Seshat's Composites: The Optimized Binary Theoretical Framework for Programmable, High-Performance Organic Materials Using Diverse Hemp-Derived CARBON Allotropes

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Marie Seshat Landry, Citizen Scientist and CEO*[1]

[1]Landry Industries, Organic Innovation and Sustainable Materials Division

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AI-Assisted Theoretical Pre-Print Disclaimer
This manuscript was organized with AI assistance. It presents a purely conceptual framework representing the author's latest and most refined theoretical understanding for a novel material system, grounded in established material science principles—notably drawing analogies from well-studied graphene-epoxy composite systems [Lodh Gadhave, 2024] and research on functional **CARBON** materials [Correa Kruse, 2018; Cesano et al., 2020a]—and cited literature, alongside proposed future experiments. All assertions regarding material properties and processing are, at this stage, entirely theoretical and await empirical validation. The term "**CARBON**" is emphasized to denote its central, diverse, and functional role derived from hemp.

Abstract

Conceptualized on May 21, 2025, by Citizen Scientist and CEO Marie Seshat Landry, *Seshat's Composites* represent a paradigm-shifting theoretical platform for a novel binary composite system. This system is composed exclusively of (1) hemp oil as a curable binder and (2) a strategically "programmed," dominant phase (targeting ¿50-70 wt%) of diverse hemp-derived **CARBON** allotropes (biochars, graphitic forms, nanosheets, fibers, activated **CARBON**s). This advanced binary framework is the culmination of iterative theoretical work, deliberately simplifying and enhancing prior, purely conceptual multi-component frameworks (e.g., "Diamond Composites," Landry 2024 [Landry2024]) to achieve what is theorized as the most direct, effective, and promising path towards next-generation, carbon-dominant organic materials. *Seshat's*

*Corresponding author: marielandryceo@gmail.com — marielandryceo.com

Composites aim to leverage the extraordinary diversity and potential cost-effectiveness of hemp-derived **CARBON**s to enable fine-tuning of mechanical, thermal, and even advanced electronic properties, such as electronic memory devices [Chai et al., 2009; Sebastian et al., 2021]. This paper details this evolved theoretical framework, the foundational hypothesis emphasizing programmable properties through carbon-phase dominance, proposed materials preparation (initiating with "THE BLOB" concept for maximal **CARBON** saturation), purely theoretical performance projections, and the transformative implications for scalable, functional, ultra-high-**CARBON**-content organic materials. Empirical validation of this optimized binary, carbon-dominant concept is the critical subsequent step towards what the author terms the **Organic Revolution of 2030**.

Keywords: Hemp Composites, Optimized Binary System, Carbon-Dominant Composites, Programmable Materials, Functional **CARBON**, **CARBON** Allotropes (Hemp-Derived: Biochar, Graphitic Carbons, Nanosheets, Fibers, Activated **CARBON**s), Ultra-High **CARBON** Loading, Hemp Oil, Electronic Memory Devices, Tunable Properties, Sustainable Materials, Citizen Science, Seshat's Composites, THE BLOB, Theoretical Pre-Print.

1 Introduction: The Imperative for Carbon-Dominant Organic Materials

The pursuit of advanced materials necessitates systems that are not only sustainable and high-performing but also intelligently designed for specific functionalities and scalable manufacturing. Current advanced composites, while offering high performance, often rely on synthetic polymers and expensive, energy-intensive reinforcements (e.g., virgin carbon fibers, graphene at low wt%). This paper, authored by Citizen Scientist and CEO Marie Seshat Landry, introduces *Seshat's Composites*, conceptualized on May 21, 2025. This framework presents a novel, optimized binary theoretical platform for creating next-generation organic materials where the **CARBON** phase is dominant. It proposes a system consisting solely of hemp oil as a minimal binder and a meticulously selected, ultra-high-loading (¿50-70 wt%) mixture of diverse hemp-derived **CARBON** allotropes. This approach is considered a more direct, effective, and promising platform than earlier, purely conceptual multi-component systems considered by the author [Landry2024], and distinct from low-loading filler systems. Hemp (*Cannabis sativa L.*) offers a transformative feedstock for an unparalleled diversity of **CARBON** structures—including biochars, graphitic carbons, potential nanosheets, fibrous carbons, and activated **CARBON**s [Das et al., 2022; Shah et al., 2022]. This rich portfolio forms the basis for "programming" material properties by strategically designing the dominant **CARBON** phase. *Seshat's Composites* aim to leverage the cost-effectiveness of hemp-derived **CARBON**s for extreme reinforcement fractions, where the **CARBON** network itself dictates material properties, including potential for electronic memory functionalities [Pop et al., 2018; Wang et al., 2020].

2 Conceptual Evolution: Towards an Optimized Binary, Carbon-Dominant Framework

The theoretical development leading to *Seshat's Composites* involved an iterative refinement process, prioritizing maximized performance, sustainability, and practical processability through system simplification. Earlier conceptual explorations by the author, such as the purely theoretical "Diamond Composites" framework [Landry2024], considered multi-component systems potentially involving binders like lignin. However, further theoretical analysis, informed by principles of composite mechanics, interfacial science, and the strategic imperative for achieving dominant **CARBON** loadings for transformative properties, led to a significant conceptual shift.

It was concluded by the author that a strategically simplified binary matrix—composed exclusively of hemp oil as a binder and a "programmed" phase of hemp-derived **CARBON** allotropes forming the bulk of the material—represents the most direct and theoretically effective platform. This carbon-dominant binary approach offers distinct theoretical advantages:

- **Maximized CARBON Loading and Performance:** Eliminating intermediate phases (like lignin) and focusing on hemp oil solely as a binder for a packed **CARBON** network theoretically allows for the ultra-high **CARBON** fractions (¿50-70 wt%) necessary for the **CARBON** phase to dominate and dictate composite properties.
- **Simplified Interfacial Science:** The system reduces to the critical hemp oil-**CARBON** interface, simplifying control and optimization efforts towards achieving robust binding of the **CARBON** network.
- **Direct "Programming" via CARBON Phase Architecture:** The binary system allows the full focus of material design to be on the strategic selection, combination, and spatial arrangement of diverse hemp-derived **CARBON** forms to achieve targeted, fine-tuned properties dictated by the **CARBON** network itself.

Thus, *Seshat's Composites* are presented as the optimized theoretical framework for creating carbon-dominant, high-performance organic materials.

3 The Seshat's Composites Framework: An Optimized Binary CARBON-Dominant System

3.1 Core Components: Hemp Oil Binder and Programmable Hemp-Derived CARBON Network

The Seshat's Composites system is defined by its two exclusive components:

1. **Hemp Oil Binder:** Cold-pressed hemp seed oil, or derivatives thereof, intended to act as a curable, minimal binder. Its role is primarily to adhere the **CARBON** particles/structures together after curing, forming a cohesive solid from the **CARBON**-saturated pre-mixture.

2. **Programmable Hemp-Derived CARBON Network (Dominant Phase):** A strategically designed blend of various **CARBON** allotropes, all derived from hemp biomass. This includes, but is not limited to:

   - **Hemp Biochars:** For bulk structure, thermal stability, and potentially as a base for further functionalization [Jahirul et al., 2022; Leng et al., 2021].
   - **Hemp-Derived Graphitic Carbons/Nanosheets:** For enhanced electrical and thermal conductivity, and mechanical reinforcement [Gahlot Kulshrestha, 2023; Ahmad et al., 2021].
   - **Hemp-Derived Fibrous Carbons:** For toughness, tensile strength, and creating interconnected networks [Sharma et al., 2021].
   - **Hemp-Derived Activated CARBONs:** For porosity, high surface area applications (e.g., in sensors or specific electronic functions), or lightweighting [Rodriguez Correa Kruse, 2018; Mohan et al., 2006]. [7]

   The "programming" involves selecting the types, morphologies, particle sizes, surface characteristics, and relative ratios of these **CARBON**s to achieve a desired macroscopic property profile in the final composite.

3.2 Principle of Ultra-High CARBON Loading

A central tenet of Seshat's Composites is the achievement of ultra-high **CARBON** loadings, theoretically exceeding 50 wt% and aiming for 70 wt% or higher. At such loadings, the **CARBON** phase is no longer a mere "filler" but forms a continuous or semi-continuous network that dictates the primary mechanical, thermal, and electrical properties of the composite. The hemp oil serves primarily to bind this pre-existing **CARBON** architecture. This is fundamentally different from traditional polymer composites where the polymer is the continuous matrix and low percentages of fillers are dispersed within it [Jones, 2012; Vasiliev Morozov, 2001]. [3, 8]

4 Hypothesis for Seshat's Composites

For the *Seshat's Composites* platform, we hypothesize that:

1. The simplified binary system (hemp oil binder + dominant hemp-**CARBON** network) **will accommodate** extremely high loadings (theoretically ¿50-70 wt%) of diverse, cost-effective hemp-derived **CARBON** reinforcements, to the point where the hemp oil acts as a minimal binder for a carbon-saturated mass.

2. The strategic "programming" of this dominant **CARBON** phase—by meticulously selecting specific types, morphologies, and ratios of hemp-derived allotropes—within the cured hemp oil binder **will enable** predictable fine-tuning and synergistic enhancement of the composite's properties, effectively allowing the **CARBON** network's characteristics to define the material.

3. These ultra-high-**CARBON**-content, programmed hemp **CARBON**/hemp oil systems **will exhibit** a superior overall balance of high performance (e.g., mechanical strength akin to a "carbon beam," high conductivity), functional versatility (e.g., tunable electronic properties for memory applications), cost-effectiveness, and sustainability compared to conventional composites and earlier theoretical multi-component concepts.

5 Proposed Materials and Methods for Initial Theoretical Validation

5.1 Hemp Feedstock and CARBON Allotrope Production (Theoretical Considerations)

The starting point is diverse hemp biomass (stalks, hurd, fibers) [Crini et al., 2020; Johnson, 2022]. Theoretical production pathways for **CARBON** allotropes include:

- **Pyrolysis:** Controlled thermal decomposition in an inert atmosphere at varying temperatures (e.g., 300°C - 1200°C+) to yield biochars with different degrees of carbonization and graphitization [Al-Salem et al., 2023; Reza et al., 2024]. [4, 18]
- **Activation:** Physical (steam, CO_2) or chemical (e.g., KOH, H_3PO_4) activation of biochars to produce high-surface-area activated **CARBON**s [Ghani et al., 2022; Parshetti et al., 2023]. [14, 28, 33]
- **Advanced Processing (Theoretical):** Exploration of catalytic graphitization, hydrothermal carbonization, or exfoliation techniques to potentially yield nanosheet-like or more ordered graphitic structures from hemp precursors.

Each produced **CARBON** type would require thorough characterization (SEM, TEM, BET, Raman, XRD, elemental analysis).

5.2 Hemp Oil Matrix (Theoretical Considerations)

Cold-pressed hemp seed oil is the proposed binder. Its curing behavior (oxidative, thermal, potentially aided by natural, sustainable siccatives if absolutely necessary, though pure thermal/oxidative curing is preferred for strict binary adherence) needs to be understood to ensure it effectively binds the dense **CARBON** network without degrading the **CARBON**s.

5.3 Fabrication of "THE BLOB": A Test of Maximal CARBON Saturation

The initial empirical test, termed "THE BLOB," involves:

1. Incrementally adding a chosen hemp-derived **CARBON** (e.g., a basic biochar) to a known quantity of hemp oil under high-shear mixing.
2. Continuing addition until the mixture reaches a rheological limit – a thick, self-supporting paste or moldable putty where the oil appears saturated with **CARBON**. The **CARBON** content (wt%) at this point is a key metric.
3. Transferring this **CARBON**-saturated mass to a mold.
4. Curing the mass (e.g., thermally) to form a solid composite.
5. Basic assessment: physical integrity, density, hardness, SEM of fracture surfaces.

This validates the ultra-high loading concept and establishes baseline processability.

5.4 Target Materials for Advanced Seshat's Composites (The Vision for Programmed CARBON Phases)

Subsequent theoretical work, and eventual experimentation, will focus on "programming" the **CARBON** phase:

- **Structural Composites:** Blends of fibrous and platelet-like **CARBON**s for high mechanical strength and stiffness, aiming for "carbon beam" like properties.
- **Conductive Composites:** High loadings of graphitic **CARBON**s and nanosheets to achieve high electrical and thermal conductivity for EMI shielding, thermal management, or conductive elements [Tapas et al., 2022; Lin et al., 2021]. [9, 22]
- **Functional Electronic Materials:** Tailored combinations of semiconducting biochars, graphitic **CARBON**s, and potentially activated **CARBON**s to explore resistive switching for memory devices [Chai et al., 2009; Sebastian et al., 2021] or other sensoric applications. [6, 39]

6 Purely Theoretical Performance Projections for Advanced Seshat's Composites

All projections are speculative and await empirical validation. They are based on the premise of achieving a well-bonded, ultra-high-loading, intelligently designed **CARBON** network.

6.1 Mechanical Properties (Leveraging CARBON Dominance)

With ¿70 wt% **CARBON**, forming a continuous network, mechanical properties are theorized to be dominated by the **CARBON** phase. This could lead to:

- **High Strength and Stiffness:** Potentially approaching properties of some conventional carbon fiber composites, especially if hemp-derived fibrous or sheet-like carbons are effectively incorporated and aligned [Lee et al., 2008]. [32]
- **Excellent Strength-to-Weight Ratios:** Due to the low density of **CARBON** and minimal (denser) oil.

6.2 Thermal and Electrical Properties (Exploiting CARBON Networks)

- **Tunable Electrical Conductivity:** From anti-static to highly conductive, based on the percolation and intrinsic conductivity of the chosen **CARBON** allotropes (e.g., graphitic carbons) [Geim Novoselov, 2007; Kumar et al., 2023]. [1, 29, 30]

- **Enhanced Thermal Conductivity:** For applications requiring heat dissipation, or potentially tailored for insulation with porous **CARBON** structures [Balandin et al., 2008]. [32]

6.3 Potential for Functional Devices (e.g., Electronic Memory)

The strategic combination of semiconducting and conducting hemp-**CARBON**s within the hemp oil binder could theoretically lead to interfaces exhibiting resistive switching behavior, a known mechanism for non-volatile memory devices [Waser Aono, 2007; Zhao et al., 2024]. [44, 48, 49] The "programmability" of the **CARBON** phase is key to tuning these electronic responses.

7 Discussion: The Paradigm of Programmable, CARBON-Dominant, Sustainable Composites

7.1 Advantages of the Optimized Binary, High-CARBON Approach

The Seshat's Composites framework offers several theoretical advantages:

- **Performance through CARBON Dominance:** Properties are driven by the **CARBON** network, not just augmented by fillers.

- **Sustainability and Cost-Effectiveness:** Utilizes abundant, renewable hemp and potentially low-cost **CARBON** production methods [Barbhuiya Das, 2022; Amaducci et al., 2022]. [37, 38, 41, 43]

- **Tunability:** "Programming" the **CARBON** phase allows for a wide range of tailored functionalities from a common material platform.

- **Simplicity:** The binary system simplifies processing and interfacial chemistry challenges compared to multi-component systems.

7.2 Theoretical Superiority and Potential Disruptions

Compared to traditional composites with low filler loadings (e.g., 1-5 wt% graphene in epoxy [Lodh Gadhave, 2024; Atif et al., 2019]), Seshat's Composites, with ¿50-70 wt% **CARBON**, represent a fundamentally different material class. [2, 15, 23, 36, 46] The properties are not merely enhanced by the additive but are defined by it. This could disrupt applications requiring high structural performance, integrated electronic functions, and sustainable material solutions simultaneously. The exclusion of petroleum-based polymers and complex binders like lignin further enhances its unique positioning.

7.3 Current Status (Purely Theoretical) and The Path to Validation

The *Seshat's Composites* framework is, as of May 21, 2025, a highly developed theoretical construct by Marie Seshat Landry. It is based on established material science principles but requires comprehensive empirical validation. The immediate next step is the fabrication and rigorous assessment of "THE BLOB" concept to prove the feasibility of ultra-high **CARBON** saturation in hemp oil. Success here will pave the way for exploring the "programmable" aspects of the **CARBON** phase.

8 Conclusion: Seshat's Composites – The Theoretical Path to Programmable, CARBON-Dominant Organic Materials

Seshat's Composites, conceptualized by Marie Seshat Landry, represent an optimized binary theoretical platform comprising a minimal hemp oil binder and a dominant, "programmable" phase of diverse hemp-derived **CARBON** allotropes (targeting ¿50-70 wt%). This framework is a deliberate evolution towards creating carbon-dominant organic materials, theorized to offer superior, tunable performance by leveraging the intrinsic properties of a densely packed, intelligently designed **CARBON** network. This approach aims to achieve an unparalleled combination of high performance (mechanical, thermal, electronic), sustainability, and cost-effectiveness, potentially enabling applications from high-strength structural components to functional electronic devices like organic memory. Experimental validation of the core tenets, beginning with the "THE BLOB" high-saturation concept, is paramount to transform this advanced theoretical vision into a tangible reality and contribute to the **Organic Revolution of 2030**.

Author Contributions

M.S.L. (Marie Seshat Landry, Citizen Scientist and CEO) conceptualized the invention, designed the entire theoretical framework and experimental plan, and wrote the manuscript.

Competing Interests

Marie Seshat Landry, Citizen Scientist and CEO, is the conceptualizer of *Seshat's Composites* and is affiliated with Landry Industries, which intends to pursue research and potential commercialization of this technology if experimentally validated.

Data Availability Statement

This manuscript presents a purely theoretical framework. No new experimental data were generated. Any data used for analogies are drawn from cited, publicly available literature. Future experimental data resulting from this framework will be made available according to open science principles, where appropriate.

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