Biomass Power Generation by CFB Boiler

Koji Yamamoto*

* Manager, Solution Engineering Center

Plant-derived biomass is now considered as one of the most prospective energy sources in the future for reducing carbon dioxide emissions and

Biomass Power Generation by CFB Boiler

- 2. Biomass power generation, problems and countermeasures
- 2.1 Biomass power generation problems

The followings are prospective biomass fuel.

(1) Waste building materials

Wood-derived wastes with inadequate quality for recy-

cling as raw materials for plywood or papermaking.

(2) Miscellaneous waste paper

Paper having problems with too poor quality to be recycled as paper.

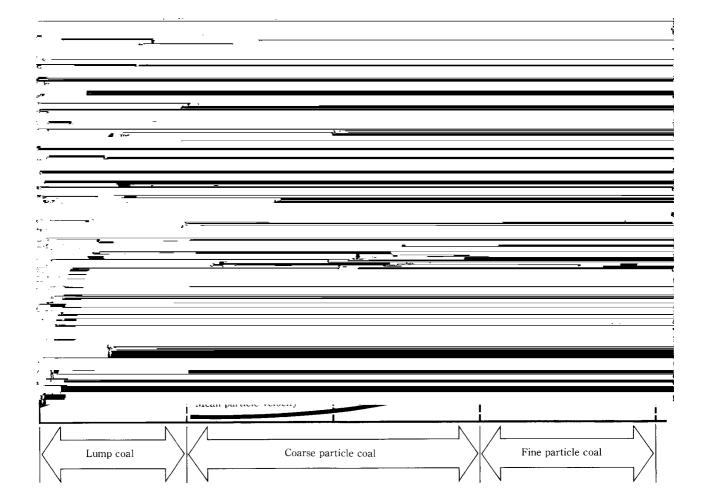
(3) Paper sludge

Organic wastes produced in paper making processes.

(4) Agricultural wastes

Combustion system	Stoker combustion	BFB (Bubbling fluidized bed)	CFB (Circulating fluidized bed)	Burner combustion	
Mechanism of combustion					
Flow of solid fuel	Transported on stoker	Fluidized by combustion air in a layer of the bed material	Fluidized by combustion air and circulated through the combustion chamber and cyclone	Moving in association with the combustion air	
Combustion zone	On the stoker	Within and on the surface of the bed material	Entire area of the combustion furnace	Entire area of the combustion furnace	
Mass transfer in the combustion chamber	Slow	Limited within the concentrated zone	Active vertical movement, and associated with heat transfer	Limited to the direction of gas flow	
Controllability of combustion	Slow response	Medium response	Quick response	Quick response	
Low excess air combustion	Difficult	Possible	Possible	Possible	
Fuel					
Applicability to various fuels	Fair	High	High	Limited	
Fuel pretreatment	Generally not necessary	Generally not necessary	Lumps must be crushed	Fine crushing necessary	
Environmental load					
Low SOx combustion	In-furnace desulfurization not possible	Poor in-furnace desulfurization	High rate of in-furnace desulfurization	In-furnace desulfurization not possible	

Table 1 Comparison of various solid combustion schemes



(4) High equipment economics

As the environmental impact of this system is low, no special exhaust gas treatment facility is required. This results in a simpler configuration of the facilities, which, in turn, reduces the initial investment. This effect is particularly eminent in medium-scale power plants.

These advantages of the system contribute to the solution of problems unique to biomass power generation.

2.2.5° Biomass combustion by CFB for power

generation

Gasification and liquefaction fuel conversion technologies have been proposed for effective biomass utilization. These technologies are, however, all in the developmental stage.

The relations of the problems unique to biomass, the requirements for power generation, and the features of CFB combustion is summarized in Fig.4. This figure shows that CFB boilers system is the most effective method for biomass power generation.

3. Example of biomass power generation plan

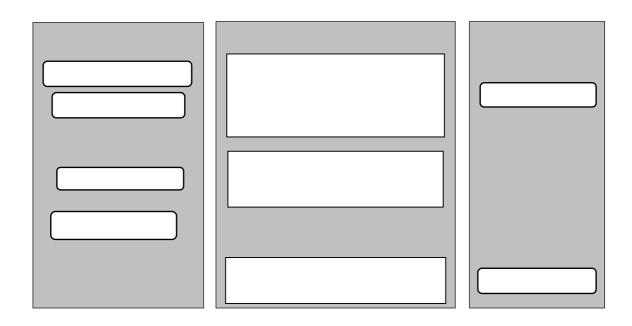
An example of a biomass power generation plan is presented below.

In Japan, the volume of building material waste is assumed to increase as the numbers of private houses rebuilt increases. The Ministry of Construction reported that 6.32 million tons of building material waste was generated in fiscal 2000⁵). This number is expected to increase four-fold by fiscal 2010⁶). **Fig.5** shows the volume and distribution of building material waste.

Fig.5 Volume and distribution of waste building materials

Building material waste fed to recycling facilities are first crushed and compacted. Higher quality chips are recycled as raw material for making plywood or paper. Low quality chips are also created. At present, the amount processed by recycling facilities is limited because the system of such recycled product is not sufficiently established. In other words, the limited demand for low-quality chips is a constraint on the recycling of building material waste as a whole.

If the use of these low-quality chips for fuel is disseminated, the recycling of waste building materials will be realized. Moreover, this application can accommodate the larger amount of building material waste in the near future. With this background, NKK developed a plan for a biomass power plant using CFB boiler to burn low-quality wood chips, and has also presented this plan to various parties concerned.



As a result of this effort, the Japan Wood Preserving Society awarded NKK, jointly with NKK's affiliate in Osaka, a project entitled "Development of Appropriate Recovery and Treatment System by Recycling and Combustion of Wood-based Wastes Including Wood Treated for Preservation." In this project, NKK participated in a feasibility study for a thermal power generation project using wood-based wastes. **Table 2** introduces an outline of this study⁷.

Table 2	Outline of the thermal power station using
	wood-based wastes

Amount of waste building materi-	Total	180 thousand tons/year
als recycled	Power generation	130 thousand tons/year
	Combustion system	CFB
Power generation	Power generation efficiency (generating terminal)	31%
facility	Capacity	20 MW
	Electric power sold to the grid	141 GWh/year
Environmental impact	Reduction in carbon dioxide emission	56.6 thousand tons/year

4. Conclusion

The use of plant-derived biomass as fuel will be expected as one of the most important primary energy sources for reducing carbon dioxide emissions and conserving fossil fuel resources. The effective utilization of waste paper, waste building materials, and such biomass wastes as agricultural wastes are particularly important.

CFB boilers have many advantages including wide adaptability of fuels, low environmental impact, and ideal methods for direct combustion of biomass. CFB biomass is an effective measure for the dissemination of utilization of biomass energy.

NKK is confident to see the bright future of CFB biomass power plant.

References

- Environment Agency. "Quality of Environment in Japan 1997". Printing Bureau. Ministry of Finance. p.477 (1997).
- Kumasaki, M. "Role of Bioenergy in a Society Based on Sustainable Resource Use". JAPAN TAPPI JOURNAL. Vol. 154, No. 11, pp.69 –74 (2000).
- Ministry of International Trade and Industry. "Technical Guideline for Facilities for Thermal Recycling of Paper Containers and Packages". Tokyo, NTT DATA INSTITUTE OF MANAGEMENT CONSULTING INC, p.23 (1999).
- Noma, T. "Significance of Waste Paper Thermal Recycling in Paper and Pulp Industry". JAPAN TAPPI JOURNAL. Vol. 53, No. 1, pp.83 – 91 (1999).
- Construction Byproducts Recycling PR and Promotion Council.
 "Comprehensive Construction Byproducts Measures". Tokyo, Advanced Construction Technology Center, p.47 (1999).
- Council for Study of Measures for Demolition Debris. "Promotion Conference for Reporting and PR of the Study Committee for Demolition and Recycling System". Tokyo, Taisei Publishing Co., Ltd., p.162 (1998).
- Japan Wood Preserving Association. "Development of Appropriate Recovery and Treatment System by Recycling and Combustion of Wood-based Wastes Including Wood Treated for Preservation". 2001.

<Please refer to> Koji Yamamoto Solution Engineering Center Tel. 045 (510) 4700 E-mail address : Yamamokr@nkp.tsurumi.nkk.co.jp

NKK TECHNICAL REVIEW No.85 (2001)