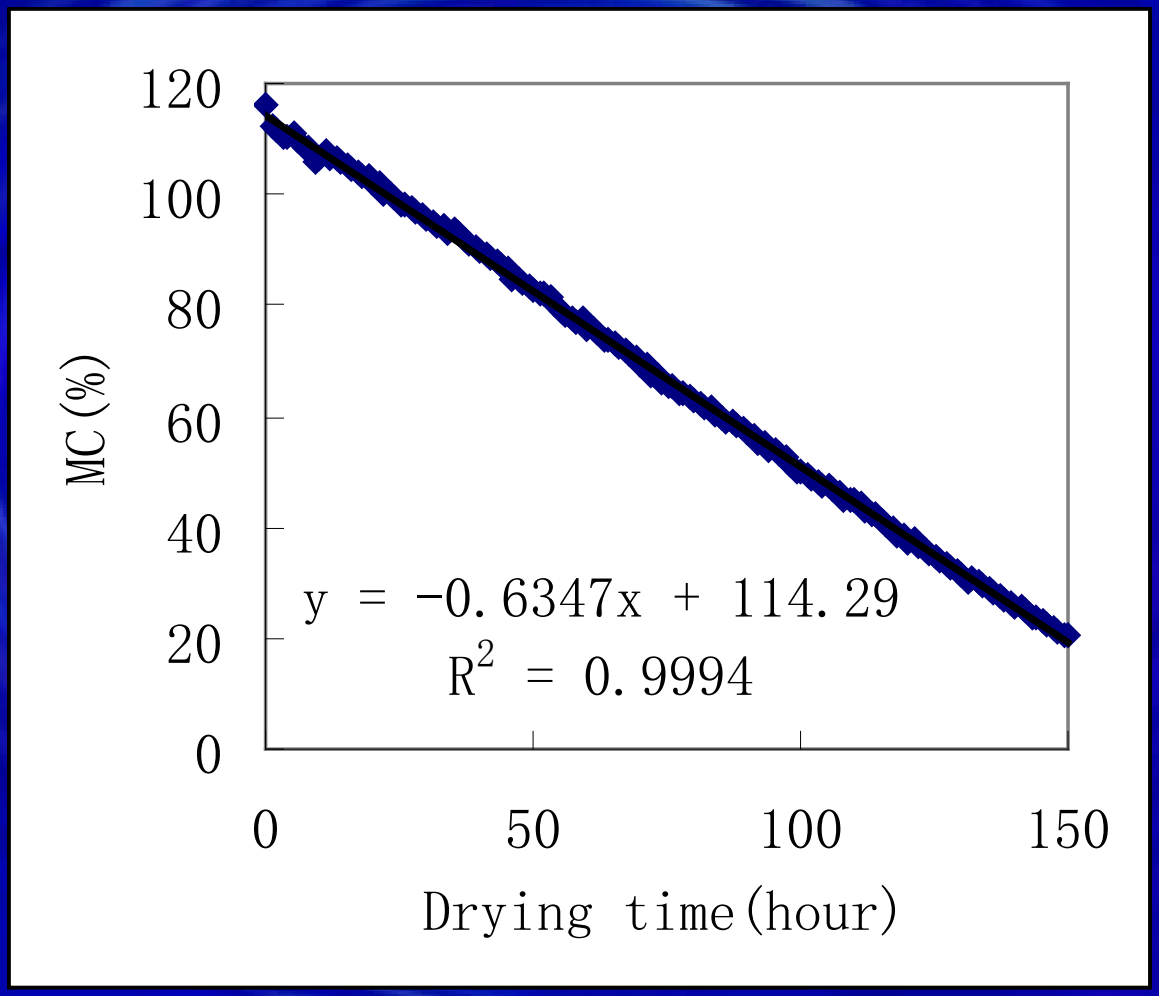
Relation between MC determined gravimetrically and NMR signal amplitude



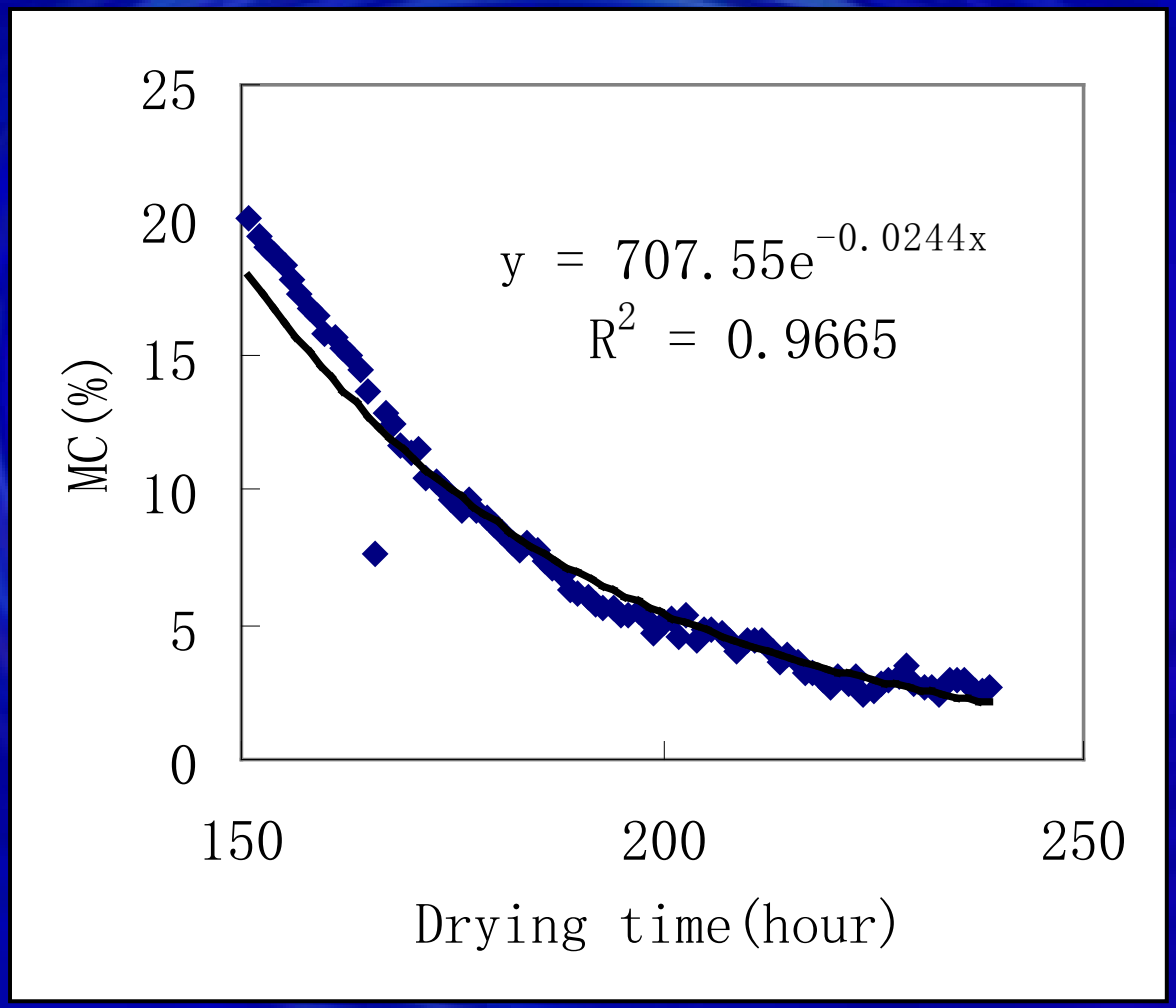
Yellow poplar MC changes with drying time



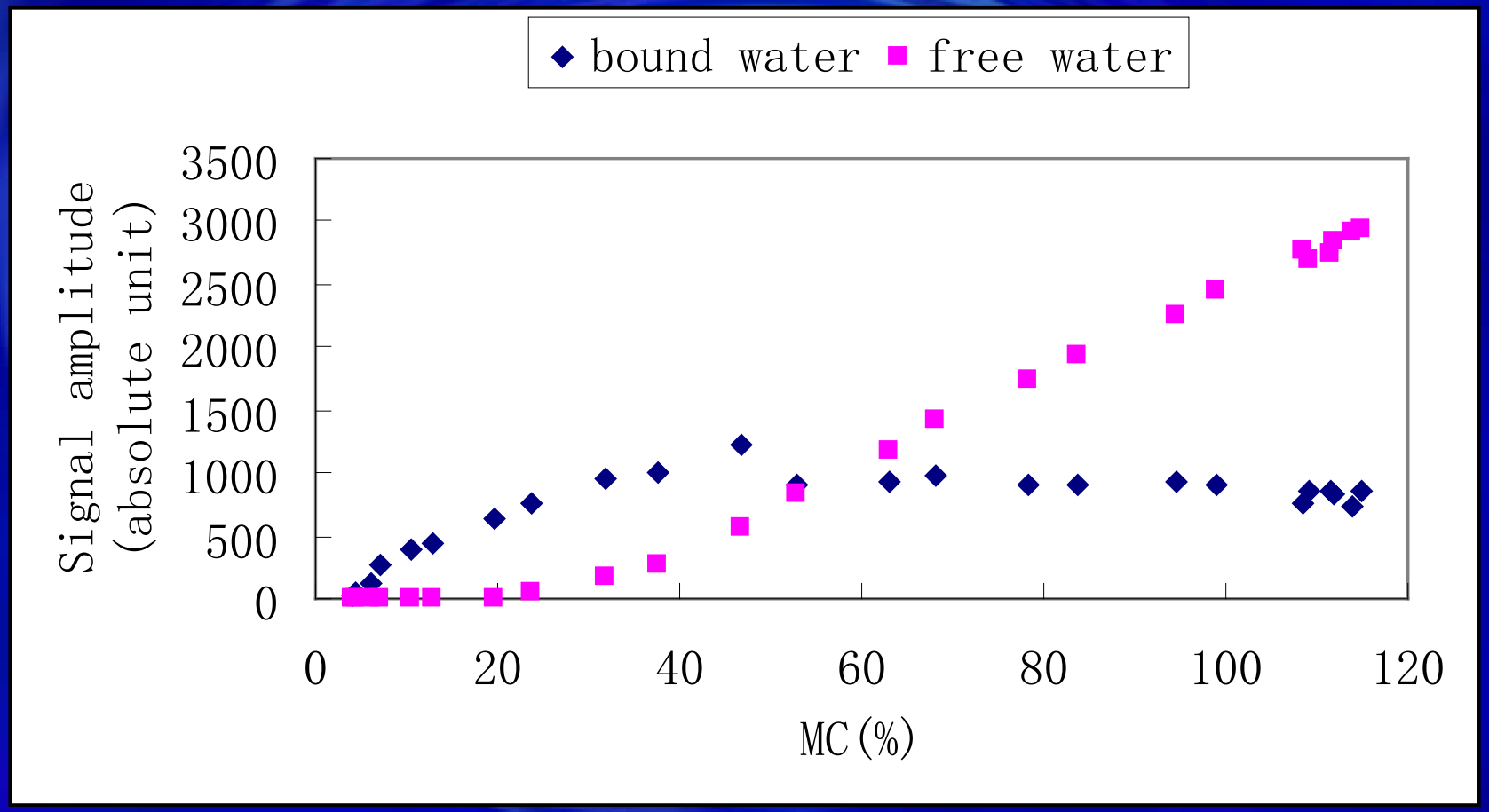
Yellow poplar MC changes with drying time



Yellow poplar MC changes with drying time



Free and bound water changes with MC during drying



CONCLUSIONS

1. Yellow poplar has at least 4 water states according to T2 values at moisture content above 100%.

2. Water states in wood will change with drying time. The T2 value will get shorter with MC decreasing.

3. Water migration in yellow poplar drying can be divided into two phase – one is following linear function and the other is exponential function.

4. It is apparent that bound water does not change too much above 50% MC.

5. Both free and bound water in yellow poplar drying happen to lose above fiber saturation point.

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THANK YOU !

QUESTIONS
COMMENTS