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Biochar Production and Uses

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Opinion

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The Biochar wonders have been known for over the las decade for its many applications in climate change, food security, renewable energy and waste management.

Biochar is carbon rich charcoal produced through thermal pyrolysis (300-700 c) of biomass (organic matters) under little or zero oxygen conditions. The process is similar to backing rather than burning or incinerating, that's why it also produces mixture of organic gaseous (syngas) and liquid fraction called "wood vinegar" as by-products. The main solid product Biochar has tremendous porous and surface structure which provides great habitant for microorganisms, increases bioavailability, and great reservoir for water nutrients and pollutants which are expected to take hundreds of years to biodegrade. Plantation over Biochar as soil amendment not only increases the rate and size of growth, it also provides an effective carbon sink for sequestering atmospheric carbon dioxide through the leaves, and bio-accumulates the heavy metals from soil (Phytoremediation) via the routes. The syngas is used as energy and the wood vinegar as value added by-products **(Figure 1).**

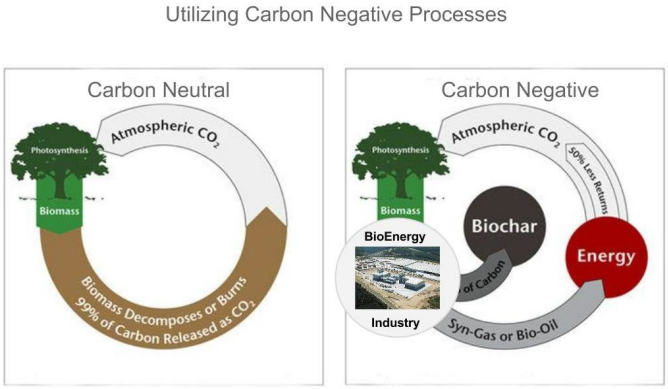

Figure 1. Utilizing carbon negative processes

Other Benefits: Biochar also reduces the risk of crop yields during dry seasons/draughts, filters out contaminants from shallow soil water, reduces the need for chemical fertilizers containing nitrogen and phosphorus, removes heavy metals and acids from abandoned mines ponds, bind toxins and prevent their leaching into surface and ground water, facilitates the reestablishment of vegetation on typically sterile ground, inhibits the growth of molds or mildews, retains nitrogen and sulfurs in soil , and reducing emissions of nitrogen oxide and sulfur oxides into the atmosphere (greenhouse effect reduction), and odor control, etc. **(Figure 2).**

The feedstock (biomass) to make biochar are abundant, including but not limited to most carbon waste streams from agriculture, forestry, urban sources, farm wastes, livestock remains, human wastes, food wastes, and all municipal's compostable wastes. They are all low-value materials with limited use and high disposal or landfilling costs.

Biochar production in farms by basic in-house methods and some commercial scale pyrolyzers are currently underway worldwide. In B.C, Canada has built a mobile batch kiln unit from recycled machinery parts which is capable of producing biochar

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from all kinds of farm wastes and utilizing it as soil amendment for crop production and for phytoremediation by planting hybrid poplar trees atop of capped decommissioned landfills or tailing ponds **(Figures 3 and 4).**

Figure 2. sustainable carbon neutral and negative economic models.

Figure 3. PRSI's mobile pyrolyzer unit.

Figure 4. Typical landfill site with leachate pond and plantation.

So far, all the Biochar producers are inconsonantly producing variety of Biochar derivatives with different properties depending on the feedstock, pyrolysis condition, residence time, and additives added. Therefore, standardization and classification of Biochar types are required if to be marketed for public uses. Such regulatory initiatives are already underway through many local and international organizations.

For in-house uses biochar can be produced and used right on the site of it production, for example famers produce Biochar from any and all kinds of organic wastes they have and utilize it right on their site as soil amendment for better plantation and as carbon snick and receive carbon credit. Similarly, the Municipalities can segregate all their organic wastes from other no organics and pry lysis them on-site and the resulting Biochar can be used as filtering medium for effluent lagoons remediation, etc. The effluent can also be used as irrigation for Biochar snick sites in their adjacent farms or use over capped landfill sites.

Unlike composting, it's obvious to expect that the fresh Biochar produced at high temperatures will be completely dehydrated and will have nothing but pure black spongy carbon, with little or no nutrients and microorganisms left in it. Therefore, typically upon discharge of fresh biochar from the pyrolyzer water is sprayed on to a desired level, and then depending on the planned use other additives can be added. For example for use ad filtering medium (like activated carbon), no additives is required, but for use as soil amendment for agricultural use one must add nutrients. Currently, a European organization have documented that mixing the compost material with biochar produces even better filterer that compost and biochar separately. This combination provides nutrients and habitant and surface for plants route to grow faster and stronger and the land use fertilization is increased to its fullest potential, **(Figure 5).**

Also, converting sewage sludge to syngas and biochar is currently underway in small municipalities in Europe in response

to high cost of sludge management (treatment, storage, transport), Typically the sludge is first dewatered and then use a slow pyrolysis to thermos-chemically convert it into synthetic gas and biochar. The syngas is then used as energy (heat and electricity) for the process. This biochar produced from municipal sludge most likely contain limited amount of heavy metals compared to sludge from other industries, which is used in land spreading.

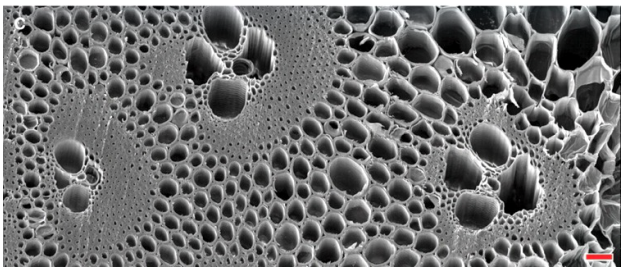

Figure 5. Microscopic Image of Biochar.

Another encouraging community concept of managing bio-wastes is the Town of Drayton Valley in Alberta, Canada, the home of the Bio-Mile, an Initiative to Create a Sustainable Economy, The Bio-Mile Concept is an integrated bio-industrial park specializing in the conversion and bio-refining of bio-mass into bio-energy, bio-chemicals, and bio-fuels. Creating value from waste fiber "one company's waste is another company's feedstock", with strategic alliance of companies and academics working in synergy with the end goal facilitating the opportunity.

NEW TREND FOR BIOCHAR PRODUCTION BY MICROWAVE

In the last few years there have been some R&D activities within the bio-energy scientific community around the globe related to the use of Microwave radiation instead of thermal energy to convert biomass into biochar. A promising industrial scale development by a Zealand company, Carbon Scape Inc. (www. carbonscape.com) is claiming producing refined Biochar from variety of biomasses at much lower energy requirements, cleaner and faster than pyrolysis. This approach may replace the thermal uses but the other factors such compatibility, applications and costs in comparison by pyrolysis methods may just create a completely different market by itself.

CONCLUSION

Sustainable biochar is one of the few climate mitigation and soil enhancement technologies that is relatively inexpensive, widely applicable, and quickly scalable

There is a strong need for small municipalities to recycle their increasing amounts of sewage sledges and solid wastes in a sustainable ways. Conversion of all municipal organic wastes into bio-products (bio-fuels, bio-char, etc.) is highly feasible and is both sustainable and renewable. Biochar production and utilization requires designed processes to tailor for each community. Different Biochars with different chemical/physical properties are produced depending upon the initial feedstock and the pyrolysis conditions. Therefore, the end use of biochar is at its minimum a soil amendment right on the municipal sites (or as cap atop of landfills) in order to create green plantation and sequester carbon dioxide emission. It seems inevitable to see each municipality built its own pyrolyzer kiln (or may be microwave oven) and start converting organic wastes into valuable products and save the planet earth from climate change disasters.