Biomass Logs: A Densified Fuel or Feedstock for Combustion, Liquefaction or Gasification

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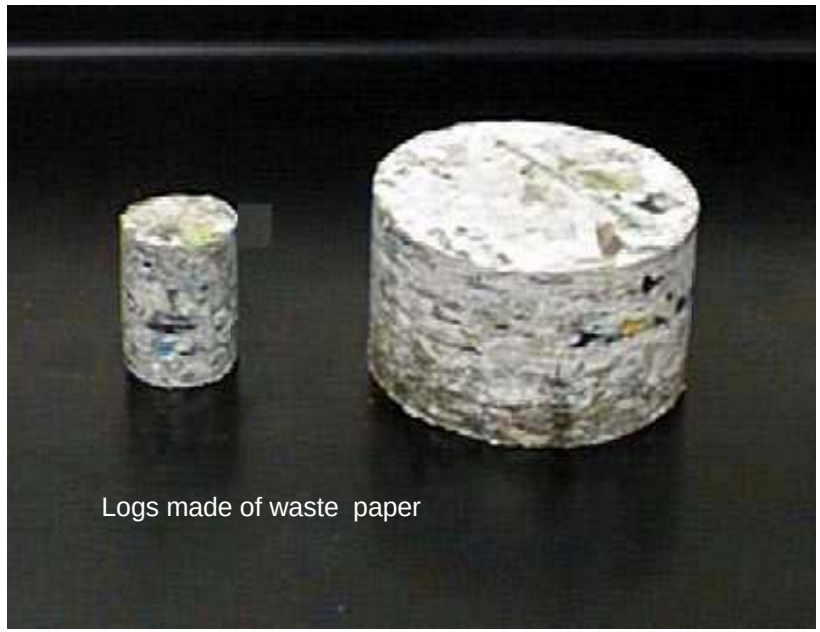
What is biomass log?

Biomass log is a densified biomass material of cylindrical shape.

Log made of dry grass



Logs made of waste paper

Why densify biomass?

Answer:

1). Biomass such as forest waste or crop residues usually has very low bulk density, making handling, transportation and storage of such biomass difficult and expensive.

Why densify biomass?

2). By densifying biomass, much cost can be saved in the handling, storage and transportation of biomass. For instance, by densifying raw biomass 4 times, one instead of four trucks will be needed to transport the same weight of biomass, and one instead of 4 silos will be needed to store the same weight of biomass.

(Common range of biomass log densification: 4 to 10 times.)

Why densify biomass?

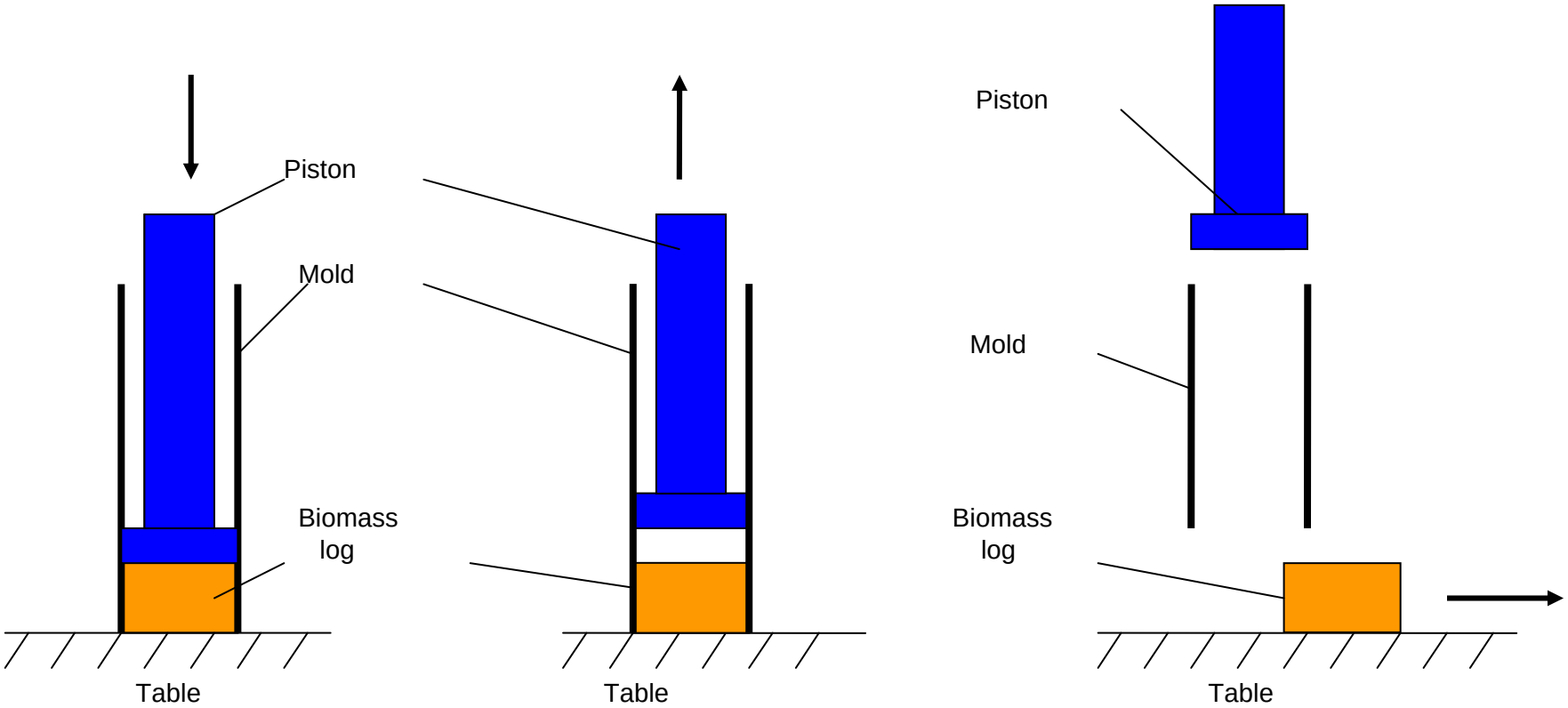
3). Densified biomass has higher energy density and hence burns longer and requires less frequent feeding of fuels. Likewise, when used as the feedstock for bio-reactors, densified biomass has larger production rates.

Different methods to densify biomass:

1. **Extrusion**– use extruder (screw or ram types). Shortcomings: need binder or high-temperature to release lignin, thus costly.
2. **Briquetting**– use briquetter, produce pillow-shaped products. Shortcomings: same as extrusion (need binder or high temperature).
3. **Pelletizing** – use pellet mill (pelletizer). Shortcomings: same as extrusion/briquetting.
4. **Uni-axial Compaction** – use piston (plunger) to compact biomass in a mold. Advantages: (a) need no binder or heating, (b) produce large units of uniform shape.
5. **Bailing**

Pellet fuel made by pelletizing biomass

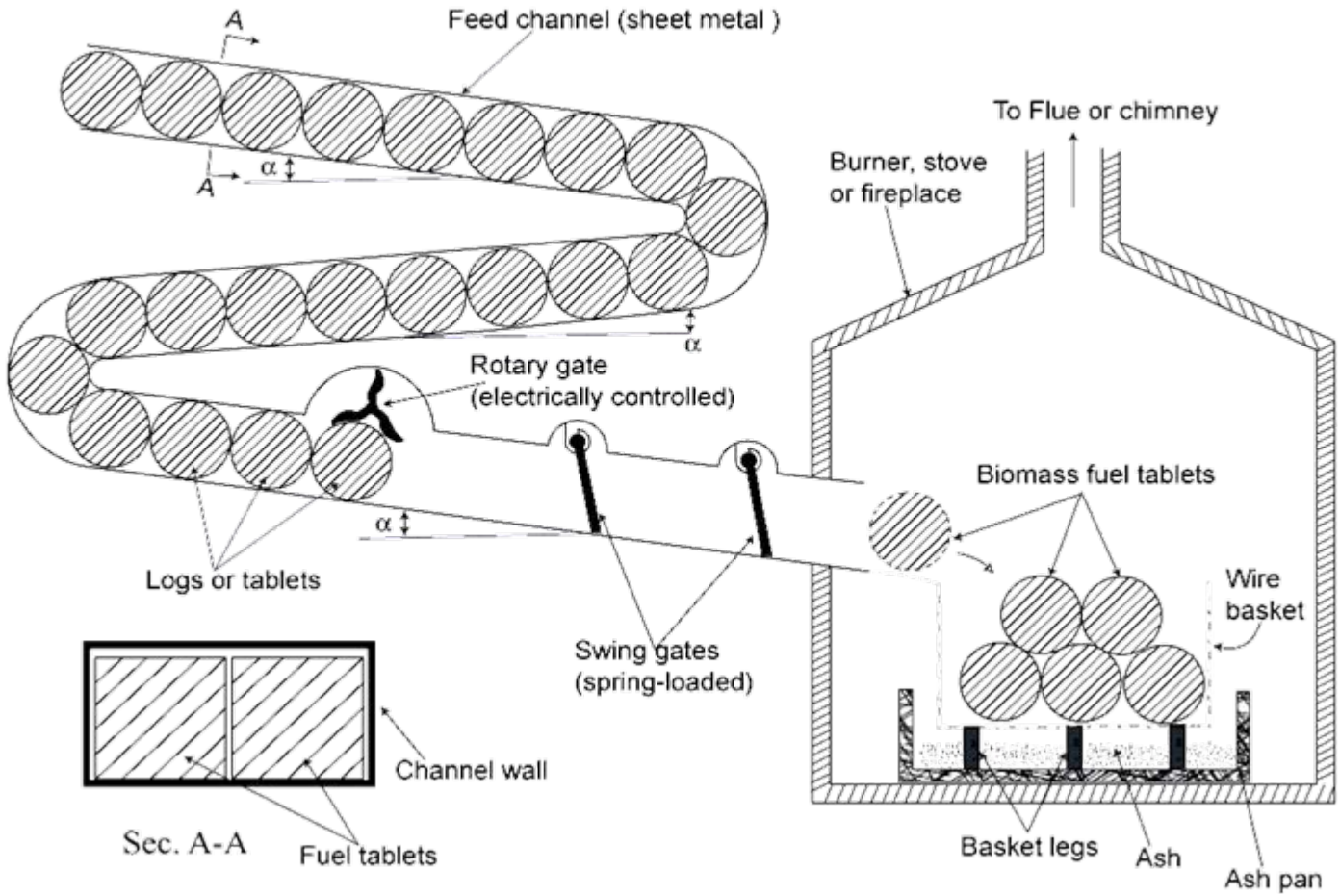
Uni-Axial Compaction



Key Features of Biomass Log Production

- **Use high compaction pressure in the neighborhood of 17,000 psi (117 MPa).**
- **Use uni-axial compaction.**
- **Biomass moisture must be in the range of 3% to 15%, approximately.**
- **The density of biomass logs produced is higher than that of water (Specific gravity in the neighborhood of 1.1.)**
- **Production cost significantly less than that of extrusion, briquetting, and pelletizing.**
- **Cylindrical shape facilitates feeding. How?**

Automatic Feeder of Biomass Logs (US Patent Pending)



Burning Characteristic of Biomass Logs

Some people wonders: with large volume-to-surface ratio, how can biomass logs burn efficiently?

Answer: Upon heating in a burner, biomass logs expands and separate into layers, which facilitates heating. It makes combustion of biomass logs easy.

Water Absorption Characteristic of Biomass Logs

Biomass logs are permeable. They readily absorb water and expand when immersed in water or exposed to heavy rains. This is both a drawback and blessing of biomass logs.

Drawback: The logs must be protected from rain during transportation and storage.

Blessing: When using biomass logs for liquefaction, the logs quickly absorb water and expand, acceleration the rate of hydration of biomass, thereby shortening process time.

How does biomass log fuel burn?

Answer: Very well !

How does biomass log fuel burn?

Answer: Very well !

History of Research on Biomass Logs

In 1998, the National Energy Technology Laboratory (NETL) of the U.S. Department of Energy (DOE) sponsored a 2-year research to explore the biomass log technology. The study was conducted at University of Missouri-Columbia, by a research team headed by Henry Liu.

History of Research on Biomass Logs (Continued)

The DOE project tested more than 30 types of biomass, including different farm residues, different forest residues, different yard wastes, different energy crops, and even components of municipal solid wastes, such as waste paper, waste wood and milk bottles, that are combustible but non- polluting when combusted. In all cases, the biomass was successfully compacted into dense logs without having to use binder or heat. This showed the versatility of the technology to produce biomass log by compaction.

History of Research on Biomass Logs (Continued)

The DOE project also conducted a detailed cost analysis to determine the cost of compacting biomass into logs in future commercial biomass log factories. It was found that the cost of compacting biomass is significantly less than the cost of pelletizing biomass. This means that in the future when mass produced, biomass logs will be cheaper than biomass pellets.

Hurdles that have prevented commercial use of the biomass log technology so far :

Is it lack of cost-effectiveness?

The answer must be **no** because mass-produced biomass pellets are significantly more expensive than mass-produced biomass logs. Since biomass pellets are being used commercially in the U.S. and Canada for heating homes and buildings, the biomass logs, when mass-produced, should have a market.

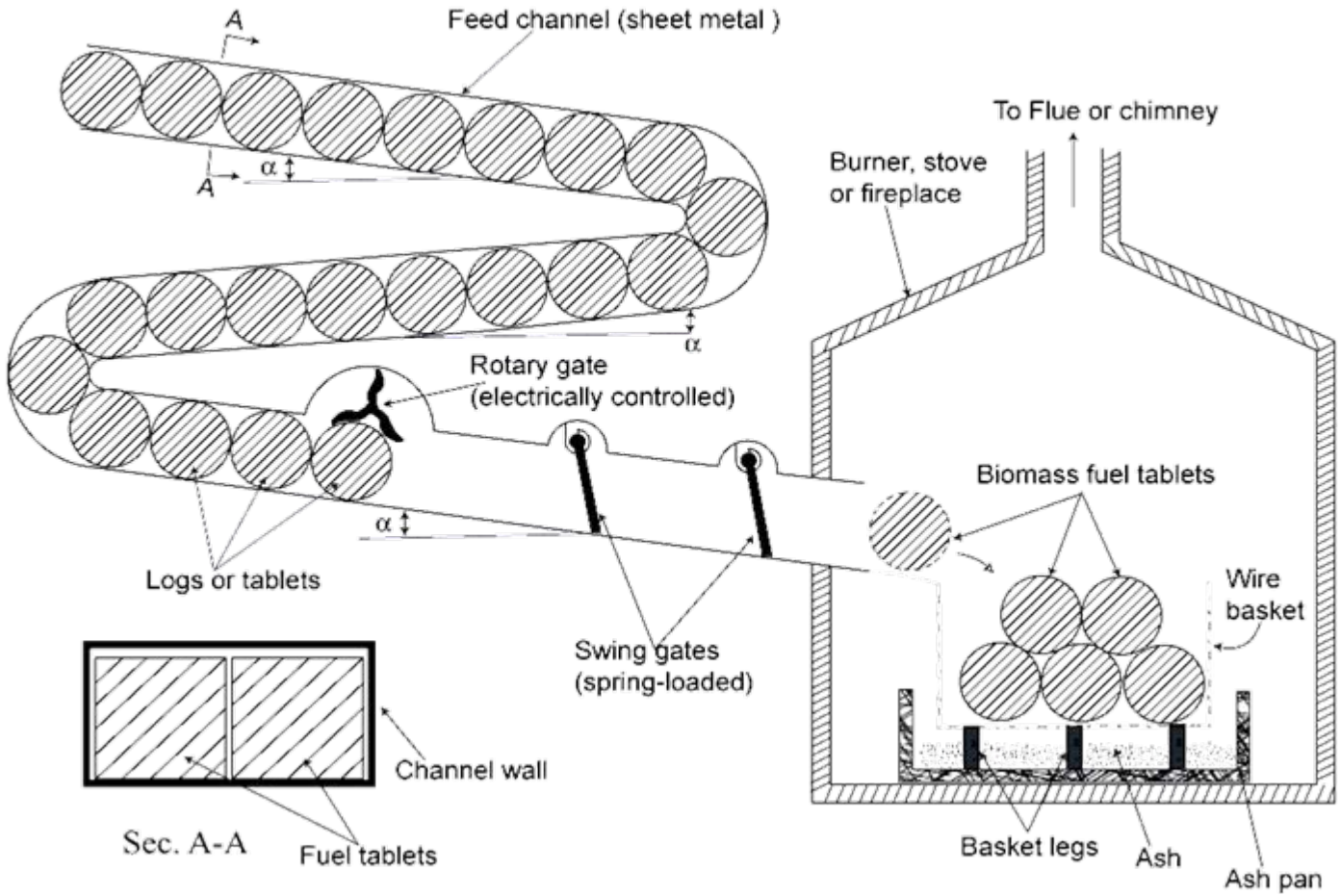
True Hurdles to Commercialization of Biomass Logs

1. No machine suitable for mass production of biomass logs exits today commercially.
2. An automatic feeding system of biomass logs has not been tested and commercialized.
3. Use of biomass logs as the feedstock for liquefaction and gasification of biomass, and for producing biomass briquettes have not been tested.

R & D Needed for Readying the Biomass Log Technology for Commercial Use

1. R & D on mass production of biomass logs and on developing a prototype machine for mass production of biomass logs.
2. Testing an automatic feeding system of biomass logs in feeding logs into commercial burners, stoves, or biomass reactors for liquefaction/gasification.

Automatic Feeder of Biomass Logs (US Patent Pending)



CONCLUSION

1. **Biomass log technology can produce densified biomass for combustion, liquifaction and gasification, at a cost less than producing pelletized biomass.**
2. **Biomass logs are dense (specific gravity 1.1 approx.), uniform in shape, durable, and easy to burn and react in water. The cylindrical shape makes the biomass logs easy to feed by using a special automatic feeder.**

CONCLUSION

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3. More R & D are needed before the biomass log technology can be used commercially. The most needed R & D are test of mass production of biomass logs, and the development of a special compaction machine suitable for mass production of logs made from certain biomass, such as agricultural wastes/residues.

CONCLUSION

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4. **Another much needed R & D for commercializing the biomass log technology is to test a prototype automatic feeder of biomass logs.**

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Thank You!