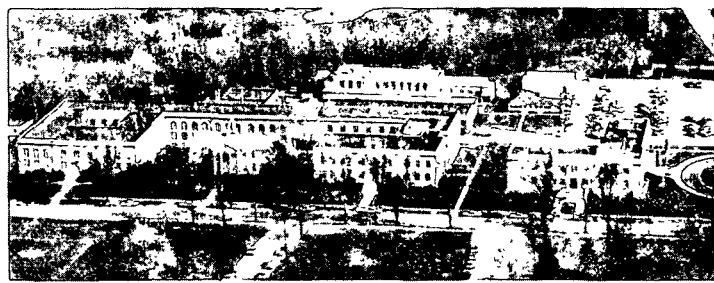


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PYCNOMETER METHOD FOR OBTAINING WOOD AND  
BARK CHIP DENSITIES

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## INTRODUCTION

The highly accurate technique described is useful for obtaining the densities of small pieces of wood and bark at various moisture contents. Increased interest in "whole-tree" chips has resulted in the need, in some instances, to segregate wood from bark chips. This method has been useful in The Institute of Paper Chemistry's bark characterization work as an indication of whether segregation would be possible through water flotation. The method also could be used to obtain the density of small objects at any moisture level.

This paper is being submitted to Forest Science for publication.

## Pycnometer Method for Obtaining Wood and Bark Chip Densities

Note by Marianne L. Harder

As part of a project on characterizing the bark of important pulpwood species, a method was developed for obtaining the densities of wood and bark chips at various moisture contents using a pycnometer. This method was useful in determining the potential of water flotation as a means of segregating wood/bark chip mixtures. Water segregation is believed to be possible when one fraction has a density of less than one and the other greater than one at a specific moisture content.

Previously, some work had been done with a density gradient column, following the techniques of Wiley (1962) and Julien, et al. (1971). However, it was soon apparent that there were many difficulties inherent in the density gradient column method for determining densities. Rather elaborate equipment was required, including jacketed columns and motorized mechanisms to move the chips in the column. The columns also had to be kept free of vibration and the overall time required to obtain readings was much greater than needed for the pycnometer method.

The pycnometer method for obtaining densities is a modification of a method for obtaining densities of solids using a pycnometer as discussed by Weissberger (1945). The chemical, heptane, is used as the displacement medium. All equipment is placed in a controlled temperature-humidity room for at least four hours prior to testing and measurements are made on an analytical balance in the same room. This is done to insure unvarying testing conditions for greater accuracy.

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The test specimens having various moisture contents are prepared by placing the required number of chips in small tightly covered jars containing varying amounts of water. Chips are allowed to equilibrate for a minimum of ten days and the basic density measurements are made following equilibration. First, the density of the heptane is determined using a 25-ml pycnometer [(weight filled pycnometer - weight empty pycnometer)/25]. (It would be possible to use a larger pycnometer if the chip size is such that it would not fit in a 25-ml pycnometer.) Each replication is blotted free of excess moisture and weighed to determine chip wet weight. The chips from a particular replication are then placed in the pycnometer, heptane added and the weight obtained on an analytical balance for the pycnometer containing the heptane + the chip replication. Usually, a rough weight needs to be obtained, the pycnometer removed, more heptane added and a final weight taken. This is necessary because of the rapid evaporation of the heptane. The pycnometer containing the chip replication and heptane should be quickly checked before weighing to be sure no air is trapped in the pycnometer. The replication is then removed from the pycnometer and placed in an appropriately marked coin envelope. The sample is oven dried at 105°C for 24 hours and an oven-dry weight obtained.

With this information, it is possible to calculate moisture content and density. Moisture content is calculated as (wet wt.-oven-dry wt.)/oven-dry wt. Density is calculated as  $(c \cdot e) / (c - (b - a))$  where

a = weight of pycnometer + heptane

b = weight of pycnometer + heptane + chip

c = wet weight of chip

d = oven-dry weight of chip

e = density of heptane

Accuracy of the method is high. Wood and bark density measurements run on 16 pulpwood species (64 samples) resulted in an average standard deviation of the mean of three replications of approximately 0.015 and a coefficient of variation (standard deviation/mean) of 2%. Regression analyses run on 32 sets of data resulted in the expected significant (5%) linear relationship between moisture content and density with most  $r^2$  values (correlation between moisture content and density) ranging from 0.50 to 0.93.

#### Literature Cited

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