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Earth Care Products, Inc.

TORREFACTION-ACTOF®

Torrefaction (using ECP's proprietary processing equipment):

I. The Torrefaction process consists basically of 3 stages as explained below:

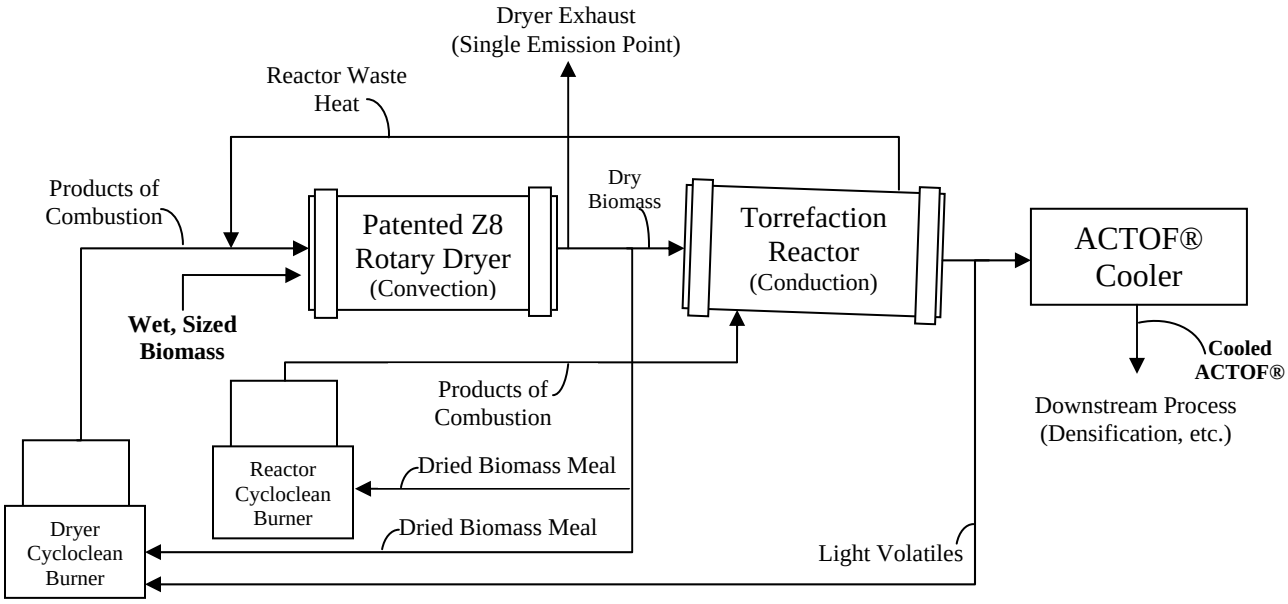

Fig: ECP's Torrefaction Process

A. Drying:

Biomass chops or chips which are less than 1/4" thick by 1.5" X 1.5" and 10 - 50% moisture content are fed into the Z8 Rotary Dryer. The Z8 Rotary Dryer is a patented, direct, convection type rotary dryer which dries the material down to low moisture content, **simultaneously preventing the formation of VOC's caused by over-drying and over-heating of the biomass particles.** The heat for the dryer is supplied by the Cycloclean Biomass Burner which is a vertical dry cell biomass-fired burner. The heat transfer within the dryer is convective in nature. The hot gases from the burner are induced into the rotary dryer by means of an induced draft fan. This, along with the patented dryer design creates turbulence and eddy currents within the dryer resulting in multiple drying rates and particle size classification, leading to efficient and uniform drying of biomass chips, and **at the same time preventing the volatilization of biomass during the dehydration process**. The biomass exiting the dryer is at 3% to 5% moisture content and around 120°F to 130°F. These biomass pieces are then metered mechanically into the Torrefaction Reactor via a dosing bin. A portion of the dried biomass is utilized as fuel for the system. The Rotary Dryer Exhaust stack is the single emission point in ECP's drying and torrefaction system.

B. Torrefaction:

The dry, sized biomass from the rotary dryer is metered into the torrefaction reactor. The torrefaction reactor consists of a rotary drum with a small angle of positive inclination. The drum rotates within an insulated furnace through which the products of combustion originating from the Reactor CycloClean Burner flow by means of an induced draft. The products of combustion transfer heat to the rotating drum via convection, maintaining torrefaction temperature within the torrefaction reactor. The rotary drum transfers the thermal energy to the incoming dehydrated biomass chips via conduction. Ingress of ambient air within the torrefaction reactor drum is minimized to ensure an oxygen-starved environment. Due to the conditions present within the torrefaction reactor, the biomass undergoes devolatilization as it completes its journey across the torrefaction reactor drum. The volatiles liberated in the process of torrefaction also produce a self-inerting atmosphere within the torrefaction reactor drum. The VOC's liberated during torrefaction are induced into the Dryer Cycloclean Burner where they are thermally destructed. The heat released by the combustion of the VOC's is induced into the Z8 Rotary Dryer to supplement its thermal energy requirement. The products of combustion resulting from the thermal destruction of torrefaction volatiles do not come in contact with the torrefied product.

The hot gas providing heat to the reactor by conduction is also induced into the Z8 Rotary Dryer to recover its sensible heat, thus minimizing heat loss and improving the process efficiency. The degree of torrefaction can be controlled by varying the torrefaction temperature and retention time of biomass within the torrefaction reactor. The temperature of torrefied biomass is too high for the biomass to be exposed to atmosphere as it can result in spontaneous ignition and therefore it has to be transferred airtight to the cooling stage.

C. Cooling:

The hot torrefied biomass is transferred into the cooler. The cooler consists of a screw conveyor held inside a continuously-circulated water jacket. The water at ambient temperature is circulated through the jacket. Water, at temperature lower than the ACTOF®, absorbs the heat from the ACTOF® in the cooling conveyor, cooling it to the desired temperature. The final temperature of ACTOF® is achieved by controlling the flow rate of water through the jacket.

The water cooling system includes an air-cooled radiator that removes the heat load from the water for recirculation.

II. Fuel for the System:

The dehydrated biomass from the dryer is transferred to the hammermill where it is pulverized, after which it is screened in the screeners. The fines are burned as fuel for the system's thermal energy in the two Cycloclean Biomass Burners; the overs are transferred to the torrefaction.

III. Densification:

Torrefied biomass cooled to controlled temperature can be metered into a densification machine to increase its bulk density by 50% to 75%. Size and shape of densified product can be tailored to shipping and storage needs.