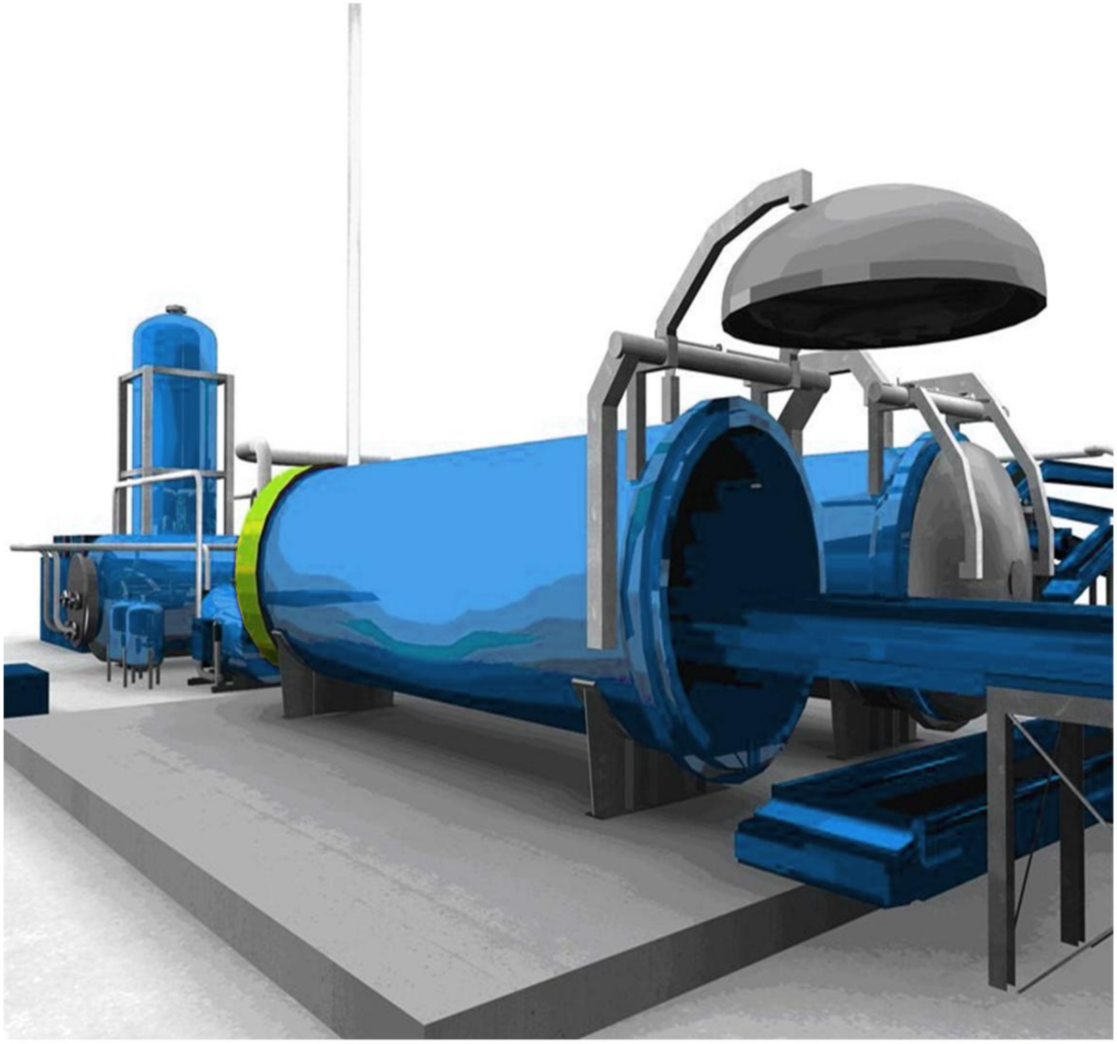
SUSTECH
Sustainable Technologies of America

COMPREHENSIVE MSW PROCESSING BIO COKE METHOD



Por un planeta saludable / For a healthier planet. BIO

Biocoke method for conversion of MSW to coal and fuel oil

SUSTECH BIOCOKE processing system is designed for converting the MSW which is received on a daily basis at the facility, into coal, and fuel oil etc.

Overview of the SUSTECH BioCcoke processing facility

The following information is a brief overview of the purpose and content of the proposed Municipal Solid Waste (MSW) processing facility provided by SUSTECH

Vehicles dump their waste in the Receiving Hall. From here it is transferred via refuse-vehicles to the feeding bunker in the receiving hall.

From the feeding Bunker the waste is transferred into a feed system, which comprises of a series of conveyors to provide a regulated flow of waste into two or more sequentially operated SUSTECH BIOCOKE system processing modules.

Included in the feed system is a weighing conveyor so as to ensure respectable accurate processing via the conveyor into the system.

On completion of loading the conveyor is automatically retracted from the system to allow the second stage which is the automatic closure and locking of the SUSTECH BIOCOKE system door.

The duration of the process cycle is a programmable function, which may be optimized to best suit specific needs.

All instrumentation, monitoring control, interlocks and shutdown system necessary for the effective running of the plant are provided by SUSTECH.

Description of the loading system:

The "automatic loading" system consists of four conveyors. The waste material is fed onto a "reversible" conveyor. This reversible conveyor discharges the materials on to one of the four movable conveyors. Under this reversible conveyor is a weighing system, which measures the amount of materials passing over the conveyor, ensuring that the correct amount of material has been loaded into each module. The movable conveyor feeds the waste material into the opening of the SUSTECH BIOCCOKE system and once the correct tonnage of material has been loaded the conveyor retracts allowing the door on the system to close.

When one of the SUSTECH BIOCOKE system has completed its operating cycle, the contents are then "emptied" onto a discharge conveyor. This conveyor, in combination with two other conveyors transports the processed material to the second moving floor bunker in the Sorting Section.

Description of the sorting system:

The 2 moving-floor bunkers, which also can store approx. 10 Tons each, of material, are meant as a buffer to equally feed the sorting installation with approx. 7.5 tons per hour.
The waste material is transported by a conveyor to a Finger screen which screens material size of approx. 200mm.The Finger screen will remove all large items and textiles.

The "unders” of the Finger screen are transported towards the Starscreen®. This screens the material to approx. < 12mm. Installed at the end of the Starscreen is an Air-Separator. This Air<Separator removes most of the light materials and transport them in to the "mixed plastics” discharge conveyor.

The Starscreen divides the materials into 2 main sorting lines, from these lines, the recoverable material will be sorted. The separated materials are then discharged on to a conveyor which transports the material in a container / bay.

The sorting can be divided into two elements:

1. 1st sorting line, 0 - 12 mm fraction.
2. 2nd sorting line, 12 – 200 mm fraction.

1st sorting line, 0 - 12 mm fraction:

The O - 12mm fractions are the "unders" from the Starscreen . The first material which is removed from out of the material flow is the Fe fraction. The Fe fraction is removed from the material flow by a Permanent Drum Magnet. The Fe fraction is discharged onto a conveyor which transports the Fe fraction into a bay.

The remaining materials are than discharged onto a Non Fe Separator. The Non Fe Separator removes the Non Fe fraction (like aluminum etc.) and discharges them onto a conveyor. This conveyor transports the Non Fe towards a bay.

The remaining materials are than discharged onto a Optical Sorter. The Optical Sorter removes the Mixed Plastics and are discharged onto a conveyor which transports the mixed plastics into a bay.

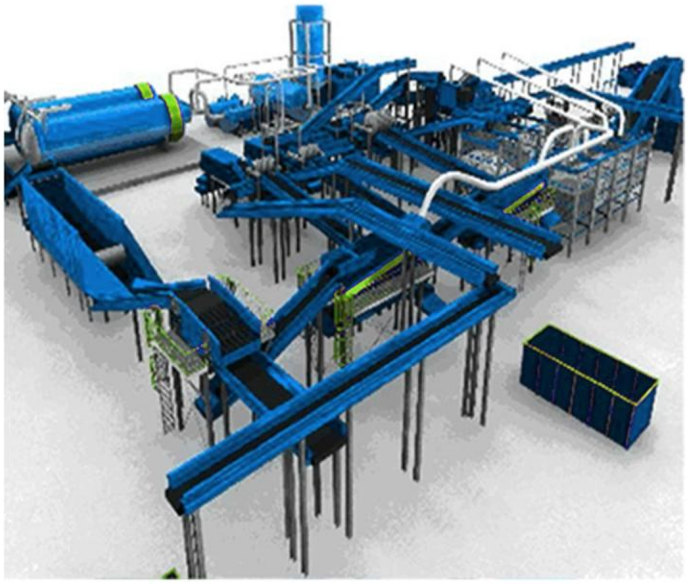
The remaining materials are than discharge onto an incline conveyor which then transports the Fibre fraction into a bay.

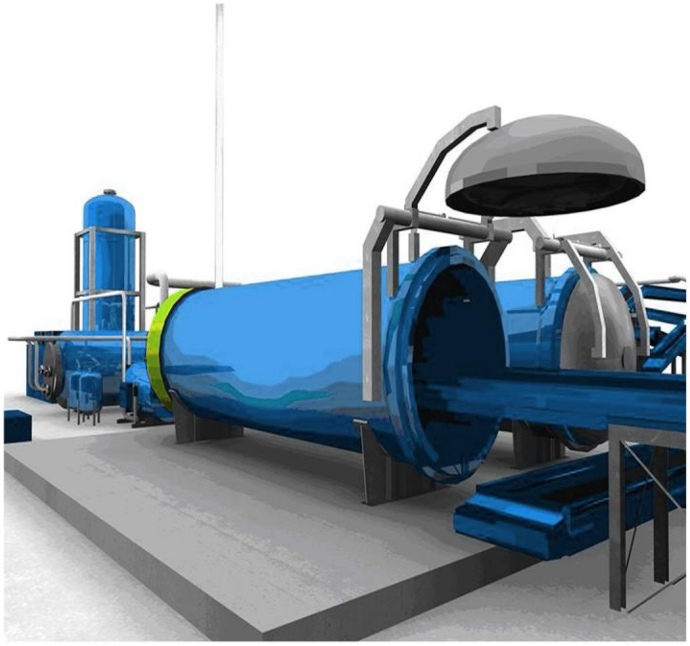
Due to the high amount of fibre fraction we have divided the 0-12 material-stream into two similar sorting lines.

2nd sorting line, 12 - 200 mm fraction:

The 12 — 200mm fractions are the "overs" from the Starscreen.
The first material which is removed from out of the material flow is the mixed plastic fraction. The Optical Sorter removes the Mixed Plastics and are discharged via Air Transport onto a conveyor which transports the mixed plastics into a bay.

The remaining materials are than discharged onto a sorting conveyor. On this conveyor all materials which are not "mixed plastics" are taken out of the material-stream. The material taken out are dropped via sorting- chutes into containers under the sorting-station.
The remaining materials, which have to be "mixed plastics" are than discharge onto a conveyor which transports the mixed plastics into a bay.





Biocoke method for biomass gasification & biocoke manufacture steps

SUSTECH uses a Top Feed Fixed Bed Gasification System. In the Top Feed fixed bed gasifier the biomass material is fed through the top of the gasifier and heated to the gasification temperature through different temperature zones. Within the gasifier the biomass feed goes through changes. The feed as it comes in may have inherent moisture. The pre-drying process may not have completely removed the moisture from the feed. In the top zone which is maintained at around 120 deg C will release the moisture in the form of steam along with lighter hydrocarbon gas factions. The steam and gas mixture then passes through the Catalyst chamber wherein, the steam is allowed to pass through whereas the hydrocarbon vapours are split into methane and other light gases.

In the middle zone the dried up matter will then enter the heating and vaporization zone, similar to a Pyrolysis zone in a conventional Gasifier. The temperature is maintained at around 250 deg C. The dried biomass is heated to this temperature in the absence of air and thus the volatile hydrocarbon vapours are released from the dried biomass. The volatile vapours will move upwards towards the catalyst chamber along with the upper zone steam and lighter gasses.

In the lower zone, the matter is heated to app 300 to 350 deg C, where in the residual vapours are released. Also, at this temperature, carbonization of biomass takes place along with the production of some Carbon Dioxide and Carbon Monoxide. The CO and CO2 along with volatile vapours move upwards to the catalyst chamber. The lower most zone is the coking zone where the temperature is maintained at 450 deg C. In this zone the biomass is converted to coke. The coke is drawn out of the gasifier through an automated Rotary valve which is timed to release a fixed quantity of coke every few minutes. This will allow the bottom cokes to be recovered and allow for fresh material flow into the gasifier for gasification. Top feed gasification is similar to up-draught gasification and has the advantage of offering the most economic and efficient gasification technology.

The single stage Gasifier:

The biomass moisture must be removed in the single stage gasifier as above. It is critical to maintain the moisture level below 20%. Lower moisture level is better. Hence it is imperative that the moisture be removed prior to in-feed of biomass into the gasifier. In order to achieve this a pre-drying arrangement is required to be established. Biomass at higher moisture levels of up to 40% can be gasified. However, the energy consumption will be very high, the generated gas will be moist and the calorific value of gas will be reduced which will make it a less efficient method for power generation. This will not be an economic proposition. Also, some of the gasses evolved in the gasification process may contribute to acidity leading to corrosion in the presence of moisture at the gasifier temperatures. This necessitates the use of additional chemicals for neutralization.

There are specific advantages of the SUSTECH gasifier design. They are:

- Low capital cost
- Higher thermal output
- Increased efficiency
- The gasifiers are smaller and occupy less space.

The biomass dryers are integrated with the gasifiers using a waste heat drying system This helps in the increased conversion to high calorific value vapours for use in IC engines.

The vapours along with the other gasses will exit from the top into a catalyst chamber. The mixture consists of hydrogen, carbon, monoxide, nitrogen, carbon dioxide, water vapour, low molecular weight hydrocarbon gases, organic vapours and aerosols containing complex organic compounds.

Raw Gas processing:

The raw gas from gasifier can not be directly used inside the IC engines. It is necessary to convert the raw mixture into a usable fuel for IC engines. The catalyst chamber containing the Polycrack catalyst converts the raw gas into lighter hydrocarbon fractions which are good for use in IC engines along with hydrogen and CO and CO2 and Nitrogen. Also, the liquefiable fractions of the light gases are also separated in the process and the same are collected as liquid fuels similar to Light diesel fuel. The process which is a single catalyst cracking process in vapour phase and consistently crack the raw gases into condensable hydrocarbons and non-condensable hydrocarbons.

The noncondensable gases are a rich mixture of Syngas like composition with higher Methane, Hydrogen and CO and makes for a high calorific fuel. Aerosols are broken in the catalytic system. Into low molecular weight fuel gas constituents and as the catalytic cracking happens at low temperature, the energy loss is minimum in conversion.

Modular Design:

The gasification system is modular in design and designed to process 25 tons per day. In case of higher processing requirements, more modules are added in series. The catalyst system is independent and attached to each module and thus the module works as a single gasifier as complete in all respects.

The common facilities will be Biomass storage, pre-drying, waste heat recovery system, Cooling towers, scrubber fluid treatment system, whereas the gasifiers are modular in design.

PROCESS DESCRIPTION

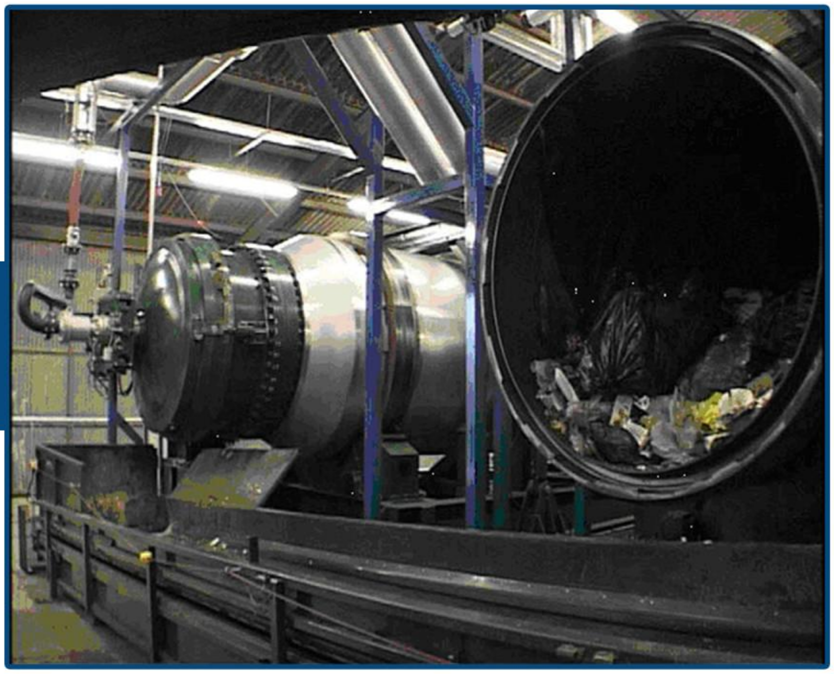
Gas processing:

The gasifier is connected to a catalytic converter. The catalytic convertor carries the Polycrack Catalyst. The catalyst has a fixed bed type design. The gases generated in the gasifier are passed through the Polycrack catalytic convertor. The unique proprietary catalyst has the ability to crack the high molecular weight gas and aerosol molecules to low molecular weight molecules and thus release a uniform composition gas containing significant percentage of Hydrogen, Methane, CO which are main contributors to the calorific value of the gas for use in IC engines. Further, the catalyst chamber arrests particulate matter and the gas released thus is free of PM and clean. Even though PM filters are not required beyond the Catalytic convertor, PM filters have been incorporated into the system as a back up. The Catalyst also has the ability to control alkalis and acid gases. The gasifier itself has an inbuilt dosage system to neutralize acid gases as they evolve.

The gas exits the cracker at a temperature of approximately 250 °C, The gas is passed through a condenser which has a water cooling circuit. The gas temperature is brought down to app 30 deg C., and the water along with other condensable fuels is condensed inside the condensers. The condensate is collected. The condensate is then treated with demulsifiers to separate the oil fractions from the water. The water is filtered to remove any traces of oil and discharged into sewage. The oil collected is view similar to Diesel fuels and thus can be sued to run the IC engines for heating purposes and drying purposes.

The non-condensable gas coming from the condenser is then collected into a gas collection tank and compressed to reduce volume and to increase pressure. The gas is then used to run [C engines to generate power for distribution. Part of the power generated is used to energize the gasifiers for heating.

BIOCOKE REACTOR



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BIOCOKE METHOD

Raw Materials for the system can be made up of both commercial and municipal waste.

The typical composition of the clean gas leaving the Catalytic converter is:

- Constituent Hydrogen
- Methane
- Water Vapour
- Carbon Monoxide
- Nitrogen
- Carbon Dioxide
- Condensable Organic Compounds Temperature 30 - 40 "C

Power Generation and Heat Recovery

The output gas can be used as fuel for the IC engine driven generator sets for the production of electricity. Waste heat generated by the engines is also be recovered and used for drying the wet biomass. As the IC Engines require constant gas pressure to the engines and also to deal with fluctuating gas demand during start up and shut down of the engines, the plant has a flare to burn excess gas and also to provide energy to the gasifier. Waste heat generated by the gas engine can be recovered from the first stage intercooler, oil cooler, waterjacket and engine exhaust. Normally, heat recovered from the exhaust is limited to a final exhaust temperature of 120°C. Non-recoverable heat from the engine are radiation losses, second stage inter-cooling and final exhaust losses. Using a combination of gas engines and the gas fired boiler the power generation facility can be operated in various ways to maximize the overall efficiency while meeting the demands of electrical and thermal requirements.

SUPPLY BY CLIENT: Items not Included within the scope of supply by SUSTECH

a) Civil Works not included.

b) Preliminary Health & Safety plan..

c) Infrastructure any necessary equipment and machinery to facilitate waste reception and handling systems upstream of the MSW loading conveyor as defined.

d) Infrastructure and any equipment or necessary machine to facilitate dispatch of separated materials including collection containers for separating materials downstream of separated materials conveyors discharge points.

e) Provide the necessary clearances and permissions from the government and government bodies.

TENTATIVE EQUIPMENT SYSTEM LIST

1	Conveyor system	2 Systems
2	Drying system	1 System
3	POLYCRACK system for processing of plastics	1 System
4	Material segregation system	1 System
5	Segregated material collection bins	1 System
6	Lifting equipment	2 Nos
7	STEPS BIOCOKE System	1 System

Further details can be had from: **www.sustechofamerica.com**

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