Stockholm Biochar Project
conventional construction for sidewalks in Stockholm a completely sealed surface where no water can be infiltrated or gas exchange can take place
Compaction of soil and dense surface layers the main reason that trees do not grow in urban environments

- subgrade
- sorted stone material 0-8, 0-16, 0-32, 0-63mm
- grain sizes between zero and upper grain fraction are included
Entrepreneurs do not have a clue on how to handle soil.
2003 we started to use a rock based ‘macadam’ growing substrate to benefit for both trees and storm water management
Macadam is a type of road construction, pioneered by Scottish engineer John Loudon McAdam around 1820, in which single-sized crushed stone layers of small angular stones are placed in shallow lifts and compacted thoroughly (WIKI)

Gives 35-40% porosity

First macadam road i the USA 1823 (WIKI)
How to create good growing conditions and taking care of the rain water

1. Pavement
2. Geotextile
3. Layer of crushed rock for infiltration of surface water and airing of the soil
4. Structure of granite stones the space between is filled with soil
5. Terrace
6. Plant box of concrete
7. Tree
8. Planting soil
9. Catchment chamber for infiltration of surface water and airing the structural soil

Inlets for Stormwater Carbon dioxide out
left 2002 right 2013  Kungsbroplan tree before and after structural soil
so if you want to be successful think Porosity!
Biochar and stone chips = crushed granite 6/8 volume parts (2-6mm) and nutrient-enriched biochar 1/8 volume parts + compost 1/8 volume parts
Bare rooted plants of shrubs and perennials get the best and fastest establishment.
Biochar compost and macadam with infiltration of stormwater
Structural soil with biochar

A method for building with stability and to create good growing conditions for trees in paved areas with the use of stormwater and the added value of decreasing the risk of roots damaging paving or underground pipes.

1. Paved surface with dished stormwater gutters
2. Geotextile
3. Leveling layer (crushed rock 8-16 mm) – also used for concrete bunker and water/air inlet.
4. Aerated bearing layer (crushed rock 32-83 mm)
5. Structural soil (crushed rock 100-150 mm) with fertilized biochar hosed into the structural volume
6. Pure biochar on terrace
7. Concrete bunker
8. Surface grid
9. Crushed rock with fertilized biochar
10. Inlet for air and water supply
connected plant beds along the block for the best conditions for the trees
Macadam Granit 90-150mm
Each layer of 300 mm is compacted for stability
Recycled concrete can be used as a part of the structural soil instead of granite
Granit size 90-150mm

Concrete box to hold the paved surface around the tree in place

Compacting before soil is washed into the voids

The stone shall fall into the box to get a stable construction
90-150mm macadam
And biochar compost 50/50 flushed down between the stones provides the strongest structure for heavy loads
Flushing the soil into the structure

Ventilation chamber and inlet of surface water

Layer for infiltration of rain water on top of the structural soil
Layer for infiltration of rain water and ventilation of the soil
Important with geotextile connection against curbs inlets concrete boxes etc. so that no fine material could run into the airy base course.
If the old trees is healthy, we will remove the material around the roots and re-fill with structural soil.
• We take water from roofs and pavements and roads through inlets bearing layer and the structural soil.

If the percolation layer is full, the storm water flows into the old street inlet.
Koelreuteria paniculata second growing season
Nybrogatan Stockholm
Biochar with infiltration of stormwater

• Plant bed renovation a block of Nybrogatan where we follow our drawing ‘structural soil with biochar’. Some of the old trees were saved.

• The stone and biochar are mixed before the material is laid down, 15% by volume biochar.

• Closest to the roots of saved trees added a mixture of crushed granite and 25% manured biochar.

• Concrete box where the tree is planted, in it you can see macadam mixed with 15% biochar
STRUCTURAL SOIL WITH BIOCHAR

The City of Stockholm have set as a goal to create sustainable and durable plant beds from locally sourced materials. Structural soils with biochar binds carbon from the atmosphere and reduces leaching of nutrients.
Biochar and stone chips = crushed granite (32-63 mm) and nutrient-enriched charcoal 15%. Volume premixed.
Nybrogatan 2015
Macadam and biochar
Plant bed for street trees charcoal and macadam = crushed granite 32-63 mm mixed with 15% nutrient-enriched charcoal, granite can be replaced with recycled concrete with reinforcement (iron)
Lingvägen
biochar with infiltration of stormwater

• Plant bed renovation a 600 meter by 2m wide and 1 m deep.
• where we follow our drawing ‘tree pit with slanting subgrade’
• The ditch filled with biochar and gravel 8-16mm
Lingvägen
biochar macadam and infiltration of stormwater
Drawing showing how we build plant bed for trees in the green area along streets and roads to maximize infiltration of storm water through a charcoal filter in the bottom of the plant bed where we catch up nutrients and pollutants.

**PLANTING PIT WITH SLANTING SUBGRADE**

ELEVATION  
SCALE 1:100

New tree, circumference 30-35

The tree’s root collar is placed at the same level as at the nursery. The rootball rest on the structural soil.

Charcoal stone chips = crushed granite (32-63 mm) and nutrient-enriched charcoal 10/1. volume. 850mm

**TREE PIT WITH BIOCHAR IN GREEN SPACE, TYPE 2**

TYPE SECTION  
SCALE 1:20
Plant bed for street trees charcoal macadam = crushed granite 8-16 mm mixed with nutrient-enriched charcoal

Charcoalsoil
2-5 mm granit
depth 100 mm
Charcoalchips
8-16 mm granit
depth 900 mm
2017 Haukadalsgatan biochar 1 part, compost 1 part, macadam 4-8mm 6 parts
Vallhallavägen
hundred year old avenue of trees get
Biochar compost and macadam

• Compacted soil which is changed to ditch filled with biochar and macadam 32-63mm to save the trees with infiltration of stormwater

• the first time we sow grass on 2-6mm 3 parts 1 part biochar 100mm
Infilttrationsröa φ 110 (längd ca 4 m) förläggs i två riktningar från brunnen längs med växtdädden

Tätt plaströr φ 200

Brunnsbetäckning med sidointag

Dagvattenbrunn φ 400 med tät betäckning

100-150 mm makadam 4-8 mm med 25 volym% näringsberikad biokol

Stödremsa 250 mm bredd makadam 8-16 mm Avjämns med makadam 2-6 mm

50 mm biokol (ogödslad)

Luckring av terrass 200 mm

850 mm makadam 32-63 mm Med 15% biokol med näringsberikning

DAGVATTENFÖRDRÖJNING - GRÄSYTA MED KOLMAKADAM
vacuum cleaned root system
Valhallavägen 2016-2018

2-6mm 3 parts 1 part biochar
100mm and grass seeds on the surface

8-16mm
30mm

32-63mm and 15% biochar
600mm
8-16mm 30mm

32-63mm and 15% biochar
800mm
100mm mix of macadam 2-6mm 3 parts, 1 part biochar/compost, and grass seed
the first time we make grass on macadam 2-6mm 3 parts and 1 part biochar/compost
Pilgatan 2014
Biochar and macadam with infiltration of stormwater
1 part biochar 0-10mm and 3 parts crushed granite size 4-8 mm 800mm deep.
Magnolia and perennials
Biochar and stone chips = crushed granite 3/4 (2-6mm) and nutrient-enriched charcoal 1/4. volume
2017 augusti
New tree in grass
planting volume 2x2x0,8m
Macadam 4-8mm 3parts
Biochar and compost 1part
Kolonivägen 2016-2017
Magnolias, Cersis, Prunus.
1 part biochar 0-10mm och 3 parts macadam 4-8 mm 600mm.
Reduce the presence of particles and carbon dioxide in the air

Reduce the risk of flooding

Reduce the heat island effect

Gives healthy trees with all the positive effects it provides

Reduces the load on the storm water systems, thereby reducing pollution in Lake Mälaren and the Baltic Sea

Locks down carbon dioxide into the ground with the use of biochar in the planting beds
300mm deep, = crushed granite 3 parts (2-6mm) and nutrient-enriched biochar (50%) + compost (50%) 1 part Magnolia tripetala
Stone trough with alpines

crushed granite $\frac{3}{4}$ volume parts (2-6mm) and nutrient-enriched biochar (50%) + compost (50%) $\frac{1}{4}$ volume part
2017
First potatoes grown in macadam biochar and compost
2018
First carrots grown in macadam biochar and compost
Växtbäddar i Stockholms stad
– en handbok 2017

http://www.stockholm.se/trad

https://www.youtube.com/watch?v=S7kbSnnJwDI