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# Guide to Biomass Feed Stocks for the GEK Gasifier

version 1-4.x

Sourcing local feed stock for your energy needs is one of the most important parts of your interaction with the GEK Gasifier and PowerPallet systems, or with any biomass energy equipment for that matter. Depending on your bioregion, the season, the existing local biomass processing and distribution value or waste streams that may be available, or the species and type of feed stock- the feed stock distribution, preparation, and storage will be unique to your situation. This guide can not be all encompassing, but will give you an idea to some of the interactions that may be required for some biomass feed stocks.

## Moisture Content

To ensure a quick start up of the GEK systems, use <15% moisture content at first, then when the flare is sustained, the system will be able to take up to 25% moisture content. Anything above this will make it difficult to light the GEK Gasifier and will burden the system with a higher amount of wood tar.

- Methods to measuring the moisture content of your feed stock:
  - **Microwave Method**
    1. Select a random sample of your biomass.
    2. Weigh the sample ( $m_{wet}$ ) and record.
    3. Place the sample in a microwave and microwave for 15-60 seconds.
    4. Record the new weight of the sample.
    5. Repeat steps 3-4 until measured weights stabilize (within the noise of measurements).
    6. Average the last three (stabilized) measurements ( $m_{dry}$ ).
    7. Report the percentage moisture content on a dry basis ( $(m_{wet}-m_{dry})/m_{dry} * 100$ ) note that it is reported dry basis.

Note: you can also use an oven, just be sure not to burn the sample.
  - **Moisture Meter**
    - Moisture meters come with the GEK kits. These will give you an estimate of the moisture content of the wood.
- Too much moisture?
  - Increase air flow and increase heat around the chips. Spreading the chips onto a black tarp in the sun for several hours will bring the moisture content down.

## Particle Size

Up to GEK versions 4.x the particle size needs to be between 0.5-1.5 inches (13-38mm) at length.

Particles below this size have less void space and prevent the flow of gasses through the packed bed of the gasifier. Sawdust and other fine material is best in fluidized bed gasifiers.

Lengths of feed stock above this tend to cause material handling issues such as bridging in the hopper and across the reduction bell in the reactor as well as jamming of the auger. Avoid any long slivers of feed stock.

- Too large or small? <http://wiki.gekgasifier.com/w/page/33062158/Densification%20Machines%3A%20Pelleting%2C%20Briquetting%2C%20Baling%2C%20etc>

After chipping, it is possible that the bulk feed stock might need to be passed through two screens to exclude the particle sizes outside of

the needed range. A simple shaker on a framed screen hung at an angle makes a great automatic sifter for this purpose.

## Fixed and Volatile Carbon Content

Fixed carbon will pass through the gasifier as charcoal which create sites for the reduction reactions. The volatile carbon, however, creates tars in the pyrolysis zone which then are cracked or partially oxidized in the combustion zone. High volatile content can overwhelm the combustion zone and produce only small amounts of charcoal in the reaction which will create a high amount of tar in the gas stream. Try not to use any species that have high amounts of resin or sap. Typical biomass volatile to fixed carbon ratios are about 75/25, it is idea to stay at or below this range.

## Ash Content

Feed stocks with high ash content increases the potential for clinker formation. Grasses and rice tend to have very high silica content that can also have this problem. Clinkers are fused silica and ash created at high heat that become problematic by immobilizing the mass flow through the reactor. Tend to avoid these feed stocks at higher demands or flow rates. It is highly suggested to conduct a few test runs with your feed stock if you are unsure about clinker formation.

## How much feed stock will I need?

First, assess the demand that will be placed on the system in kW or m<sup>3</sup>/hr of wood gas. Your demand should fall within the range of the 10kW (3" bell) and the 20kW (4" bell). The system ranges are as follows:

	<b>10kW (3" bell)</b>	<b>20kW (4" bell)</b>
electrical output	2 - 10kW	4 - 20kW
gas flow output	5 - 27m <sup>3</sup> /hr	10 - 54 m <sup>3</sup> /hr
feed stock consumption range (dry weight)	2.5 - 14 kg/hr	5 - 27 kg/hr

To find the volume of feed stock you will need, measure the bulk density of the feed stock and convert to volume. To find the bulk density, weight a known volume of your bulk feed stock.

## Gas Quality and Feed stock

Gas quality can change across characteristic differences in the feed stock bulk. It is advised to test the tar content of the gas with your given feed stock before running an engine with the GEK. We offer a Research Experimenters Kit that has extra tools for tar testing, gas flow monitoring, extra thermocouples, and flow control as well as some other tools that are useful for investigating the operation of the system and gas quality.

For an example of tar testing across multiple feed stocks check out the Multi Fuel Comparison page: <http://wiki.gekgasifier.com/w/page/6123786/Multi-fuel%20Run%20Comparison>

More information about pre processing and equipment on our forum: <http://gekgasifier.com/forums/>