Global Certificate Course in Biomass Pyrolysis

Environmental

Biomass Pyrolysis: Biomass pyrolysis is the thermal decomposition of biomass in the absence of oxygen, resulting in the production of solid (char), liquid (bio-oil), and gas (syngas) products. This process occurs at temperatures between 300 and 800 degrees Celsius. Biomass pyrolysis is an important technology for the production of renewable energy and bio-based products.

Biomass: Biomass refers to organic materials derived from plants, animals, and microorganisms that can be converted into fuel, heat, or electricity. Examples of biomass include wood, agricultural residues, municipal solid waste, and algae. Biomass is considered a renewable resource because it can be replenished through sustainable practices.

Thermal decomposition: Thermal decomposition is the process of breaking down a substance using heat. In the case of biomass pyrolysis, heat is applied to biomass in the absence of oxygen, causing the biomass to break down into its component parts.

Absence of oxygen: The absence of oxygen is critical for the pyrolysis process to occur. In the presence of oxygen, biomass would instead undergo combustion, producing heat and carbon dioxide. By excluding oxygen, the biomass is instead broken down into its component parts.

Solid product (char): Char is the solid product produced during biomass pyrolysis. Char is composed primarily of carbon and can be used as a fuel or as a soil amendment.

Liquid product (bio-oil): Bio-oil is the liquid product produced during biomass pyrolysis. Bio-oil is a complex mixture of organic compounds and can be used as a fuel or as a chemical feedstock.

Gas product (syngas): Syngas is the gas product produced during biomass pyrolysis. Syngas is composed primarily of carbon monoxide, hydrogen, and methane and can be used as a fuel or as a chemical feedstock.

Fast pyrolysis: Fast pyrolysis is a type of biomass pyrolysis that occurs at higher temperatures and shorter residence times than traditional pyrolysis. Fast pyrolysis produces a higher yield of bio-oil and is typically used for commercial-scale biomass pyrolysis.

Higher temperatures: Fast pyrolysis occurs at temperatures between 450 and 600 degrees Celsius, higher than traditional pyrolysis.

Shorter residence times: Fast pyrolysis occurs over a shorter period of time, typically less than a few seconds, compared to traditional pyrolysis which can take several minutes.

Traditional pyrolysis: Traditional pyrolysis is a type of biomass pyrolysis that occurs at lower temperatures and longer residence times than fast pyrolysis. Traditional pyrolysis produces a higher yield of char and is typically used for small-scale or laboratory-scale biomass pyrolysis.

Fluidized bed reactor: A fluidized bed reactor is a type of reactor used for biomass pyrolysis. In a fluidized bed reactor, hot sand is used to heat the biomass, causing it to break down into its component parts.

Entrained flow reactor: An entrained flow reactor is a type of reactor used for biomass pyrolysis. In an entrained flow reactor, biomass is injected into a high-velocity gas stream, causing it to break down into its component parts.

Abiotic pyrolysis: Abiotic pyrolysis is the thermal decomposition of biomass in the absence of microorganisms or enzymes. Abiotic pyrolysis occurs under high temperatures and pressures and is typically used for the production of biofuels.

High temperatures: Abiotic pyrolysis occurs at temperatures above 800 degrees Celsius.

High pressures: Abiotic pyrolysis occurs under high pressures, typically above 10 atmospheres.

Biochar: Biochar is a type of char produced during biomass pyrolysis. Biochar is composed primarily of carbon and has a porous structure that makes it an effective soil amendment.

Soil amendment: Biochar can be added to soil to improve its fertility, water retention, and carbon sequestration.

Carbon sequestration: Carbon sequestration is the process of capturing and storing carbon dioxide in the soil, plants, or geological formations. Biochar is an effective carbon sequestration tool because of its porous structure and high carbon content.

Carbonization: Carbonization is the process of converting biomass into char through pyrolysis.

Conversion: Carbonization is a conversion process that transforms biomass into a solid, carbon-rich material.

Thermochemical conversion: Thermochemical conversion is the use of heat and chemicals to convert biomass into fuel or chemical feedstocks. Biomass pyrolysis is a type of thermochemical conversion.

Heat and chemicals: Thermochemical conversion uses heat and chemicals to break down biomass.

Energy crop: An energy crop is a plant grown specifically for the purpose of producing energy. Examples of energy crops include switchgrass, miscanthus, and willow. Energy crops are typically high-yielding and have low input requirements.

High-yielding: Energy crops produce a high yield of biomass per acre, making them efficient for energy production.

Low input requirements: Energy crops require minimal inputs such as fertilizers, pesticides, and water, making them environmentally friendly.

Co-firing: Co-firing is the process of burning biomass in combination with fossil fuels in a power plant. Co-firing can reduce greenhouse gas emissions and increase the use of renewable energy.

Fossil fuels: Co-firing involves burning biomass with fossil fuels such as coal or natural gas.

Power plant: Co-firing occurs in power plants that generate electricity.

Biomass-to-liquid (BTL) fuel: Biomass-to-liquid (BTL) fuel is a type of biofuel produced through the gasification and subsequent upgrading of biomass. BTL fuel is a liquid fuel that can be used in transportation.

Gasification: Gasification is the process of converting biomass into a gas through partial oxidation.

Upgrading: Upgrading is the process of converting the gas product from gasification into a liquid fuel.

Bio-refinery: A bio-refinery is a facility that produces fuels, chemicals, and other products from biomass. A bio-refinery is similar to a petroleum refinery but uses biomass instead of oil as its feedstock.

Fuels, chemicals, and other products: A bio-refinery produces a range of products, including fuels, chemicals, and materials.

Feedstock: Biomass is the feedstock used in a bio-refinery.

Carbon capture and storage (CCS): Carbon capture and storage (CCS) is the process of capturing carbon dioxide emissions from industrial processes and storing them in geological formations. CCS can reduce greenhouse gas emissions and mitigate climate change.

Carbon dioxide emissions: CCS captures carbon dioxide emissions from industrial processes such as power generation.

Geological formations: CCS stores carbon dioxide in geological formations such as depleted oil and gas fields.

Renewable energy: Renewable energy is energy produced from sources that are replenished naturally, such as solar, wind, and biomass. Renewable energy is environmentally friendly and reduces greenhouse gas emissions.

Replenished naturally: Renewable energy sources are replenished naturally through processes