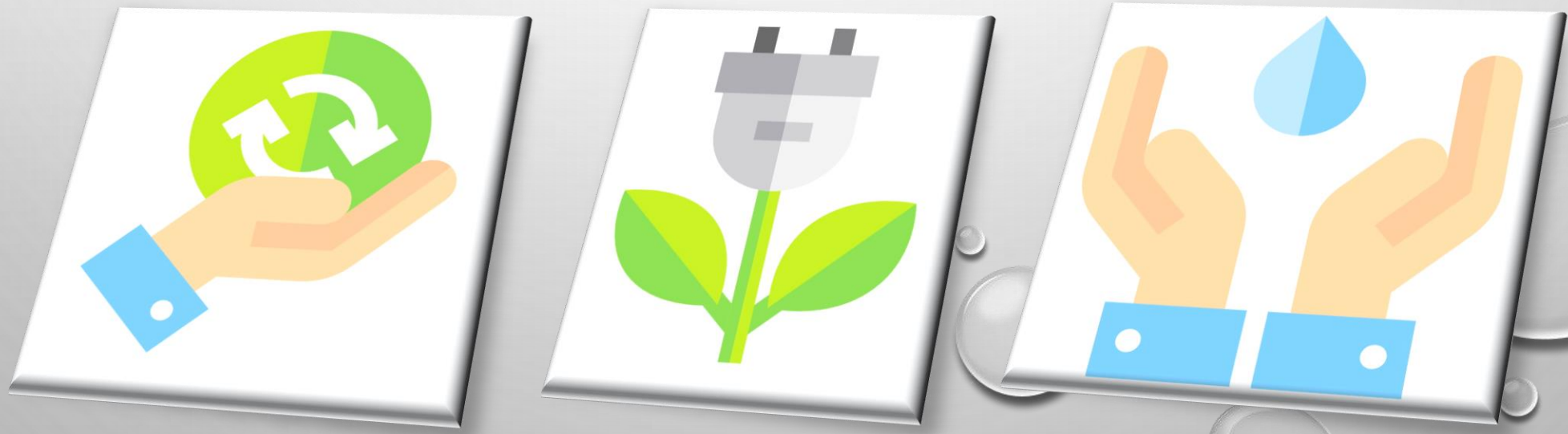
ECOLOGICAL CLEAN UTILIZATION OF MUNICIPAL SOLID WASTE (MSW) WITH CONVENTION INTO GREEN ENERGY



INTRODUCTION

- It has been said that the growth of any country can also be determined to a large extent on the availability of basic services. With a more stable and adequate power supply, we can always be assured that progress will continue, as it will ensure sustained economic growth. One of the important aspects of today's environmental problems is to find a viable solution to not only eliminate the unwanted waste but turn it into safe and friendly energy.
- MSW represents one of the biggest environmental problems in the modern world. It contributes by large to global warming and the ozone depletion of the atmosphere. The handling of this problems in a proper way by producing a safe energy from MSW while keeping the environment clean has been a great challenge to mankind.
- MSW and biomass contributes as the world's fourth largest energy source today. It is a versatile source of energy that can be readily stored and transformed into electricity and heat. It also has potential for use as a raw material for production of fuel and chemical feedstock.

- Admittedly, wind and solar energy continue to be good source of electricity applying renewable energy. Landfill gas to energy is a method of harvesting landfill methane for conversion to electricity or for direct use as a fuel for industry or vehicles. It has been proven that this is a long-term contender in the war on man-made greenhouse gases. However, landfill gas contains at least 50% carbon dioxide that does not help the environment. Our technologies converts the MSW into gas in the absence of oxygen. This will eliminate the production of gases such ad furan or dioxin. It also reduces the formation of carbon dioxide. Compared to biomass, the good thing about municipal solid waste is the fact that there is a systematized and established collection for it.
- Landfill methane gas is generated by decomposing organic material in municipal solid waste like food, yard waste, leaves, grass, paper, and lumber, and accounts for about a quarter of total man-made methane emissions. Today the most common problem for landfill owners is the buildup of garbage. However, they cannot simply burn the trash because there are laws like the clean air act that prohibits them from doing it. With the use of garbage as fuel to power generators, the garbage build up problem can be resolved.
- Studies show that beyond the landfill gas' local volatility, due to methane's heat trapping ability, this greenhouse gas warms the earth 23 times more than carbon dioxide. Thus, it only makes sense to use this landfill MSW and convert it into gaseous fuel to either directly run an industrial boiler or kiln, or run a turbine that can generate electricity.

MSW PROCESSING TECHNOLOGY

1) WASTE SORTING SYSTEM
2) SIAFU TECHNOLOGY
3) PELLETIZING
4) THERMO-CONVECTION SYSTEM

+ THERMAL-DISTILLATION

1) WASTE SORTING SYSTEM

- MSW is shredded in a primary shredder, which shreds all waste to 300mm fractions. Waste is then passed to an overhead-belt magnetic separator that separates metal that can be sold for recycling.
- Remaining waste continues to a wind shifter, which separates heavy fraction (remaining metals, glass, stones, etc.) And light fraction (plastics, rubber, paper, etc.). Heavy fraction is removed from the waste stream, since it contains no energy and can damage the equipment. Parts of the heavy fraction can be recycled (glass) and others can be used in the construction industry.
- Separated light fraction is then sent to an optical sorting system, which uses optical scanning to identify and remove specific material, as configured by the system operator (for example, valuable plastic or unwanted plastic, such as PVC).
- Remaining waste then passes to a final sorting station where unusable waste is manually removed. This is performed in a sorting cabin with several work stations and a state-of-the-art air filtration system to ensure safe working conditions
- After sorting is complete, waste is shredded in a secondary shredder, which further reduces its size to 100mm (ideal for further processing). Waste is then stored in a temporary storage bin and fed to the Siafu system.

2) SIAFU TECHNOLOGY

- Siafu technology is a unique and revolutionary method of waste treatment that accomplishes three critical goals in just one step:
- - Dries input material (biologically degradable, pre-sorted waste) to whatever moisture is desired (usually 15%);
- - Eliminates odor from waste by sterilizing and killing all bacteria;
- - Brakes the material on molecular level and convert it into new product with highcalorific value, which is ideal for pelletizing or briquetting.
- The technology is based on a patented high-speed milling process that is very clean and efficient. High-speed impact during the process disrupts the surface of waste to shred it to millimeter size. Temperature of 500°C is achieved for organic fraction of a second in order to concurrently sterilize it and evaporate water. A specially developed activator increases the calorific value. The result is clean product, and clean steam. A single unit has a capacity of 8-10 tons per hour, with low electricity consumption. The unit is very compact and can be stored in just two 40’ containers.

3) PELLETIZING

- The final stage of the process is pelletizing, which creates very dense (up to 800kg/m3) refuse-derived fuel (“RDF”) pellets. The density of the pellets greatly improves efficiency of the Thermo-convection process (as well as other technologies that use RDF pellets), and their reduced size decreases transportation costs.
- Feedstock created by the Siafu is ideal for pelleting due to its small particle size and low moisture content.
- Standard pellet diameter is 12mm, with additional sizes available if required. The process generates Siafu pellets (“SP”), a high calorific value, dry and fully sterilized fuel that is very efficient and affordable.
- SP have a very high calorific value of 15-20MJ/kg (dry), which equals, or even exceeds, that of wood pellets. The exact heating value depends on the input material, the process does change the chemical composition.
- It can be used for many applications, such as commercial heating, residential heating, and production of electricity. Moreover, SP production costs are 3 time less expensive than traditional drying technologies, making it a far superior product. The pellets are particularly suitable for processing through Thermo-convection system.

4) THERMO-CONVECTION SYSTEM

- The thermo-convection system consists of a compact unit with two retorts. The raw material is received in the upper retort and exhausts from the lower retort. The upper retort acts as a fast thermo-unit, while the lower retort operates at a slightly higher temperature and residence time and will be the slow thermo-convection system.
- The residence time for the system can be up to 3.5 hours depending on the material and the temperature requirements.
- As the material moves through the system it decomposes into different chemical components. The further process of the material is focused on maximizing the production of gas and minimizing the production of liquid fuels. Liquid fuels are produced only when the system is directed to. In the case of producing liquid fuels, the system will be operated at a lower temperature so the hydrocarbons produced minimize breaking beyond C5's.
- The gas produced carries some carbon with it as it exits the system. Trying to capture these carbons before it goes into the wash system, the gas is moved through a carbon capturing box where the gas velocity is reduced from 8.0 meter /sec to 0.6 to 0.8 meters/sec levels. At these velocities the carbon particles are too heavy for the gas to carry through and they drop in the carbon separation box. The gas moves next through a gas filter system where most of the carbon heavier than 1 micron will get separated from the gas.

- The gas moves through 3 more cooling sections;

  - in section 1 the gas is washed with an oil. The water and carbon is separated from the gas. Any heavy condensable gases also turns to liquid.

  - The remaining gases move through the second scrubber and the temperature of the gas is reduced to around 40 °C.

  - From the second scrubber the gas moves through a chilled condenser where the final temperature is not higher than 15 °C.

- In this case 99% of all condensable gases are removed and the gas is clean to be used for the operation of the system and for power generation using a gas generator.

- The gas at this stage is transferred through high quality blowers. The blowers are designed to operate according to the gas production in the retorts through a pressure control system. The retort pressure is normally kept at a negative level around -50.00 to -100.00 mm of water column.

- The clean gas is transferred into an intermediate gas tank from which it is transferred to storage tanks using high pressure compressors. Thermo-convection system normally does not supply the compressors, but as a separate item, can supply the gas compression and storage tanks including the electronic controls for automatic performance of the system.

- The feed material must be densified to over 320 kg/m^3 for proper operation. Low density material will produce gas at an efficient level. This is the process needed to make the system work:

    1. Waste material is processed so it has minimum amount of inorganics such as rocks, metal or glass.

    2. Waste material is shredded to fine pieces.

    3. Waste material is densified to little cubes or higher density pellets.

    4. Material is transferred into the system through augers or belts at a rate determined bythe controls.

    5. Carbon is removed from the bottom through a cooling auger and stored for either sellor removal from the plant.

    6. Oil, if any, will be cleaned up through a centrifuge system supplied by Thermo-convection system and isrecirculated for the cooling purposes. Extra oil is transferred to an oil tank for sale purposes.

    7. Water is removed and is cleaned up for discharge.

    8. Carbon is removed and stored for reuse or discharge.

    9. Gas is transferred into storage tanks using high efficiency compressors from which theyare regulated to be used as fuel for the pyrolysis system and for the production of electricity.

    10. High efficiency generators are used to produce power.

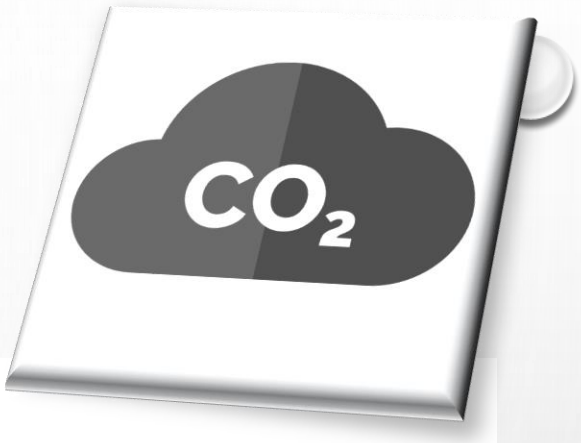
THE THERMAL DISTILLATION TECHNOLOGY

- The thermal-distillation unit is a skid mounted, self-contained unit designed to convert waste into hydrocarbon fuels suitable for clean combustion and generation of electrical power.
- The unit consists of gas heated retort with internal transport augers, gas cleaning and condensing components, gas and liquid pumps, cooling tower and a storage tank.
- The following components are the major parts of the thermal-distillation system:
    - 1. The furnace
    - 2. The auger
    - 3. The retort
    - 4. The burner
    - 5. The particle wash system
    - 6. The condenser
    - 7. The gas blower
    - 8. Storage tank
    - 9. The cooling tower

- System operation:
  - The burner in the furnace is started and a flame is established monitoring three important items such as furnace temperature, retort temperature and retort pressure. The retort pressure is kept at a slight negative level. This helps to raise the retort temperature faster and ensure a safe operation. As the burner operates, it will increase the temperature of the thermal-unit until the desired temperature is reached.
  - At this point material can be fed to the retort via the air locked valves initiating the thermal-distillation process. Once the preset retort temperature is reached the burner will automatically shut down. The burner will not re-energize until another preset burner starting temperature is reached in the ideal preset operating temperature.
  - As the material begins to gasify, the gases will build a pressure which is higher than the preset negative retort pressure, the pressure transducer senses this change and sends a signal to the gas blower which is programmed to response to this demand by bringing the pressure down to the preset level.
  - The gases are drawn constantly from the retort and washed out of dust, dirt and may be some pollutants such as sulfur compounds. Once the gas is washed, in the next two stages of operation it is important that all condensed liquids are separated from the gas using a condenser and water separators before it reaches the gas blower.

- The gas blower sends this gas to an immediate tank at a low pressure from which it is drawn and kept in a higher pressure tank. The condenser is cooled using a cooling tower, which recirculates the water as a cooling media to the condenser and the gas washing heat exchanger.
- Once the thermal-distillation process is completely finished, the unit has to run for at least another hour in order to gasify the material that was just introduced to the unit. It is important that the furnace temperature is monitored to make sure the flame temperature does not increase beyond 1050C. Although the retort is manufactured using high temperature alloys, it is key that too high temperatures are avoided at all time. This will insure a long retort life.

AIR EMISSIONS



Air Emissions:
Emissions for Pyrolysis/Gasification Facilities/Technologies
(Values are in mg/Nm^3 unless noted.)

	PM	NO_x	CO	VOC	SO_2	Dioxins/ Furan (ng – TEQ/Nm^3)	HCl	Cd	Pb	Hg
Regulatory Limits										
U.S. EPA Limits	18.4	219.8	89.2		61.2		29.1	0.01533	0.1533	0.0613
ARTI Limits	0	<50	<40		<30	ND	ND	ND	ND	ND

Notes:
PM = particulate matter - NOx = oxides of nitrogen - CO = carbon monoxide
VOC=volatile organic compounds - SO_2 = sulfur dioxide - Cd = Cadmium,
Pb=Lead – Hg= Mercury

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