

What is Gasification?

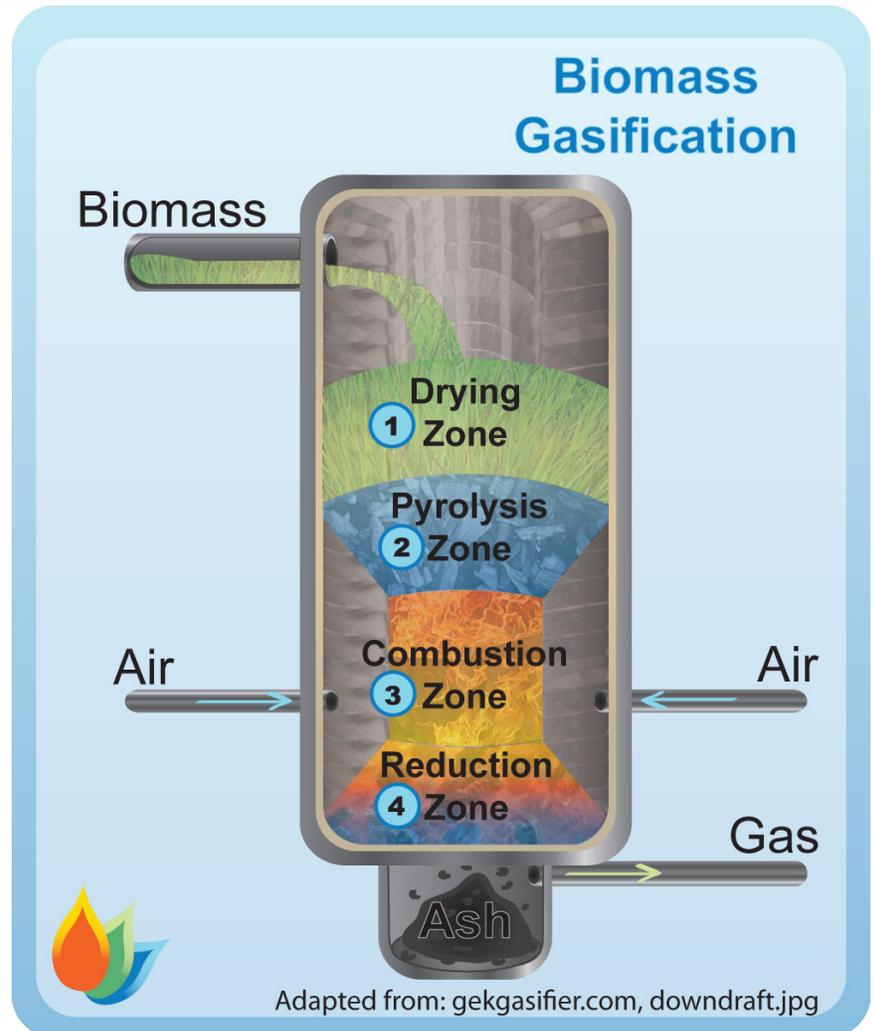
Gasification is a slight variation on the combustion process. Utilizing chemical reactions at high temperatures (~800°C) and under high pressure, steam and reduced oxygen solid organic materials (biomass) are converted into combustible gases (carbon monoxide, methane, and hydrogen). Other secondary by-products include charcoal and tars.

The combustible gases are referred to as syngas (from synthesis gas or synthetic gas) and can be used as a fuel or used to manufacture fertilizers, pure hydrogen, methane, or liquid transportation fuels. Feedstocks can include waste materials from the forestry and agricultural sectors, as well as household and food industry waste. This type of gas is considered a form of renewable energy because, when managed sustainably, the feedstocks are part of a closed-loop carbon cycle. This means the carbon that is emitted during the burning phase is recaptured from the atmosphere during the growth phase.

How Gasification Works?

Gasification is a series of chemical reactions, which take place in the controlled environment of a gasifier. There are multiple types of gasifiers and the model chosen is dependent on the feedstock to be gasified. The process itself can be broken down into various stages:

1. Biomass fuel is heated in a reduced oxygen gasifier chamber to about 100°C under high pressure (about 1000 lbs per in²) so that drying occurs.
2. Pyrolysis follows at 200-300°C. During pyrolysis, volatiles in the form of gas and



liquids are off gassed and solid char rich in carbon is left behind. It is this char that will undergo gasification reactions.

3. Combustion occurs as the previously produced volatiles, along with some of the char, reacts with limited amounts of oxygen. This creates carbon dioxide and small amounts of carbon monoxide. The combustion provides heat for the subsequent gasification process to occur.

4. Gasification happens once the char starts to react with carbon and steam to generate carbon monoxide and hydrogen. It is this mixture of carbon monoxide and hydrogen, which comprises syngas. Whatever parts of the fuel are not converted, are reduced into charcoal and tar and fall into an ash bin.

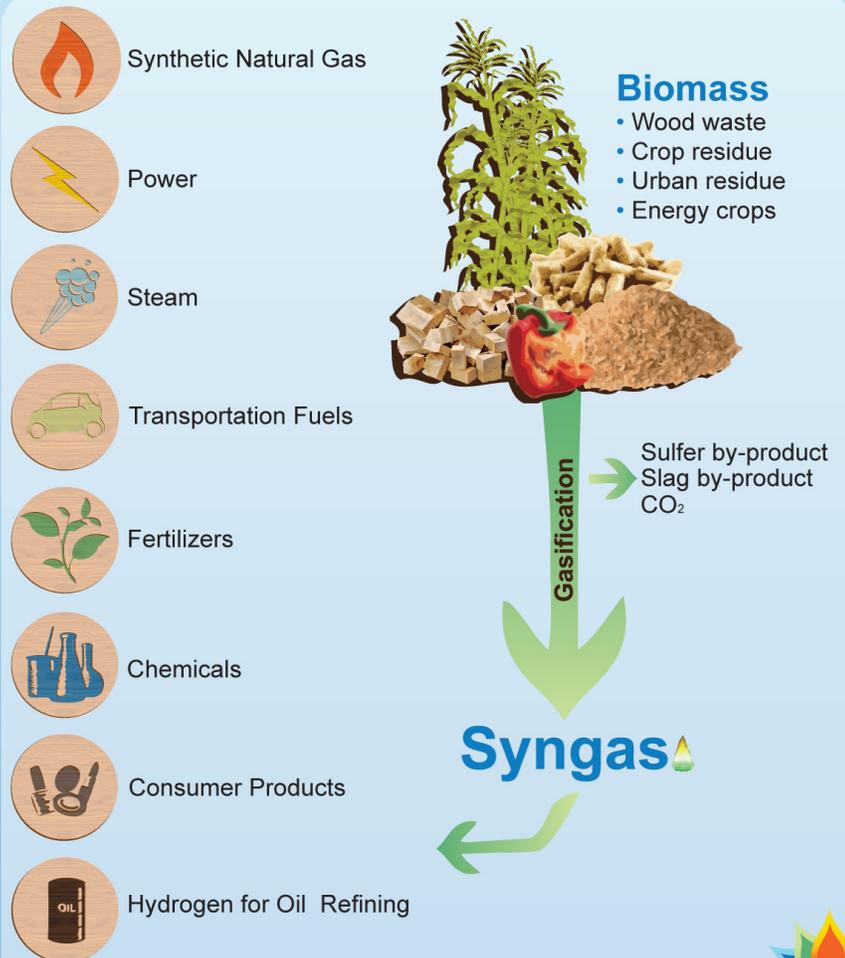
Syngas undergoes various cleaning (scrubbing) processes after creation to remove particulates and soluble components, and to separate it from other desirable products.

Syngas mixed with oxygen can be burnt in much the same way that natural gas or propane is combusted. The gas can be used to power turbines, create electricity, or used in modified combustion engines. Syngas can also be converted to bio-alcohols, which are then separated and purified to produce ethanol, methanol, and other valuable products.

Benefits of Gasification

- Gasification displaces the use of fossil fuels by making use of waste materials and renewable resources to generate fuels and energy.
- Renewable energy strengthens local energy independence while reducing dependence on foreign oil and other fuels.
- Products of gasification can include syngas, fertilizers, pure hydrogen, methane, or liquid transportation fuels. This value-added production stream creates local wealth and jobs.
- By using secondary sources of biomass such as farm residues, municipal waste or waste from the food industry, a great deal of waste is diverted from landfills to generate renewable energy.
- Gasifying waste products kills bacteria and eliminates odour, which lowers the risk of soil and water contamination by creating only small amounts of ash and tar in the process.

Biomass Gasification Products



Adapted from: zeep.com, GasificationProducts.gif

Information Sources:

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