Summary Series

The status of large scale biomass firing

The milling and combustion of biomass materials in large pulverised coal boilers

IEA Bioenergy

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The milling and combustion of biomass materials in large pulverised coal boilers

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Summary

Biomass (co)firing in pulverised coal-fired power boilers is a very attractive renewable energy option in terms of the capital investment requirement, the security of energy supply, the power generation efficiency and the generation cost as it builds upon large scale existing infrastructure for power generation from coal. As relatively large volumes of biomass can be introduced in a single plant, it offers an **opportunity to rapidly increase the fraction of renewable electricity in a grid and reduce the carbon emissions significantly**. It is also apparent that, coupled with carbon capture and storage (CCS) technologies, biomass firing and co-firing provides one of the very few means of removing substantial quantities of CO_2 from the atmosphere.

There are three principal options for the utilization of biomass materials for power production in combustion-based conventional steam cycle plants:

- The installation of **new, dedicated biomass power plants** which are normally based on grate fired or fluidised bed combustion systems,
- The co-utilization or **co-firing** of biomass with a more conventional fuel, normally coal, in large pulverised coal boilers, and
- The **conversion of existing pulverised coal boilers** to 100% biomass firing.

BIOMASS CHARACTERISTICS

The **combustion characteristics of biomass are different from coal**. If co-fired in modest quantities (generally <10%), various types of biomass can be used, even with higher ash contents, and ashes with higher levels of alkali metals and lower ash fusion temperatures than woody materials. To a large extent the negative implications on boiler performance (e.g. ash deposition problems) are then mitigated by the coal. For higher co-firing shares, however, the preferred fuel for large scale biomass firing in large pulverised coal-fired boilers is pelletized sawdust, with relatively low ash fractions and high ash melting temperatures. It is now traded in very large quantities worldwide.

After modification, existing coal mills can typically be used to grind wood pellets. When using hammer mills, a wider range of fuel types may be possible, e.g. biomass materials in granular and coarse dust forms, and with higher moisture contents, up to 15-20%. Recently, significant interest arose in the production and utilisation of thermally treated biomass materials using torrefaction or steam explosion. Although these fuels show superior storage, handling and milling properties compared to white pellets, it takes time to commercialise these pretreatment technologies.

TECHNICAL CHALLENGES

Important technical challenges are related to the **fuel handling and storage** (as wood pellets are more susceptible to moisture) and **boiler performance** (e.g. increased fouling and corrosion of heat exchanger surfaces, flame shape, minimisation of unburned carbon in ash, NOx emissions, etc.). The **flue gas emission reduction** system may also be influenced by the fuel switch. For all of these aspects, however, significant experiences has been gained over the years. If properly done, these risks are therefore acceptable.

The storage and handling of the biomass materials, and particularly the **tendency of the biomass to generate significant dust levels, have presented the most important problems**. It is fair to say, however, that the fuel suppliers and the materials handling equipment supply industry have learned many lessons over the past few years, and the solutions currently being offered for biomass projects represent a significant improvement over previous practice.

Through a number of case studies for specific plants and country reports, the report shows how the introduction of biomass can be practically done in a variety of power plant configurations, and how conducive policies can stimulate rapid market introduction of biomass co-firing.

Conclusions

Both biomass co-firing with pulverised coal and full conversion of pulverised coal fired power stations to biomass are very attractive options for large scale, cost effective and rapid delivery of renewable electricity. Biomass conversion projects offer various technical and commercial advantages:

- The **capital investment** requirements of power plant conversion projects are much lower than the investment costs of a new build power plant,
- The **reliability and security of the supply of the power generated** are higher than most other forms of renewable energy, and
- The **electric efficiency** and the **generation costs** are much better than dedicated biomass power plants at industrial scale. Of course at the larger scale, there are less options for utilisation of the waste heat.

The case studies and country reports in this report illustrate that the key technical options for the conversion of large pulverised coal boilers to the firing and co-firing of biomass have been successfully demonstrated, principally in projects in Northern Europe, over the past 10 to 15 years. These projects show that the **technical risk areas have been managed successfully** and that the plant availability and efficiency levels after conversion have been acceptable. A number of plants are fully converted to biomass firing, and there are a small number of further conversion projects currently in the proposal stage. As biomass is typically **more expensive per GJ** than coal delivered at the power station, the conversion of power plants to the firing or co-firing of biomass materials will normally **require financial support**. In most cases this is delivered in the form of an agreed power price under some government policy instrument aimed at the promotion of electricity from renewable sources.

The full report is available at
http://www.ieabcc.nl/publications/IEA_Bioenergy_T32_cofiring_2016.pdf

IEA BIOENERGY

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The mission of IEA Bioenergy is to increase knowledge and understanding of bioenergy systems in order to facilitate the commercialisation and market deployment of environmentally sound, socially acceptable, and cost-competitive bioenergy systems and technologies, and to advise policy and industrial decision makers accordingly. The Agreement provides platforms for international collaboration and information exchange in bioenergy research, technology development, demonstration, and policy analysis with a focus on overcoming the environmental, institutional, technological, social, and market barriers to the near- and long-term deployment of bioenergy technologies.

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