BIOCHAR CASE STUDY

Improving Council Tree Planting with Biochar - Dubbo Regional Council

Tree planting in urban streets can be a challenge for local municipalities across Australia. The trees are often grown in high traffic and pedestrian areas among hard surfaces. In addition, the trees must coexist with underground utilities, stormwater drains and other infrastructure including concrete kerbs and channelling. Water use is also an issue when trying to establish new plantings or managing older trees, especially with persistent drought conditions

Ideally, the method of tree planting used should incorporate stormwater management and reuse all available naturally occurring water resources in the growing substrate.

Overview of the Council's Experience

Dubbo Regional Council in central NSW has successfully implemented the innovative structural rock pit method[1] to address the challenges outlined above. This method involves creating a planting pit for the tree's rooting area and filling with rock matrix, biochar and compost.

Ian McAlister, Manager Recreation and Open Space at the Council explains, "In October 2015 we started using a combination of rock, biochar and compost for tree planting. This met both our structural and root zone requirements while being cost effective due to the use of waste materials and reduced labour costs during planting."

The Council also found that with biochar's moisture-holding capacity, the tree watering rate was less than one-third of what it had been traditionally, when establishing advanced tree plantings. With Dubbo's harsh environment there is excessive heat reflection from bitumen and concrete, further contributing to the city's summer heat island effect.

Tree Planting Progression

Five years ago, Dubbo Regional Council progressed from small tree ring planting pits to using structural plastic cells. This led to a big improvement in providing a large tree root zone and promoting tree growth. The benefits of the structural plastic cells included better support for traffic loads and the soil remained permeable due to the structural matrix of the cells, allowing for good root growth.

"Even so, when Craig Hallam at ENSPEC made the Council aware of the structural rock pit method we were keen to try it," said Ian. "The Council is proactive in investigating new technologies and planting methodologies as part of its continuous improvement plan in improving the public urban forest of Dubbo," he added.

[1] Patent application No. 2017903473 - Traffic Load Bearing Structure

Council's Implementation of the Structural Rock Pit Method

When planting trees using the structural rock pit method, Dubbo Council uses the ENSPEC blend of 50 percent rock matrix, 35 percent biochar and 15 percent compost. The diameter of the rocks vary from around 7cm to 15cm. This blend is applied in 30cm layers with a vibrating roller used to ensure the rock matrix interlocks. Once installed correctly this rock matrix is extremely stable and resists subsidence. It also has an unlimited lifespan due to the materials being utilised.

As Ian explains, "It is important to ensure that the biochar and compost do not separate the rocks. The vibrating roller also helps reduce the potential of large air pockets to maximise the media for roots to live in and grow through. It also assists with settling and compaction, to ensure no future subsidence occurs once the road is built over the pit."

Each of the components in the blend have a role to play:

- The rock matrix provides the structural support needed in high traffic areas and to meet engineering approval (this needs to be determined on a site specific basis due to differing soil conditions and rock used) for load-bearing capacity under typical urban traffic conditions.
- The biochar has excellent water holding capacity resulting in a watering rate less than one-third compared to previous tree planting methods, as well as adding cation exchange capacity.
- The compost gives trees a head-start by making nutrients immediately available to promote root growth. This bio-boost provides the newly planted tree with initial nutrients until it establishes its own self-sustaining system.

The small fibrous tree root hairs reproduce every day, with about 50 percent naturally dying daily. This enables a massive self-feeding biomass that is quickly established for trees to live and feed on. The result is a self-sustaining system with stormwater contributing to the nutrient load required to grow high quality street trees.

"It is appealing to Council that we can use rock and compost which are essentially waste products that are available to us at a very low cost," said Ian. "Also, managing underground utilities is easier with the rock matrix as conduits can be retrofit by excavating a section of the root vault, installing the conduits and then backfilling with the same structural mix. With other planting methods, forward planning is required to install conduits to minimise damage to the structural vault."

Since 2015, the Council has planted over fifty trees in high traffic areas using the structural rock pit method and the native tree species are performing particularly well in terms of growth.

While still under trial, the structural rock pit method is now the Council's preferred approach to tree planting in the urban road environment.

Cost Comparison for Tree Planting

For Dubbo Regional Council the reuse of waste rock from Council sub-divisions, and compost from its green waste site coupled with a significantly lower labour requirement, make the structural rock pit method around 40 percent more cost effective than other tree vault systems.

Most of the trees are retro plantings. The cost per tree is typically $15,500 using the structural rock pit method depending on the location of the pit. This includes excavation, rock and compost (basically at cost), biochar, geo fabric, vents/pipes, root barriers, tree, labour and plant.

In the Council's circumstance the structural rock pit method is more cost effective because:

- The rock and compost are waste products that are available at very low cost.
- It is less labour intensive with 95 percent of the installation completed with machinery.
- Less expenditure is required for traffic management due to faster planting. Trees are typically planted in a roadway setting where traffic management is a safety priority.

ENSPEC and Dubbo Regional Council are looking at trialling the use of recycled concrete to replace the rock thereby making use of another waste stream. However species selection may be limited due to the alkaline nature of the concrete. ENSPEC is currently evaluating the effect of pH on susceptible species.

The rapid growth of the trees planted using the structural rock pit method in 2015. Within 42 months from planting, the trees were eight metres in height. The team has attributed the rapid growth to the improved conditions for root growth and the benefits of biochar through its water holding capacity – even through the extended drought.

Various Stages in the Structural Rock Pit Method

Placing geo fabric at the base of the new structural rock pit to assist with preventing future subsidence and ensuring specified compaction rates are achieved.

Root barrier being installed to prevent future damage to the road as the new trees mature.

Rock, mulch and biochar being mixed before delivery to the tree pits.

The mix being tipped into the pit, an excavator used to move the mixture around and a radio-controlled vibrating roller being used to achieve the correct compaction.

One of the completed plantings 16 months after completion of the project (photo 2017).

Learnings from Stockholm

The city of Stockholm in Sweden is built on rock where trees grow everywhere naturally. The Stockholm Project took this concept further by using planting pits with rock matrix, soil, compost and biochar. By adding biochar to the mix with the disturbed urban soil, street trees were revitalised and rainwater runoff was more effectively managed to prevent flooding in the city streets.

The Stockholm Project was the winner of the Bloomberg Philanthropies Mayor's Challenge in 2014. As part of the project, a biochar facility was set up by the municipality to carbonise green waste from local parks and homes. The energy created during the biochar production is used to provide heat and hot water for city apartments providing environmental advantages all round.

Craig Hallam, Managing Director at ENSPEC was inspired by the Stockholm tree planting method during a trip to the city in early 2014. With the insights gained in Stockholm and by working with Dubbo Regional Council, the ENSPEC structural rock pit method was developed. This method provides engineers with confidence regarding load-bearing capacity while improving labour efficiency and delivering a system that will allow large trees to fulfil their normal life expectancy.

Unlike the Stockholm Project where typically the biochar is added last and washed into the voids, the methodology used by Dubbo Regional Council enables the ingredients of rock, biochar and compost to be mixed off-site and then installed in a single operation. The approach is extremely time and cost efficient due to its low labour component demand and ease of installation.

About Biochar

Biochar is derived from biomass via thermal decomposition. The biochar used by Dubbo Regional Council is manufactured with Pyrocal Continuous Carbonisation Technology and is supplied as Terix Stabilised Biochar. The Council has previously purchased biochar from Charman, although other suppliers are entering the market place.

The clean feedstock used to produce this biochar is sourced from Australian agricultural process and forestry residues that would otherwise go to less beneficial uses or end up in landfill. This is an example of a circular economy where residues from agriculture and forestry are used to create biochar, which in turn is used for growing trees.

Other amenity horticulture applications for biochar include the planting of roadside vegetation and top dressing of playing fields.

References

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