WOODCRAFT TECHNIQUE

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§Introduction§

Wood is a great structural material applied to engineering and design, but it is not readily transfigured to fit the purposes of craft without losing its mechanical properties. The anisotropic properties of wood has high value in both disciplines, but its formability is rather difficult to attain (i.e. twisting, bending acute arcs, folding, etc.). Hence, I wish to apply a recently studied method of delignification and water shock that induces the "moldability" of wood to the purposes of woodcraft to achieve more versatility and creativity in our final wood products[1]. I believe this applied method will allow craft students/workers to explore and utilize a novel engineering technique to their craft for the benefit of individual creativity and the discipline itself. The way in which "moldable wood" is achieved is through a delignification process by submerging wood in boiling NaOH and Na_2SO_3 solution for 48 hours to remove some lignin and hemicellulose (components of the cell wall) followed by air drying and water shock to attain the "highly-foldable" wood material. Through shaping and subsequent drying, the final craft piece becomes hardened while sustaining its mechanical properties. The ultimate goal of this study is to discover a way to implement the procedure in the craft building for woodworkers to learn from, apply, and innovate to their craft.

§Objective§

(1) To apply a cell wall engineering technique to the craftsmanship of wood.
(2) Test different wood species to ensure diversity and versatility.
(3) Transfer this laboratory technique to the crafts building for woodworkers in the future.

§Materials§

- Sheet of natural wood (virtually any)
- 2.5 M NaOH (*Sigma Aldrich*)
- 0.4 M Na_2SO_3 (*Sigma Aldrich*)
- Precision scale
- Graduated cylinder
- Deionized water
- Hot plate (boiling)
- Tongs or forceps
- Beakers
- Rinsing bowl

§Procedures§

1. Prepare 300 mL solution of 2.5 M NaOH and 0.4 M Na_2SO_3. Place weigh boat on scale and nullify the mass on scale to 0 grams. Measure out 30 grams (0.75 mol) of solid NaOH (if standard solution is not provided). Next, measure out 15.12 grams (0.12 mol) of solid Na_2SO_3, or dilute the standard solution. Place samples in 500 mL beaker and add 300 mL deionized water.

2. Prepare wood samples to be delignified and submerge into the 300 mL solution in the 500 mL beaker.
3. Place the 500 mL beaker on a hot plate and leave boiling for 48 hours.
4. After boiling, turn the hot plate off and allow brief cooling. Then, with tongs or forceps, carefully grab the wood samples and place into a rinsing dish. Rinse the samples thoroughly with deionized water to remove any chemicals remaining. Repeat three times to as much as needed.
5. Leave these partially delignified wood samples (~300 wt % water content) to air dry for at room temperature and a relative humidity of 45-60% for 30 hours to form the shrunken wood intermediate (~8-12 wt % water content).
6. Immerse this wood intermediate into deionized water for approximately three minutes (water shock) to form the moldable wood (~100 wt % water content).
7. MOLDABLE WOOD SAMPLE PROCEDURE. Shape the wood sample into virtually any form perpendicular to the direction of the grain.
8. Once the desire wood form is achieved, begin by air-drying at room temperature the molded wood sample for 30 hours to restore the rigid wood properties (~8-12 wt % water content).

§Dissemination§

Upon completion of the project, it would be ideal to share the information with the chemistry department and the woodcraft labor department for future projects. Specifically, the goal is to translate the chemical procedures into an operable task in the woodcraft department that is safe, manageable, and efficient. Other institutional or departmental publications or presentations are appropriate for terms of an independent study project.

§Reference§

1. Xiao S., Chen C., Xia Q., Liu Y., Yao Y., Chen Q., Hartsfield M., Brozena A., Tu K., Eichhorn S., Yao Y., Li J., Gan W., Shi S.Q., Yang V.W., Ricco M., Zhu J.Y., Burgert I., Luo A., Li T., and Hu L. (2021). Lightweight, strong, moldable wood via cell wall engineering as a sustainable structural material. *Science*. *374*(6566), 465-471. DOI: 10.1126/science.abg9556