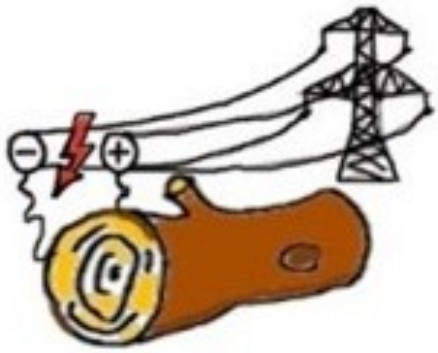
woodgas



Context

Gasification is most simply thought of as a process of staged or choked combustion. It is burning solid fuels like wood or coal without enough air to complete combustion, so the output gas still has combustion potential. The gas produced by this method has varified names: “wood gas”, “syngas”, “producer gas”, ““town gas”, “generator gas”, and others.

The input to gasification is some form of solid carbonaceous material– typically biomass (wood) or coal. All organic carbonaceous material is made up of carbon (C), hydrogen (H) and oxygen (O). The goal in gasification is to break down this wide variety of forms into the simple fuel gases of H_2 and CO_2, hydrogen and carbon monoxide.

Booth **hydrogen and carbon monoxide are burnable fuel gasses**. We do not usually think of carbon monoxide as a fuel gas, but it actually has very good combustion characteristics. Carbon monoxide and hydrogen have about the same energy density by volume. **Both are very clean burning** as they only need to take on one oxygen atom, in one simple step, to arrive at the proper end states of combustion, CO_2 and H_20. **This is why an engine run on syngas can have such clean emissions.**

Four processes of gasification

Now let's complicate things slightly. "Proper" gasification is a bit more than just the "choked combustion" summary above. It is actually a series of distinct thermal events put together so as to purpose convert solid organic matter into specific hydrocarbon gasses as output. Simple incomplete combustion is a dirty mess. The goal in gasification is to take control of the discrete thermal processes usually mixed together in combustion, and reorganize them towards desired end products. In digital terms, "Gasification is the operating system of fire". Once you understand its underlying code, you can pull fire apart and reassemble it to your will, as well as a stunning variety of end products and processes.
Gasification is made up for 4 discrete thermal processes: Drying, Pyrolysis, Combustion and Reduction. All 4 of these processes are naturally present in the flame you see burning off a match, though they mix in a manner that renders them invisible to eyes not yet initiated into the mysteries of gasification. Gasification is merely the technology to pull apart and isolate these separate processes.

Pyrolysis:
Pyrolysis is the application of heat to raw biomass, in an absence of air, so as to break it down into charcoal and various tar gasses and liquids.
Biomass begins to "fast decompose" with once its temperature rises above around 240°C. The biomass breaks down into a combination of solids, liquids and gasses. The solids that remain we commonly call "charcoal". The gasses and liquids that are released we collectively call "tars".

Reduction:
Reduction is the process stripping of oxygen atoms off completely combusted hydrocarbon (HC) molecules, so as to return the molecules to forms that can burn again. Reduction is the direct reverse process of combustion. Combustion is the combination of an HC molecule with oxygen to release heat. Reduction is the removal of oxygen from an HC molecule by adding heat. Combustion and Reduction are equal and opposite reactions.
Reduction in a gasifier is accomplished by passing carbon dioxide (CO_2) or water vapor (H_2O) across a bed of red hot char (C). The hot char is highly reactive with oxygen, and thus strips the oxygen off the gasses, and redistributes it to as many single bond sites as possible. Through this process, CO_2 is reduced to CO. And H_2O is reduced to H_2 and CO. Combustion products become fuel gasses again.

Combustion and Drying:
These are the most easily understood of the 4 Processes of Gasification. They do what we think by common understanding, though now they do it in the service of Pyrolysis and Reduction.
Combustion is what generates the heat to run reduction, as well as the CO_2 and H_2 to be reduced in Reduction.
Drying is what removes the moisture in the biomass before it enters Pyrolysis. All the moisture needs to be (or will be) removed from the fuel before any above 100°C processes happen. All of the water in the biomass will get vaporized out of the fuel at some point in the higher temp processes. Where and how this happens is one of the major issues that has to be solved for successful gasification.

Reference: http://driveonwood.com/learn/basics-woodgas

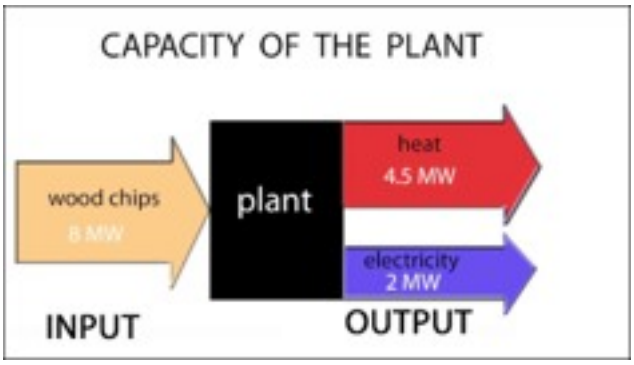
The following movies explain the production of woodgas by gasifying at the Wood gas plant in Güssing/Austria (European Center of Renewable Energies)

Introduction

Please pay full attention to:

- *gasifying*
- *flammable gases*

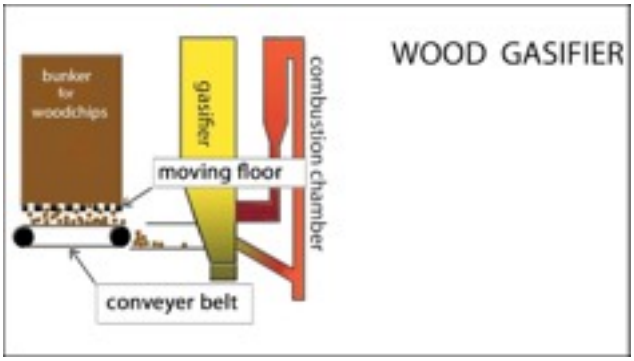
Basics about wood gas



Please pay full attention to:

- *what kind of energy is produced*
- *efficiency*

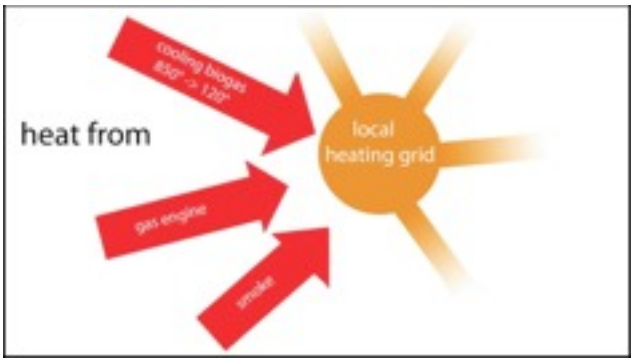
Capacity of the plant



Please pay full attention to:

- *gasifier*
- *combustion chamber*
- *olivine*

The process of wood gasification



Please pay full attention to:

- *local heating grid*
- *gas engine generator*

Heat and electricity from wood gas

Please pay full attention to:

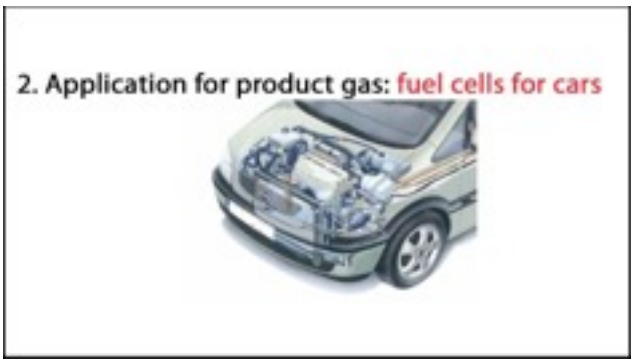
- *flue ash*
- *tar*
- *gas engine*

Purification of wood gas

Please pay full attention to:

- *percentage of methane*
- *methanation*
- *natural gas*

From wood gas to synthetic natural gas



Please pay full attention to:

- *fuel cell*
- *biodiesel*

Two uses of syngas

Task

Do you remember what gasifier, methane or syngas mean? Improve your knowledge: 

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