International Research Journal of Engineering Science, Technology and Innovation Vol. 8(6) pp. 1-3, December, 2022
Available online http://www.interesjournals.org/IRJESTI

Editorial

In Vivo Soil Engineering: Utilizing Natural Biogeochemical Systems to Create Multi-Purpose Long-Lasting Engineering Solutions

Richard Adrian*

Department of Civil and Environmental Engineering Egypt

*Corresponding Author's E-mail: Richard_a@gmail.com

Received: 08-Dec-2022; Manuscript No: irjesti-22-83467; **Editor assigned:** 10-Dec-2022; Pre-QC No: irjesti-22-83467 (PQ); **Reviewed:** 15-Dec-2022; QC No: irjesti-22-83467; **Revised:** 24-Dec-2022; Manuscript No: irjesti-22-83467 (R); **Published:** 30-Dec-2022, DOI: 10.14303/2315-5663.2022.88

Abstract

These issues of the twenty-first century—global warming, carbon sequestration, rehabilitating infrastructure, cleaning up brownfields, disposing of hazardous waste, protecting water resources, and protecting against carbon sequestration—cannot be addressed by merely tweaking or optimizing these processes. A more extremist, comprehensive methodology is expected to foster the reasonable arrangements society needs. The majority of the problems listed above are caused, supported, enabled, or grown by soil. Contrary to conventional civil engineering thinking, soil is a living system that supports multiple concurrent processes. This paper proposes that "soil engineering in vivo," in which the natural capacity of soil as a living ecosystem is used to provide multiple solutions simultaneously, may provide novel, creative, and long-term solutions to some of the major issues facing the 21st century. To provide multifunctional civil and environmental engineering designs for the soil environment, this necessitates a multidisciplinary perspective that incorporates the sciences of biology, chemistry, and physics. For instance, is it possible for native soil bacterial species to moderate the carbonate cycle in soils in such a way that they can simultaneously solidify liquefiable soil, immobilize reactive heavy metals, and sequester carbon—thereby effectively providing civil engineering functionality while also clarifying the ground water and removing carbon from the atmosphere? In recent years, serious exploration of these concepts has been initiated.

Keywords: Bioengineering, Bio-mediated soil improvement, Sustainability, Microbial induced calcite precipitation, Bio soil, Ground improvement

INTRODUCTION

The challenges of the twenty-first century—such as carbon sequestration, the rehabilitation of infrastructure, the clean-up of brownfields, the disposal of hazardous waste, the protection of water resources, and global warming—are too vast, complicated, and intertwined to be addressed through the high-energy consumption practices that characterize industry today (Renforth P, 2009). The majority of the aforementioned difficulties arise within, are supported by, are enabled by, or are grown from soil, making brute force engineering at the required scale impossible. The total amount of resources required for their implementation is also unavailable (Manning DAC, 2008). Soil is viewed from a conventional perspective as an infinite resource made up of distinct, in fact distinct functions. The deformation and strength of soil are taken into account in geotechnical engineering; Environmental engineering takes into account soil contaminants; the suitability of a substance for plant growth and crop productivity is taken into account in plant science. The gravity of the situation is becoming apparent (Fujita Y, 2000). Soil is a limited resource that requires our stewardship. In some first-world practices, sustainability ideas and planning for soil reuse are being implemented. New development is considered in contrast to carbon impression energy proficiency and absolute life-cycle examination measures (Dupraz S, 2009). Sadly, the "savings" gained from these reforms continue to outpace the demands of the expanding global population, accelerating consumption. There must be a more radical, all-encompassing strategy For instance, is it possible for native soil bacterial species to moderate the carbonate cycle in soils in such a way that they can simultaneously solidify liquefiable soil, immobilize reactive heavy metals, and sequester carbon—thereby effectively providing civil engineering functionality while also clarifying the ground water and removing carbon from the atmosphere? This paper focuses on one biogeochemical function of soil that has shown promise and is rapidly developing, highlights the potential, challenges, and opportunities of this new field, and proposes a generalized approach in which the potential of this new field can be fully realized (Ferris FG, 2004).

Thinking about the possibilities

Dreams of the potential are arising more quickly than specialized capacities. Green Wall Sahara is an anti-desertification project that aims to stabilize a 6000-kilometer stretch of sand dunes in northern Africa. Desertification threatens one quarter of the world's landmass, which is home to more than one billion people across countries (Thullner M, 2008). Specifically, the M. concept cannot be realized with conventional concrete-and-chemical-based soil-solidification methods; however, stimulating and harnessing a natural process that is inherent to living soil—like the bio-mediated calcification process discussed in this article—may bring about this dream Near plant root exudates in highly alkaline soil, biologically assisted carbon sequestration facilitated by pedogenic carbonate precipitation may be an untapped naturally occurring reservoir ready to address this global problem (Ivanov V, 2008). Through their roots and the mycorrhizal fungal associations that are associated with them, plants expel 10–30 percent of the carbon that has been captured from the atmosphere through photosynthesis. Any compound in the root tissue might be delivered into the dirt as an exudate consequently root exudates are a complicated material made out of polysaccharides, proteins, phospholipids, cells that isolate from the outside layers of the root and numerous different mixtures (Mitchell JK, 2005). Particularly interesting are resorbed CO2 and organic acid anions, which can react with calcium-rich silicates in soils and naturally decompose. Others have documented that this natural process takes place in brownfields soils. About 10% of the world's carbon emissions are the result of the production of cement and iron and steel. Recycled concrete and furnace slag could be mixed into soils used for non-food crops and urban re-vegetation to re-sequester some of this carbon, as proposed.

CONCLUSIONS

The extensive use of energy in twentieth-century treatment methods cannot address society's most pressing civil and environmental issues (Fatahi B, 2010). There is a need for new sustainable solutions. An emerging interdisciplinary approach that recognizes soil as a living, active system with the potential to provide sustainable solutions is called "soil engineering in vivo," and this paper proposes that it might be one of them. The potential uses are numerous and extensive, ranging from desertification prevention measures for northern Africa to reducing foundation building liquefaction settlement. Several biogeochemical systems are proposed to be capable of simultaneously providing multi-functional solutions, despite the fact that most of the applications investigated thus far have focused on single-function solutions Immobilization of heavy metals, atmospheric carbon sequestration, and improvements to mechanical and hydraulic soil properties are all potential applications for MICP, which has rapidly matured toward field implementation (Loades KW, 2010). Understanding and controlling MICP across all length scales has significantly improved thanks to advances in experimental and numerical modelling, as well as real-time process monitoring. The emerging sustainability criterion must be met before MICP and similar processes can be realized as field-scale multi-functional solutions. This necessitates a significant shift in the way science and engineering is carried out. Huge extra innovative work is required to give arrangements inside the regular ecological that depend on first standards. Assessment of subsurface ecosystems and their interaction with the fluids and minerals that are available, as well as mapping and modelling of subsurface variability in pore structure, mineralogy, ground water flow and transport, and bacterial diversity, are the primary obstacles in this field.

REFERENCES

1. Renforth P, Manning DAC, Lopez-Capel E (2009). Carbonate precipitation in artificial soils as a sink for atmospheric carbon dioxide. Appl Geochem. 24: 1757–1764.
2. Manning DAC (2008). Biological enhancement of soil carbonates precipitation: passive removal of atmospheric CO2. Mineralog Mag. 72: 639–649.
3. Fujita Y, Ferris FG, Lawson RD, Colwell FS, Smith RW (2000). Calcium carbonate precipitation by ureolytic subsurface bacteria. Geomicrobiol J. 17: 305–318.
4. Dupraz S, Parmentier M, Ménez B, Guyot F (2009). Experimental and numerical modeling of bacterially induced pH increase and calcite precipitation in saline aquifers. Chem Geol. 265: 44–53.
5. Ferris FG, Phoenix V, Fujita Y, Smith RW (2004). Kinetics of calcite precipitation induced by ureolytic bacteria at 10 to 20°C in artificial groundwater. Geochim Cosmochim Acta. 68: 1701–1710.
6. Thullner M, Baveye P (2008). Computational pore network modeling of the influence of biofilm permeability on bioclogging in porous media. Biotechnol. Bioeng. 99: 1337–1351.
7. Ivanov V, Chu J (2008). Applications of microorganisms to geotechnical engineering for bioclogging and biocementation of soil in situ. Rev Environ Sci. Biotechnol. 7: 139–153.
8. Mitchell JK, Santamarina JC (2005). Biological considerations in geotechnical engineering. ASCE J Geotech Geoenviron Eng. 131: 1222–1233.

9. Fatahi B, Khabbaz H, Indraratna B (2010). Bioengineering ground improvement considering root water uptake model. Ecol Eng. 36: 222–229.

10. Loades KW, Bengough AG, Bransby MF, Hallett PD (2010). Planting density influence on fibrous root reinforcement of soils. Ecol Eng. 36: 276–284.