

# FACTORS AFFECTING THE OCCURRENCE OF BROKEN FIBERS IN MACERATED WOOD

## A RESEARCH NOTE

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### ABSTRACT

A high ratio of broken to unbroken fibers in macerated wood samples has generally been considered to indicate the presence of minute compression failures and hence brittle heart in wood. It has been found that agitation during maceration produces broken fibers. The counting of broken fibers from macerations is therefore questionable as a technique for quantifying brittle heart and hence the brashness of wood.

*Keywords:* Broken fibers, maceration, brittle heart.

### INTRODUCTION

In 1920 Robinson noticed an abundance of cell-wall deformations (slip planes) in buckled or wrinkled walls of macerated tracheids. He also observed that these cell-wall deformations were infrequent in undeformed cell walls. As the site of cell-wall deformations was considered by Wardrop and Dadswell (1947) to be susceptible to acid attack and to result in broken fibers, it would appear that any buckling or crinkling caused by agitation during maceration may likewise produce broken fibers.

Dadswell and Langlands (1934) concluded that minute compression failures (horizontal rows of slip planes) are an indicator of the brash wood known as brittle heart. They suggested that in macerated wood there is a definite connection between minute compression failures and broken fibers, and they observed a relationship between the period of maceration and the ratio of broken to unbroken fibers.

The aim of this study is to determine the influence of maceration technique on the development of broken fibers in macerated wood. To do this both macerating time and maceration agitation were examined.

### PROCEDURE

Wood samples were taken at breast height (1.3 m) from the outside of a 40-year-old *Eucalyptus pilularis* tree of 0.24 m diameter. It had been determined previously, by light microscopy, that these samples did not contain compression creases.

Samples were separated into four groups. These were subjected to long or short maceration (48 hours or 24 hours, respectively) and either long or short agitation (agitation involved inverting a vial containing the macerated wood and 10 ml of distilled water either 100 or 50 times). The macerating fluid consisted of equal parts of glacial acetic acid, 27.5% W/W hydrogen peroxide, and distilled water. Maceration took place in a water bath at 100, but the macerating solutions did

TABLE 1. *Results of counting broken and unbroken fibers in macerated samples taken from the outside of a 40-year-old Eucalyptus pilularis tree.*

Preparation*	Sample position in tree**	Number of broken fibers in slide	Number of unbroken fibers in slide	Ratio broken/unbroken fibers
LM LS	1.0	25	25	1.0
LM LS	0.9	32	29	1.1
LM SS	1.0	20	30	0.67
LM SS	0.9	47	71	0.66
SM LS	1.0	23	27	0.85
SM SS	1.0	18	32	0.56

\* LM, long maceration (48 h); SM, short maceration (24 h); LS, long agitation time (see text); SS, short agitation time (see text).

\*\* Position is measured as a fraction of the radius. Samples were taken from zones considered to have minimum brittle heart.

not boil. Microscope slides were prepared by pipetting the macerated samples onto glass slides. These were then gently dried on a slide warming plate.

A glass microscope slide that had been etched with fine parallel lines was used in place of a normal coverslip. Glycerol was used as the mounting medium so as to reduce the manipulation of fibers that occurs when making permanent slides. Acrylic glue was used on the edges to prevent movement of the coverslip and slide.

The counting of broken and unbroken fibers was performed by examining the projected image of the macerated fibers. To avoid sampling bias, only fibers intersecting with the lines on the coverslip were inspected. They were recorded as either broken, unbroken, or unsuitable. Unsuitable fibers were those whose ends were obscured or those with both ends missing.

#### RESULTS AND DISCUSSION

The results of the count of broken and unbroken fibers are shown in Table 1. It can be seen that samples taken from adjacent areas of the same tree showed almost identical ratios of broken to unbroken fibers when subjected to the same maceration procedure. This suggests that the two factors considered, macerating time and agitation of the macerated fibers if controlled, may be used to standardize macerations, therefore allowing limited comparisons of brashness between woods with similar macerating properties. Wood of different ages may not be suitable for such a comparison of brashness as it is suggested that juvenile wood is more rapidly macerated, which would make it preferentially susceptible to the formation of broken fibers when agitated.

A chi square analysis was performed on the results in Table 1 to determine if a relationship exists between macerating time and the number of broken fibers. A similar analysis was performed to determine if a relationship exists between agitation of macerated fibers and the number of broken fibers.

The results of the chi square analysis showed there is a significant relationship between degree of agitation and the number of broken fibers in a maceration at the 0.05 significance level. As the value of the phi coefficient is low, however, this relationship appears weak (phi may be interpreted in the same way as a Pearson coefficient of determination). The chi square value relating period of maceration to number of broken fibers was not found to be significant.

## CONCLUSION

It has been found that the number of broken fibers in a maceration is significantly influenced by the amount of agitation. However, macerating time was not shown to have a significant influence on the frequency of broken fibers.

It is suggested that boiling samples while macerating may provide the amount of agitation necessary to break fibers. This may explain the relationship between time of maceration and the ratio of broken fibers described by Wardrop and Dadswell (1947).

It is further suggested that maceration makes a fiber susceptible to deformation during agitation. Such deformation may occur at sites of accelerated delignification during maceration. This results in the breaking of the fiber at the point of deformation, as suggested by Wardrop and Dadswell (1947).

It is recommended that considerable care be taken to standardize methods when maceration techniques are used to determine the presence of brittle heart.

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