Gasification

(TurnW2E™ Gasification; Enhanced Gasification Performance)

TurnW2E™ Gasification is waste-to-energy-through-gasification technology (WTETG) that is able to convert a variety of waste materials into renewable and alternative energy products. The technology can process virtually any carbonaceous material, converting it into forms of usable energy that can be consumed or sold easily.

At the core of the TurnW2E™ Gasification technology is an advanced gasification process. Gasification is a well-known technology for converting materials into a clean-burning synthesis gas, which is then combusted for power production, or further processed to produce hydrogen for transportation fuels, or ammonia for use in fuel cells or as fertilizer. The history of gasification process development goes back many decades. At present, in the US and abroad, there is significant experience with wood gasification at various system sizes, and with coal gasification, at relatively large applications. The process, developed by W2E, has incorporated the best elements of past gasification designs and performances to yield a very flexible and reliable waste-to-energy system. It is called TurnW2E™ Gasification.

WHAT IS GASIFICATION?

Gasification converts any carbon-containing material into a synthesis gas (syngas). The syngas is a combustible gas mixture - sometimes known as 'producer gas' - and it typically contains carbon monoxide, hydrogen, nitrogen, carbon dioxide and methane. The syngas has a relatively low calorific value, ranging from 100 to 300 BTU/SCF. The syngas can be used as a fuel to generate electricity or steam. Alternatively, it can be used as a basic chemical building block for a large number of applications in the petrochemical and refining industries.

The overall thermal efficiency of gasification process is more than 75%. Gasification can accommodate a wide variety of gaseous, liquid, and solid feedstocks and it has been widely used in commercial applications for more than 50 years in the production of fuels and chemicals. Conventional fuels such as coal and oil, as well as low- or negative-value materials and wastes such as petroleum coke, heavy refinery residuals, secondary oil-bearing refinery materials, municipal sewage sludge, hydrocarbon contaminated soils, and chlorinated hydrocarbon byproducts have all been used successfully in gasification operations.

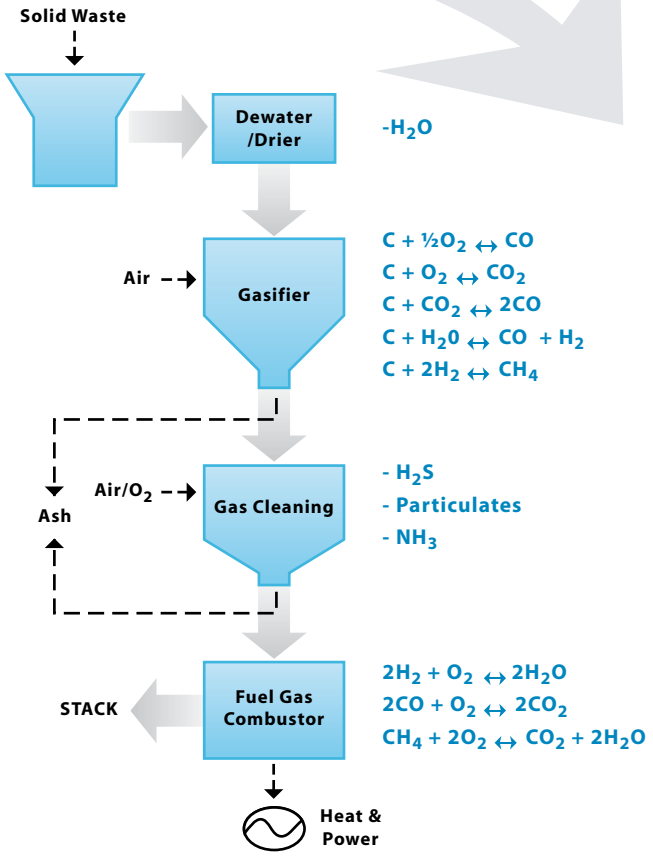
CHEMICAL REACTION OF GASIFICATION

The chemical reactions in gasification process take place in the presence of steam in an oxygen-lean, reducing atmosphere. The ratio of oxygen molecules to carbon molecules is far less than one in the gasification reactor.

A portion of the fuel undergoes partial oxidation by precisely controlling the amount of oxygen fed to the gasifier. The heat released in the first reaction provides the necessary energy for the other gasification reaction to proceed very rapidly. In the TurnW2E™ system, gasification temperatures and pressures within the refractory-lined reactor typically range from 800°C to 1200°C and near atmospheric pressure to few inches of water respectively. At higher temperatures the endothermic reactions of carbon with steam are favored.

A wide variety of carbonaceous feedstocks can be used in the gasification process. Low-BTU wastes may be blended with high-BTU supplementary fuels such as coal or petroleum coke to maintain the desired gasification temperatures in the reactor.

The reducing atmosphere within the gasification reactor prevents the formation of oxidized species such as SO_2 and NOx which are replaced by H_2S (with lesser amounts of COS), ammonia, and nitrogen (N_2). These species are much easier to scrub from the syngas than their oxidized counterparts before the syngas is utilized for power.



GASIFICATION Vs. INCINERATION

While gasification and incineration are both thermal processes, it is important to point out the advantages of gasification over incineration. Incineration is simply a mass burn technology with heat recovery to produce steam and/or electricity. It has negative connotations because during the direct combustion of the waste,

1850 to 1940
- Production of "town gas" for light and heat
- Gasification of coal - All gas for fuel and light

1940 to 1975
- Production of synthetic fuel
- Production of liquid fuel and chemicals

1975 to 1990
- First Integrated Gasification Combined Cycle (IGCC) electric power plant

1990 to 2000
- US agencies provided financial support for IGCC process

2000 to present
- Turnkey thermal & power Green house gas from biomass
- Renewed focus on reducing GHG emissions
- Biomass to liquid fuel conversion commercialized

dangerous carcinogenic compounds such as dioxins and furans are formed, which are discharged into the atmosphere. In contrast, gasification employs the conversion of waste into syngas, which can then be used for generating steam and/or electricity, for producing chemicals for high-value products, or for producing liquid fuels. The synthesis gas is produced under controlled conditions, and is generated without the formation of impurities associated with incinerator flue gas. Gasification emissions are generally an order of magnitude lower than the emissions from an incinerator.

Key differences between Gasification and Incineration:

INCINERATION	W2E GASIFICATION
Combustion Vs. Gasification	
Designed to maximize the conversion of waste to CO_2 and H_2O	Designed to maximize the conversion of waste to CO and H_2
Employs large quantities of excess air	Operates under controlled amount of air
Highly oxidizing environment	Reducing environment
Gas Cleanup	
Treated flue gas discharged to atmosphere can contain dioxins and furans	Cleaned syngas used for chemical production and / or power production (with subsequent clean flue gas discharge)
Fuel sulfur converted to SOx and discharged with flue gas	Recovery of reduced sulfur species in the form of a high purity elemental sulfur or sulfuric acid byproduct is feasible
Residue and Ash Slag Handling	
Bottom ash and fly ash collected and disposed as waste	Bottom ash and fly ash collected and disposed of as waste

GASIFICATION FEEDSTOCK

There are many carbonaceous materials that are suitable for gasification. These include wood, paper, peat, lignite, coal, including coke derived from coal, saw dust and agro-residues. All of these solid fuels are composed primarily of carbon with varying amounts of hydrogen, oxygen, and impurities, such as sulfur, ash, and moisture. Municipal Solid Waste (MSW) is also a good candidate for gasification; however, it poses a special challenge for waste processors, due its non-homogenous characteristics, high moisture content and unpredictable calorific value. W2E has overcome this challenge by designing a unique gasifier.

Thus, the TurnW2E™ gasification process presents a new and better method for the treatment of non-homogenous waste streams.

Gasification is fast becoming a favored technology for recovering energy from MSW and other solid wastes, and the TurnW2E™ Gasification system is available at commercial scale to provide this service to the industry.

GASIFICATION TECHNOLOGIES

Moving Bed: The fuel is dry-fed through the top of a reactor onto a bed – usually a slow-moving metal grate. As the fuel descends, it reacts with gasifying agents (steam and oxygen) flowing in a counter-current through the bed. The syngas has a low temperature (400-500°C) and contains significant quantities of tars and oils.

Entrained Flow: The fuel and gasifying agents flow in the same direction (and at rates in excess of other gasifier types). The feedstock – which may be dry-fed (mixed with nitrogen) or wet-fed (mixed with water) – goes through the various stages of gasification as it moves with the steam and oxygen flow.

Fluidized Bed: The fuel, introduced into an upward flow of steam/oxygen, remains suspended in the gasifying agents while the gasification process takes place.

Rotary Reactor: Gasifying agents, air and/or oxygen and steam are introduced along a rotating horizontal cylindrical reactor vessel. Gasification takes place along the length of the vessel in stages until Syngas is released from the end while ash drops out. Rotary reactors, such as the TurnW2E™ developed by W2E, enable complete mixing of the gasifying agents with air while the process is closely controlled by the rotational speed and air flow. The lower gas temperatures (800-900°C) - while high enough to volatilize tar and oils – allows easier handling of ash.

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Providers of
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Waste to Energy Systems