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Effects of Different Bio-Chars on the Seed Fermentation and Planting in Vegetation Porous Concrete for Sustainable Ecosystem.

D. Vishwak Sena [a], B. Kusuma Kumari [b], Ch. Verra Nagababu [c], G. Sharath Kumar [d], B. Amar Santosh [e]

[a,b,c,d,e] *UG Students, Department of civil Engineering, GMR Institute of Technology, Vizianagaram District, A.P, India*

ABSTRACT:

Vegetation concrete is an effective material to improve the landscape, reduce pollution and protect the environment. To further improve the plant compatibility of vegetation concrete, our project recommends an improved method of adding biochar particles to vegetation concrete. In this experimental investigation, different masses of biochar were mixed into concrete to study the trend in mechanical properties, average grass heights, root development lengths and leaves relative water content. Wheat grass was planted over the Vegetation concrete in our project; it shows rapid and better growth. As the content of biochar increased, the porosity and permeability coefficient of vegetation concrete continued to decrease, while the effect of biochar on plant growth promotion at first showed an increase to maximum and then a gradual decrease. When the biochar content was 15 kg/m^3, wheat grass showed the best growth. With addition of biochar 15 kg/m^3 the compressive strength also increased slightly and also shows a good improvement of water infiltration through the vegetation concrete. Therefore, adding a 15 kg/m^3 amount of biochar can improve the characteristics of vegetation concrete.

Keywords: Vegetation concrete, potential of hydrogen, landscape, biochar, average grass heights, compressive strength, infiltration

INTRODUCTION:

The rapid development of infrastructure neither in the valley nor in the hilly leaving bare slope that is highly susceptible to water runoff and soil erosion and have possibility for shallow landslides. Particularly, the storm water runoff during the monsoon season, adversely affect the slope and its surroundings. Numerous approaches have been developed to negate these unfavourable effects as a form of slope protection. Through the slope protection methods includes vegetation, wire mesh, Geo textiles, Soil stabilizing agents both organic and inorganic are stabilized the slope effectively, Which are primarily involved using concrete including shotcrete method, pre cast, masonry and they may not provide sustainable resisting forces to the slope as anchoring and retaining structures. Because the inorganic methods are highly expensive, these methods are typically designed to satisfy the functional purposes achieving stability based on geotechnical investigations. The most favourable and eco-friendly techniques to prevent a runoff on a slope is to vegetate it. The progressiveness and the effectiveness of vegetation on slope protection have been documented, through; soils are vulnerable to storm water. It is well documented that the surface drainage can commendably inhibit the slopes from the heavy runoff. The soil-cement cover is a common and effective surface drainage method, through; the growing vegetation on the surface drainage method, through; the growing vegetation on the surface of the cover limits the viability of the method. As remedy, porous concrete which also referred to previous concrete by encouraging infiltration of storm water runoff. In addition, the utilization of previous concrete reduce the erosion, deviate the water flow pattern and improve the groundwater level recharge as well. By combining traditional concrete technology with horticulture influence, the new type of concrete named vegetation concrete (VC) evolved very recently. VC integrates vegetation and porous concrete medium in which water, air, soil and roots itself through the porous concrete frame and into the underlying soil strata. The fundamental intent of this investigation is to utilize the porous concrete to provide immediate slope protection whilst also facilitating the growth of beneficial surface vegetation. Through, few researchers were explored the effectiveness of VC severely limited its application. The pH value of planting concrete cannot be too high for plants growing. The appropriate pH values suitable for plants growing were between 8 and 10. The alkalinity of VC mainly came from the hydration phase of cement and the PH value of hydrated Portland cement was up to 13, making it inappropriate for planting concrete. So Portland cement cannot be simply used to make planting concrete. Biochar in VC to improve the mechanical properties of concrete and to improve the plant growth. Biochar is a type of refractory fine granular charcoal generated by pyrolysis of vegetation or waste materials. Compared with activated carbon, biochar is not only more prominent in improving soil properties as a soil conditioner but also more economical and practical in terms of environmental impact and cost. The test results M. Zhao et al, were revealed that incorporation of biochar improved the plant growth and strength properties of the concrete.

Plenty of researches indicated that application of biochar as an amendment has the beneficial effects of improving soil fertility, which refers to the ability of soil to promote agricultural plant growth. Its well-developed pore structure, large specific surface area and high physical biological stability allow biochar to charge the physical, chemical and biological properties of soil within the plant root zone. In acidic soil, biochar has an obvious effect on increasing crop yield and improving soil properties, while it also has a promotion effect on the growth of crops in alkaline soil, it is not as obvious as seen in acidic soil. In recent years, there has been increased interest in research related to the absorption of heavy metals and organic pollutants by biochar. Mohamed combined K_3PO_4 and plagioclase with biomass to reduce the plant toxicity and plant absorption of heavy metals. Kasak and Gupta et al added ligneous biochar to artificially treated wetlands, which not only improved the efficiency of wastewater treatment but also promoted the development of organisms. The application of biochar in other building materials has also shown positive results. For example, as a modifier for asphalt cement, biochar has improved anti-aging performance and relieved temperature sensitivity.

Since the incorporation of Supplementary Cementitious Materials (SCMs) in cement reduced the alkalinity properties of the Portland cement and the utilization biochar promote the agricultural plant growth in concrete , the main objective of this research is to develop the VC using slag cement with the various incorporation of biochar. Slag cement received from the local market was used in the study to prepare VC. Further the VC was incorporated with biochar ranging from 0 to 10% with the increment of 2%. Furthermore, since the coarse aggregate size significantly influenced the porous of the previous concrete, the coarse aggregate size ratio of 1 was followed in the present study. To enhance the strength of the porous vegetation concrete a small amount of river sand has been added to the concrete. Still the development of vegetation concrete is in infant stage, Indian native grass species was considered in this study for concrete integration. Accordingly, the present only investigated the growth characteristic includes plant height and roots length/development of Perennial Ryegrass on the porous concrete.

LITERATURE REVIEW:

1) Effects of concrete content on seed germination and seedling establishment in vegetation concrete matrix in slope restoration F. Chen, Y. Xu, C. Wang, J. Ma0

In this paper they study about the Vegetation Concrete Base Spraying technique (VCBS) is an ecological slope restoration technique to strengthen slope stability and restore slope vegetation in the meantime. They conducted experiments with various concentrations of concrete content in vegetation concrete matrices to test the effect of concrete content on seed germination and seedling establishment for three pioneer species, Festuca arundinacea, Magnolia multiflora and Medicago sativa. They mainly focus on Variations in seed germination, seedling survival and seedling growth were monitored. The experimental results showed that the concrete content had significant effects on seed germination, seedling survival and growth of all three species. Seed germination of F. arundinacea and M. sativa decreased with increased concrete content. With 0% concrete, F. arundinacea achieved a germination rate of 72.2%, and 46.6% for M. sativa. At 16% concrete content, germination of F. arundinacea decreased to 27.4%, and to 41.3% for M. sativa. Germination of M. multiflora seeds increased slightly when concrete content increased to 4%, and achieved the highest germination rate of 77.0% with 4% concrete content, while its germination rate decreased when concrete content increased from 4 to 16%. Seeding survival of F. arundinacea and M. sativa increased as the concrete content increased from 0 to 8%, while decreased when concrete content increased further to 16%. F. arundinacea achieved a seedling survival rate of 51.9%, and 32.9% for M. sativa, with concrete content at 8%. In contrast, survival of M. multiflora seedlings decreased continually with the increase of concrete content, and its survival decreased to 41.1%, compared with the highest survival 81.2% with 0% concrete in the pot soil mix. Root length, root surface area, average root diameter and root volume of seedlings of the three species increased as concrete content increased from 0 to 8%, while it decreased when concrete content increased higher from 8 to 16%. The leaf number, plant height, aboveground biomass, belowground biomass and root length, root crossing number of plants all increased with increased concrete content between the range of 0-8%, but decreased significantly when concrete content was over 8%. Finally they concluded that 8% concrete content in the vegetation concrete matrix is appropriate in terms of seed germination.

2) **Experimental study on the vegetation characteristics of biochar-modified vegetation concrete Min Zhao, Yinghui Jis, Linjuan Yuan, Jing Qiu, Chao Xie**

In this paper they study about the further improvement of the plant compatibility of vegetation concrete, it recommends an improved method of adding biochar particles to vegetation concrete. In this research, different masses of biochar were mixed into concrete to study the trend in porosity, permeability and plant compatibility. They planted the three types species(ryegrass, tall fescue and Bermuda grass) on the vegetation concrete and observed the plant height, root length, germination rate& germination time. 27.7% of porosity & 16.3mm/s permeability coefficient were obtained with 0 kg/m^3biochar content, as the content of biochar increased, the porosity and permeability coefficient of vegetation concrete continued to decrease, maximum compressive strength of 21.25Mpa was obtained at 20kg/m' biochar addition into the concrete, with increase in biochar content the mechanical properties were increased. The biochar content of 5kg/m^3 shows the germination rate of 84%, plant height of 19.8cm & root length of 9.2cm these are the as maximum of all test results, while the effect of biochar on plant growth promotion at first showed an increase to the maximum and then a gradual decrease. When the biochar content was 5 kg/m3, ryegrass showed the best growth. The optimal mix proportion of biochar-modified vegetation concrete was recommended with a biochar content of 5 kg/m3 and suitable porosity of 24,9%.

3**) Influence of plantation on microbial community in porous concrete treating polluted surface water Yan Long, Yongxin Bing, Zhengke Zhang, Kai Cui, Xiaokang Pan, Xiongfeng Yan Bingxin Li, Shuguang Xie, Qingwei Guo**

In this paper they investigated the influences of plantation and plant species on bacterial and archaeal communities in porous concrete unit treating polluted river water. The microbial richness, diversity and structure in porous concrete system treating river water were influenced by both plantation and plant species type. Bacteria had higher community richness and diversity than Archaea. Proteobacteria was the dominant bacterial group, while Thaumarchaeota consisted of a considerable proportion in archaeal community.

4) **Effects of Concrete Content in Vegetation Concrete Matrix on Seed Germination and Seeding Establishment of Cynodondactylon Yang XU, Fangqing Chen**

In this paper they study about the association between concrete content, seed germination, and seedling establishment, measured changes in germination rate, survival rate, plant height, leaf number, and related root growth parameters under various percentages of concrete. One of the three warm-season turf grasses in the globe is Cynodondactylon. It has low height, thin texture, good propagation capacity, wide distribution range, and strong resistance, among other characteristics. The species is especially useful for slope restoration, as its well-developed root system may create a criss-cross network that helps to support and protect the slope. The range of concrete content from 0 to 8% enhanced good plant growth indices such as stem height, leaf number, seedling biomass and root length, root surface area, and root crossing number. Seed germination was improved by the low concrete content (8%).

Table 1 Basic properties of perennial wheat grass

S.no	PROPERTIES	
1	Life expectancy	**Perennial**
2	Average mature height	**300 to 600**
3	Season	**Cold and warm**
4	Preferred soil type	**Alluvial and red, sandy to heavy clay**
5	Other tolerance	**Good cold tolerances, heat and drought tolerance**

Table 2 Details of mix proportion

S.NO	MATERIAL	1(kg/m^3)	2(kg/m^3)	3(kg/m^3)	4(kg/^3)
1	Cement	300	300	300	300
2	Water	130	140	143	145
3	Coarse Aggregate	1520	1520	1520	1520
4	Bio Char	0	5	10	15
5	Fine Aggregate	40	40	40	40

Table 3 Grass height and root development length observation

S.NO	DAYS	AVERAGE GRASS HEIGHT	ROOT DEVELOPMENT LENGTH
1	7	150	120
2	15	220	140
3	28	500	160

Figure 1 Vegetation concrete blocks with different biochar contents

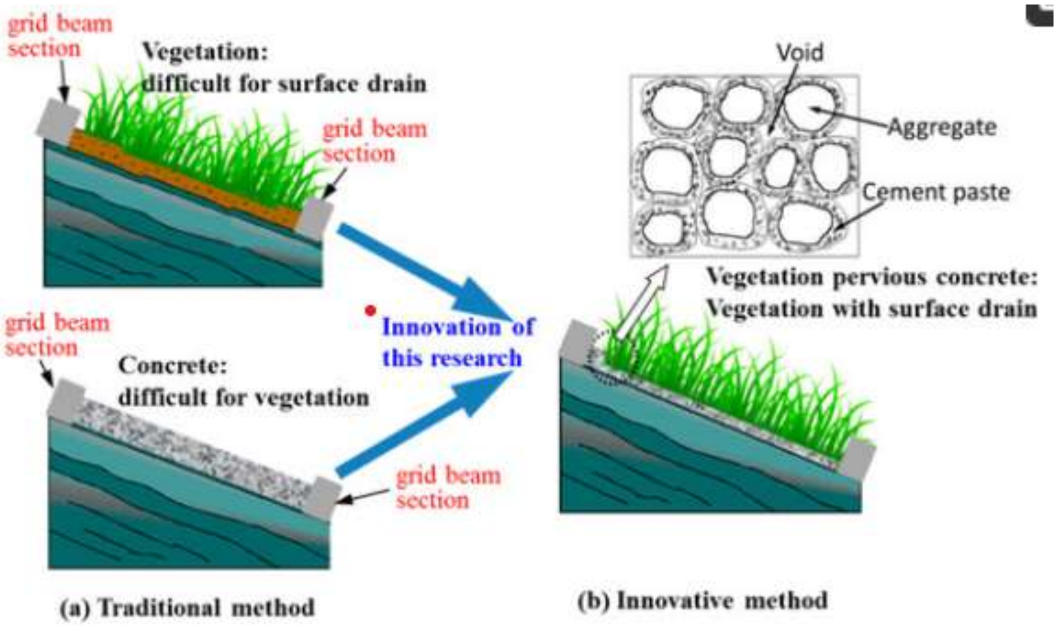

Figure 2 Functions of pervious concrete for earth flow preven

CONCLUSION:

The optimum compressive strength for the addition of 15 kg/m^3 biochar is around 25 N/mm^2 after 28 days respectively in the Vegetation concrete. The average grass height & root development lengths were obtained as 500 mm & 160 mm after 28 days respectively, it was concluded that grass have a excellent growth over the vegetation concrete. Finally, we concluded that the addition of biochar 15 kg/m^3 in the vegetation concrete will improve the mechanical strength, vegetation growth.

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