

工業技術研究院

Industrial Technology
Research Institute

Application of Bamboo Charcoal used as Biochar on Ecological Environment

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Office Locations





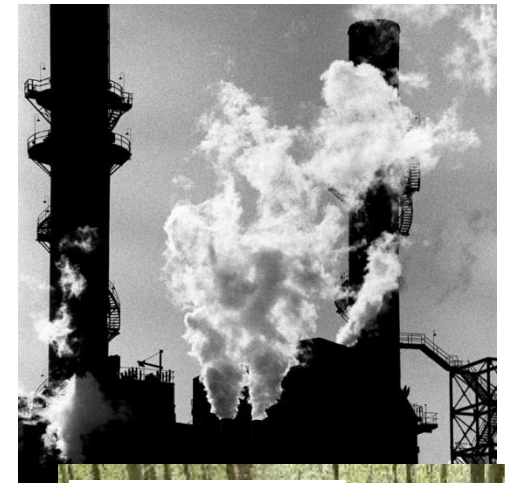
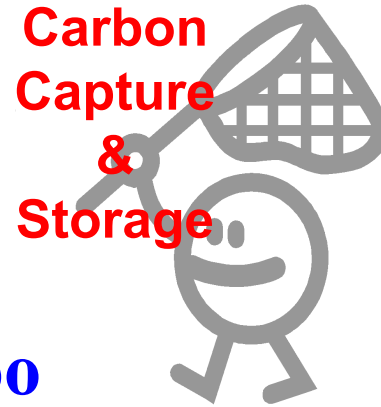
Outline

- ✓ Introduction of bamboo in Taiwan
- ✓ Application of bamboo biochar on organic agriculture
- ✓ Summary



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Moso bamboo

48 tons/ha



Makino bamboo

22 tons/ha

Ecological features of bamboo

- Fastest growth among all plants on Earth
 - Growth is completed within 40 days after budding.
(Maximum 25cm growth per day)
- Replacement of diminishing forests
 - replacing wood to produce similar products
- Best species of plant to protect against landslide and earthquake
- Absorption of carbon dioxide: 29.34 tons/ha (4 times more than pine trees (7.68 tons/ha))
- Emission of oxygen: 35% higher than other species of trees

Development of bamboo in ITRI (1/2 ; before 2011)

ITRI+TEMA → Taiwan Bamboo Industry



Development of bamboo in ITRI (2/2 ; 2012 later)

- ✓ Whole bamboo
- ✓ Feed additives
- ✓ Cosmetic
- ✓ Composite filter
- ✓ Biochar
- ✓ Pet supplies
- ✓ Building material
- ✓ Insulation material
- ✓ Filling material
- ✓ Functional paper

Regional industry

Circular Economy

Green material

Industrial Ecosystem

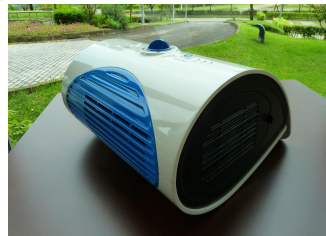
Satoyama Initiative

High quality Filter

Green building

- ✓ Bamboo Charcoal
- ✓ Tableware
- ✓ textile
- ✓ Livelihood

Raw Material



✓ Energy-Saving carbonization Furnace



2010

Electronic Component

2013

2015

2018

Now

資料來源: 工研院中分院



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□ Forest Area in Taiwan: 2.20 Mha(61%)

- Hualien county has the biggest forest area (about 373 thousand hectares) and contains 7,800 hectares of bamboo forest.
- The most species is *makino* bamboo that was a raw material for the handicraft 50 years ago.



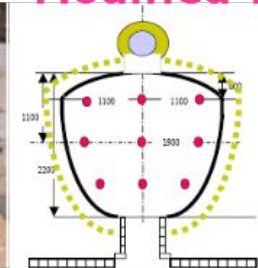
Smaller than 3 cm

- ✓ Plant pillar
- ✓ biochar

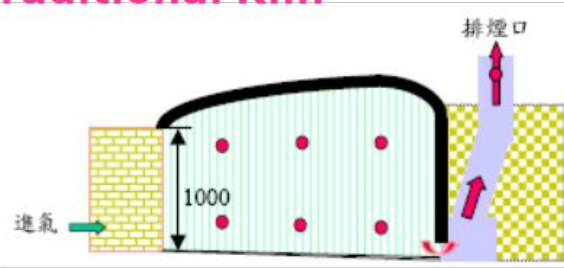


Equipment to produce bamboo charcoal

Modified Traditional Kiln



Rapid Carbonizing furnace



Multifunctional carbonization furnace

the yield
the quality



Continuous carbonization furnace



Continuous Activation furnace



Horizontal

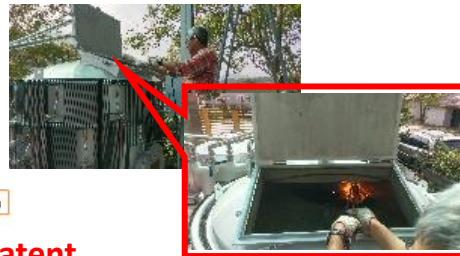
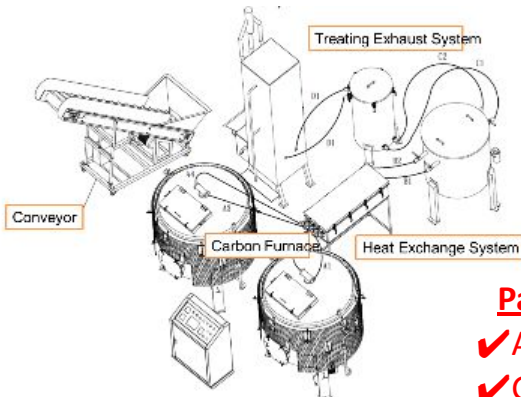
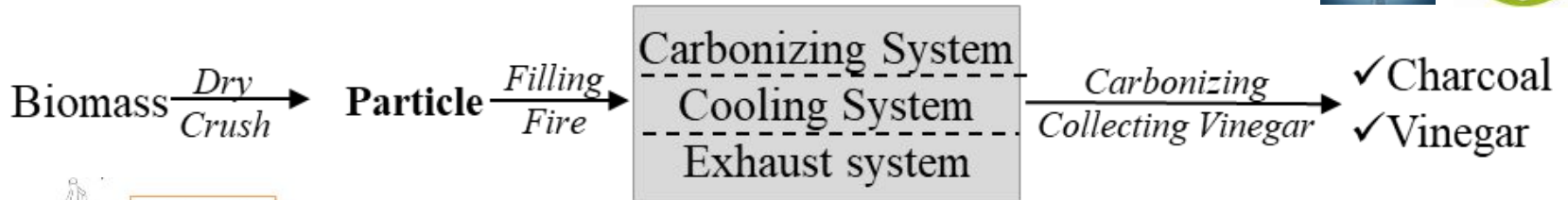
Vertical



Rapid Customized and Energy-Saving Carbonization Furnace

The Specification

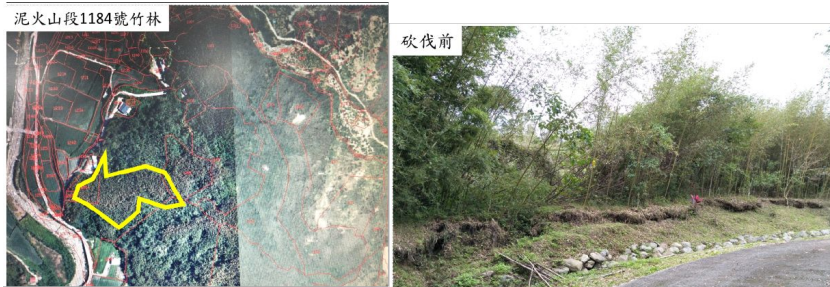
- Equipment: 2 carbonizing system, 1 cooling system, 1 the exhaust system
- Fuel: No extra fuel
- Operating Power demand: 220V, 10A (electricity consumption each batch is less than 10 kw)
- Control System: Human-machine interface
- Capacity: about 100-300kg/bat depending on the species of granular biomass (~3-5cm) with the moisture lower than 12%
- Carbonizing time: 8-10 hours from the ambient temperature to carbonizing temperature 700-800°C
- Cooling time: ~12 hours depending on the ambient temperature
- Biochar Yield: >25 wt. %
- Yield to collect vinegar: >30 wt. % cooled by water system



Patent
 ✓ ANOXIC COMBUSTION SYSTEM
 ✓ GAS RECOVERY DEVICE



Before

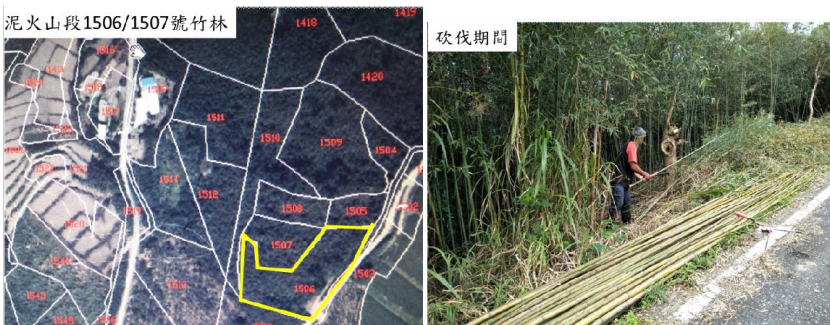


Proper felling bamboo forest



Ecological trail

After



Properties of Bamboo Biochar and Vinegar

□ Bamboo biochar

- ✓ The yield: 25%
- ✓ pH=9.43
- ✓ Fix carbon: 83.7%
- ✓ Organic matter: 10.3%
- ✓ 0.24% of phosphorus,
1.99% of potassium



□ Vinegar

- ✓ pH=2.89
- ✓ Organic acid: 50.59%
- ✓ Phenolic compound: 23.56%



Bamboo Biochar and Vinegar for the field test



the porosity
keep water
provide the nutrition

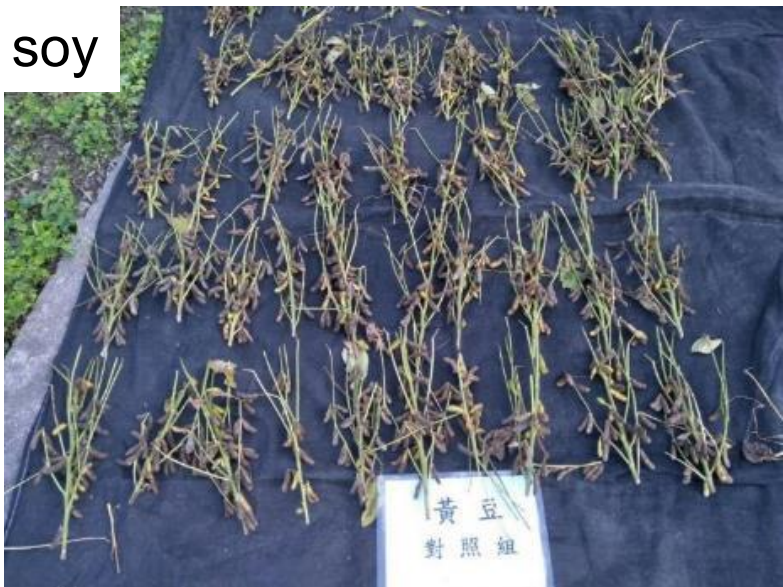


Result

Control group

Experimental group

soy



Number of pods (10plants) 366

396



50 plants



the soy weight 831 g

1,000 soys



280 g

50 plants



1,081 g

1,000 soys



292 g



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Performance of Rapid Energy-Saving Carbonization Furnace in Taiwan





農業部林業及自然保育署

Forestry and Nature Conservation Agency



FULI FARMERS' ASSOCIATION

富里鄉農會



Thanks for your attention

