Pyrolysis of biomass

The pyrolysis (or devolatilization) process is the thermal decomposition of materials at elevated temperatures in an inert atmosphere. It involves a change of chemical composition. The word is coined from the Greek-derived elements pyro "fire" and lysis "separating".[1]

Pyrolysis is most commonly used in the treatment of organic materials. It is one of the processes involved in charring wood. In general, pyrolysis of organic substances produces volatile products and leaves char, a carbon-rich, solid residue. Extreme pyrolysis, which leaves mostly carbon as the residue, is called carbonization. Pyrolysis is considered the first step in the processes of gasification or combustion.

Just about any organic waste, whether animal or plant based, may be fed into a pyrolysis machine and decomposed by heat. The trick to deteriorating the waste at high temperatures and not having it catch fire is the exclusion of oxygen. Without fresh oxygen, nothing burns, so that the feedstock separates into separate products. The products can be sold or employed in other processes.

The main product is pyrolysis oil. This oil can be utilized “as is” in various kinds of industrial boilers or utilised in chemical processes to make plastics, or refined further into gasoline or diesel. The other two products are biochar (or biocarbon) depending on its application, and combustible gases.

The biochar is a potentially valuable product as it stores carbon in a form which takes a number of years to decompose. It may be used as a soil enhancer on farms where it holds moisture from rain and releases it slowly in the coming days to help extend water supply to plants. It may also help provide valuable nutrients to the plants at the same time. Concurrently, the biochar is acting as a carbon sink, storing carbon that could normally be released into the air as fractional CO_2.

The combustible gases are captured and used by the pyrolysis process itself to heat the reaction chamber. This allows the process to be circular without adding extra fuel. Pyrolysis plants are available in many sizes, and specialties that will handle almost any type of organic waste. Some also have preheat chambers that run off the main reactor chamber to pre-dry the feedstock if it’s wet.

The process is used heavily in the chemical industry, for example, to produce ethylene, many forms of carbon, and other chemicals from petroleum, coal, and even wood, to produce coke from coal. It is used also in the conversion of natural gas (primarily methane) into non-polluting hydrogen gas and non-polluting solid carbon char, initiating production in industrial volume. Aspirational applications of pyrolysis would convert biomass into syngas and biochar, waste plastics back into usable oil, or waste into safely disposable substances.

[1] Wikipedia