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Application of Biochar as Carbon Sequestering and Beneficial Additive in Concrete

Abstract.

North American biochar production ranges from 36,700 to 76,600 tons per year. The biochar industry in Nebraska and the US is nascent but growing with markets in agriculture, animal husbandry, composting, and water filtration. The development of a new materials market for biochar would have a substantial impact on the market, providing an outlet for untapped wood resources. The proposed work is targeting an innovative usage of biochar in concrete, which is the most used manmade material in the world, with approximately 10 billion tons of annual production. Besides potential technical benefits, including the nucleus and internal curing effects that could improve concrete strength and durability, the preliminary study demonstrated that additional CO₂ could be stored inside biochar with treatment before being applied in the concrete. The interdisciplinary research team, which is composed of experts in Civil Engineering, Forest, and industry partners, is to conduct a comprehensive study to justify the feasibility and marketability of using biochar as a high-value additive to produce concrete. The proposed work composes of biochar selection and process, CO₂ treatment, concrete mix development and performance evaluation, and economic and environmental benefit analysis. The proposed two-phase approach, with Phase 1 (Year 1) focuses on the lab-scale study, and Phase 2 (Year 2) focuses on the field-scale study, and industrial applicability and marketability analysis is targeting an industrial-ready approach that can realize the approach in industry setup. In addition to the carbon sequestration and storage markets/credits from the inclusion of biochar in concrete, due to the tremendous amount of potential concrete usage, the success of the project could significantly broaden the application and usage of biochar. The beneficial use of biochar in concrete will also provide a safer and more sustainable infrastructural system.