Aspects of Biomass Preparation

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Bioresidues

- ***Solid*** → branches of wood, agroresidues like coconut shell, cotton stalk, mulberry stalk, weeds like Juliflora Prosopis, ipomia Sizing → Gasifiers → ***Energy***
- **Light residues** → Rice husk, groundnut shell, sugarcane trash, bagasse, coir pith Preprocessing → Gasifiers → ***Energy***

Catch

- Once Biomass usage is contemplated, the question arises “Where is Biomass?” “Forests are being denuded!”.
- Answer
- Grow energy plantation.
- Use waste lands
- Fast growing species of Biomass

Estimates of degraded land availability in India (Mha)

SPWD (1984); degraded (waste) land, quoted in PC (1992)	**Degraded forest** **Degraded non-forest** **Total degraded land**	**36** **94** **130**
Chambers et. al. (1989); land available for tree planting	**Cultivated land** **Strips and boundaries** **Uncultivated, degraded land** **Degraded forest land** **Land for tree planting**	**13** **2** **33** **36** **84**
Kapoor (1992); land available for tree planting	**Agricultural land** **Forest land** **Pasture land** **Fallow (long)** **Fallow (short)** **Urban land** **Total land for tree planting**	**45** **28** **7** **10** **15** **1** **106**

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Ministry of Agricultural (1992); land use statistics	**Forest land with < 10 % tree crown cover**	**11**
	Grazing land (pasture land)	**12**
	Tree groves degraded)	**3**
	Culturable waste	**15**
	Old fallow	**11**
	Total	**52**
	Current fallow	**14**
	Total degraded land	**66**

Productivity from this land:

- **5 to 20 dry tonnes/hectare/year.**
- **Since most of the land is degraded, one can compute potential at 6 tonnes/hectare/year. For 60 million hectares, the total woody biomass productivity is 360 million tonnes (dry)/year. This is equivalent of 60000 MWe.**
- **The magnitude from bioresidues is comparable to the current installed capacity of power generation in the country – 85000 MWe.**

Biomass preparation methods

- The gasifiers can accept varied ligno cellulosic material and generate producer gas.
- The gas quality largely depends on input fuel quality.
- To obtain good quality gas, the following fuel properties are important
  1. Fuel particle size
  2. Moisture content
  3. Ash content

Fuel particle size

- Use of very large-sized biomass creates very little surface area per unit volume of the reactor (in the reaction zone) so that the volatilisation becomes less than adequate in the given time and the quality of the gas comes down.
- Use of too small-sized biomass leads accelerated pyrolytic products generation to an extent that tar generation is significant even though the gas quality is good in this limit.
- The typical rule of thumb is that one should use biomass size about one sixth to one twelfth of the reactor diameter, preferably a mix of sizes than a single size.

Concept of Bridging and Tunneling

- Bridging is the physical interlock between the feed stock and the walls of the reactor. This do not allow the material to move down.
- Tunneling is seen when loose agro residues is used as such. The air drawn cuts a hole throughout the bed and hence gasification gets affected.
- Bridging can be overcome by proper sizing of feedstock and tunneling from briquetting the loose biomass.

Summary on Fuel size

- The fuel particle size specification varies according to power level of the gasifier.
- A mix of sizes is recommended rather than a single particle size.
- Higher than recommended size can take more time for pyrolysis than the other case and alters the gas quality.
- Lower than recommended size can cause rapid pyrolysis and affects the gas quality.
- Typically a 100 kg/hr gasifier capable of generating 100 kWe in dual fuel mode and 70 kWe in gas alone mode can have a particle size mix in the range of 10 mm X 10 mm X 25 mm to 30 mm X 30 mm X 70 mm.

Technologies for achieving the required fuel size - For solid bio-residues

- The solid bioresidues like wood stocks should undergo size reduction in cutters.
- The woodcutters are basically circular saws rotating at high speeds.
- The biomass has to be fed against the rotating saw to achieve the required cut.
- Thin sticks like mulberry and cotton stalks can be cut using chaff cutter.
- The chaff cutter uses shear forces to size the material.

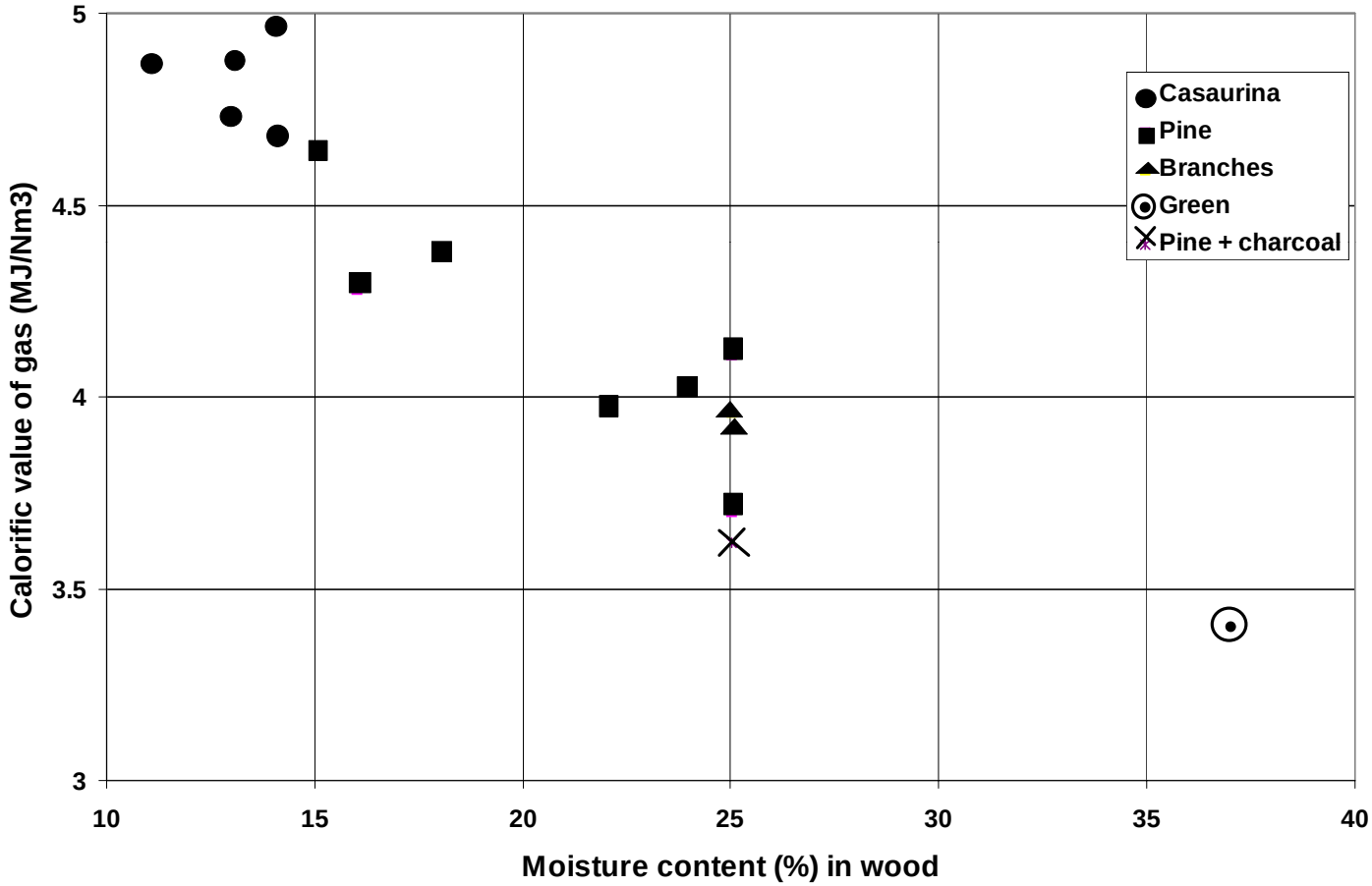
Technologies for achieving the required fuel size - For Loose bio-residues

- Typically agro residues like rice husk, saw dust etc have bulk densities ranging form 80 – 120 kg/m3.
- Transportation of these to sites where power generation is possible involves high transportation charges and consumption of fossil fuels.
- To a certain extent, this can be saved if the light agro residues are densified at site.
- The densification will also qualify these residues for gasification.
- This can be achieved in briquetting machines.

Concepts of briquetting

- Two types of binderless briquetting techniques are practiced
- Screw type
- Ramtype
- Screw type briquetting machines use extrusion principle for densification.
- Ram type briquetting machine employs a ram (piston), which reciprocates in a die where the densification occurs.
- The Ram machine uses flywheel for pressure transfer to bioresidues

Moisture Content



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- Moisture in biomass is due to interaction with the atmosphere
- Typically the moisture content for god gasification should be less than 20%
- Methods of reducing the moisture content
  1. Sizing the fuel increases the surface area of the fuel and hence drying can be faster.
  2. Spreading and sun drying will remove surface moisture, but the draw back is it involves more time
  3. Use of dryers

Dryers

- Types of dryers
- Direct dryers
- Indirect dryers
- In Direct dryers, hot air or flue gases intimately mix with material.
- In indirect dryers, heat is transferred to materials trough a metallic surface.
- Typical direct dryers are fluidized bed and Flash driers.
- The direct dryers have advantage of better efficiency and require less heat transfer area.
- The process should be well controlled or the dryer may end up being a combustor.