Producing Pyrolysis Liquids and ‘Wood Vinegar’ from Biomass

Earth Systems specialises in the development of technologies that sustainably convert biomass into energy and other useful solid and liquid products. We have designed, manufactured and patented a slow pyrolysis technology called the CharMaker Mobile Pyrolysis Plant. The CharMaker can efficiently extract bio-liquids from waste biomass, which are a sustainable alternative to many fossil-based fuels and chemicals.

With a global trend towards a more sustainable economy based on renewable resources, biomass derived products are becoming increasingly attractive. Pyrolysis involves the high temperature treatment of biomass without oxygen and offers a way of efficiently transforming biomass into a spectrum of valuable and useful products. The products represent a sustainable alternative to fossil-fuel based products and a natural alternative to synthetic chemicals including fertilisers, and pesticides.

At Earth Systems we have developed an innovative technology that can effectively pyrolyse a wide range of biomass feedstocks. The CharMaker Mobile Pyrolysis Plant (MPP) is a batch pyrolysis unit that was developed primarily to generate large amounts of biochar per batch. Biochar is a charcoal like substance and is itself a valuable product for use as a soil conditioner.

Recently, we have upgraded the CharMaker technology to include an optional Bio-liquids Recovery System. This technology provides a number of liquid fractions that are sustainable alternatives to petroleum derived products. The CharMaker can produce the following:

- Biochar (solid charcoal like substance)
- Pyrolysis liquids (bio-oils and ‘wood vinegar’)
- High grade heat

APPLICATIONS OF ‘WOOD VINEGAR’

PESTICIDE
Wood vinegar can be used as a natural plant-derived pesticide for use on a number of crops. It has been shown to deter aphids and termites from rubber wood plantations. It can also be used in animal husbandry. For example wood vinegar used in chicken farms successfully decreased the prevalence of red mites, a serious pest in poultry farming.

HERBICIDE
Wood vinegar has been applied at higher concentrations as a herbicide on various plants.

PLANT GERMINATION/GROWTH ENHANCER
Wood vinegar can enhance the growth and germination rates of many plant species. It is therefore a very useful product for a range of applications such as nurseries, botanical gardens and large ecosystem regeneration projects.

OTHER USES:
- Enhance composting processes
- Fungal growth enhancer
- Natural preservative
- Dilute with water at different ratios for various applications including: enriching soils, soil treatment, fertilisation, pesticide use, seed germination, fungal disease treatment
- Healthcare products
The CharMaker works by heating woody biomass without oxygen until a smoky vapour is produced. The vapour is cooled as it leaves the pyrolysis chamber, condensing into a liquid that can be extracted via our Bio-liquids Recovery System. This system collects and separates the liquids into three main fractions — a light oil, heavy oils (bio-oil) and the majority fraction ‘wood vinegar’ (also known as ‘liquid smoke’ or ‘pyrolygenous acid’). Earth Systems has now pioneered a commercial Bio-liquids Recovery System specifically for the CharMaker. This technology is available as a standard add-on to the CharMaker MPP pyrolysis unit.

Once separated, the light and heavy oil fractions present in the liquids are energy rich and can be used as a sustainable fuel source, replacing fossil fuels such as diesel. Earth Systems is developing the ability to utilise these oils as a fuel source for the CharMaker and also for other heating energy needs such as in boilers and building heating systems.

The ‘wood vinegar’ fraction offers a wide range of very exciting applications. These include application as a pesticide, herbicide and germination enhancer or even as a disease suppressant in animal husbandry (see box insert for more details). These applications can benefit agricultural, horticultural and ecosystem regeneration activities.

The liquids produced in the pyrolysis process also contain many valuable chemicals such as acetic acid, acetal, methanol, phenols, catechol, pyrine, vanillin and syringol. These ‘bio-based’ chemicals offer sustainable alternatives to similar products derived from petroleum and synthetic chemicals.

The CharMaker offers a way of turning your biomass waste streams into a number of valuable and sustainable products while sequestering carbon — helping move towards a greener global economy.

CASE STUDY: KADOORIE FARM & BOTANIC GARDENS - HONG KONG

Earth Systems have been working with Kadoorie Farm & Botanic Garden (KFBG) in Hong Kong to install a full CharMaker solution on the premises. KFBG are using the CharMaker to process waste biomass from woody weed clearance and general garden maintenance. The biochar produced is being utilised in forest regeneration work within the gardens.

The unit also has an integrated and fully automated Bio-liquids Recovery System. The system produces 250 litres of bio-liquids per batch. The ‘wood vinegar’ is extracted from the recovered liquids and applied around the gardens as a natural pesticide and herbicide spray product for pest control, and other botanic garden uses.