

Project Proposal: Hemp Root vs. Stalk Biochar Composites (Comprehensive)

1. Introduction & Hypothesis

This study explores hemp roots as a lignified precursor for high-performance biochar compared to hemp stalks. **Hypothesis:** Hemp root-derived biochar improves mechanical stiffness, thermal stability, and electrical conductivity of epoxy composites due to higher lignin content and superior carbon framework density.

2. Experimental Variables

Type	Variable
Independent	Biomass Source (Root vs. Stalk)
Dependent	Young's Modulus (GPa), Tensile Strength (MPa), Td (°C), Conductivity (S/m)
Controlled	Pyrolysis (550°C, 2h), Particle Size (<75µm), Filler Loading (10%wt), Curing Cycle (80°C/4h)

3. Standard Operating Procedure (SOP)

- Preparation:** Clean biomass, dry to <5% moisture, ball-mill to <75µm.
- Pyrolysis:** 550°C at 10°C/min, 2-hour soak under N₂ flow.
- Fabrication:** Disperse 10% wt biochar into epoxy; high-shear mix, vacuum degas.
- Curing:** Cast in ASTM D638 molds, cure at 80°C for 4 hours.
- Testing:**
 - Mechanical: ASTM D638 Tensile Test.
 - Thermal: Thermogravimetric Analysis (TGA).
 - Electrical: Four-Point Probe Conductivity Measurement.
 - Morphology: SEM analysis of biochar surface.

4. Expanded Data Collection Template

Metric	Root Composite	Stalk Composite
Tensile Strength (MPa)	_____	_____
Young's Modulus (GPa)	_____	_____
Electrical Conductivity (S/m)	_____	_____
Pore Surface Area (m ² /g)	_____	_____

5. Mandatory Safety Protocols

- **Pyrolysis:** Use vent hood + N₂. Never open hot.
- **Chemicals:** Epoxy is a sensitizer. Use fume hood, goggles, nitrile gloves.
- **Particulates:** Biochar dust (<75µm) is hazardous. Use N95 masks.
- **Mechanical:** Stand clear of UTM during testing.

6. Regulatory Compliance & Disclaimer

Compliance: Biomass must meet hemp regulations (e.g., <0.3% THC). Retain Certificates of Analysis (CoA).

Liability: This is an open-source proposal. The author accepts no liability for injury, damage, or legal issues.