ACCEPTED MODERN TECHNOLOGY

IN

WOOD-FIRED BOILERS

FOR

SOUTHWOOD RESOURCES
FORESTRY TASMANIA

PREPARED BY

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Introduction

Jott Engineering has prepared this report on behalf of the proponents for the Sawmill and the Rotary-Peel Veneer mill, in order to comply with Condition GG2 of the Southwood Operating Permit.

Condition GG2 states that:- "***All wood-fired combustion sources on the land must utilise technology generally accepted as constituting AMT in relation to Greenhouse Gas Emissions. Within 60 days of issue of this permit, the proponent must provide the Director with a report which demonstrates that the chosen technology constitutes AMT in relation to greenhouse gas emissions***."

The Permit also specifies that AMT is defined as:- *"'AMT' or* ***'accepted modern technology' means a technology which has a demonstrated capacity to achieve the desired emission concentration in a cost-effective manner, takes account of cost-effective engineering and scientific developments and pursues opportunities for waste minimisation***."

The use of wood by-products as fuel in boilers for steam generation is very well known. The range of boiler designs incorporating symbiotic mechanisms and technologies used for the combustion of such fuels is very wide.

The key emission from combustion processes of carbonaceous materials that has greenhouse gas impacts is Carbon Dioxide, with minor contributions due to Methane and Nitrous Oxide. Emissions of NOx, Carbon Monoxide and particulates from such installations are essentially related to ambient air quality rather than greenhouse issues. For greenhouse gas emissions the fuel choice (wood versus fossil fuel) and source of fuel (renewable versus non-renewable) is the significant issue rather than boiler technology.

State of Biomass Technology

In the process of obtaining commercial advantage in a very competitive environment, manufacturers of boiler equipment have introduced many variations in design with mixed levels of success.

Biomass fuels cover a range of compositions, impurities and moisture contents. Included in the range are fuels such as bagasse, wood, demolition waste, green waste from municipal refuse and mixed municipal refuse.

Over the last thirty years, energy prices and environmental issues have introduced market forces which have resulted in the introduction of increasingly sophisticated technologies that have only really matured over the last ten years or so:- for example, Bubble-Bed; Fluidized-Bed; Two-Stage (gasification + second-stage); combustion systems are but a few. In addition, a multitude of fuel preparations and mixes have also been introduced:- for example, one of the latest is pelletised and dried wood and/or biomass waste, which enables a large variety of wood-waste sources to be homogenized into a very tractable and easily combustible fuel.

Most of the above innovative approaches, however, have been necessitated by an increased need to combine the combustion of conventional fuels with the disposal of a range of biomass by-products right through to municipal-type waste, in a useful manner. This trend has been accepted in Europe for most of the above-mentioned period, and, has had some success in a number of "demonstration-type" plants in the North American Continent and even Australia:- one very successful plant was built in the NSW suburb of Waterloo and had been in operation until some four years ago; a more recent candidate was the proposed Carole Park Biomass Boiler plant in a Brisbane suburb, which could have used a fluidised bed with triple stage combustion and re-cycling of fluidising materials and combustion products; again, this technology could accept a very wide range of biomass fuels whilst meeting all the environmental requirements.

Combustion Systems for Wood Chips

In contrast with the above-mentioned more complex (and costlier) technologies, the combustion of clean wood-waste, in the form of wood chips, is a relatively tame affair, which has needed very little improvement, if any (depending on the manufacturer) for the last few decades.

The fundamentals of combustion of the woodchips in an environmentally acceptable way simply involves:-

- Ensuring that even and controlled distribution of the fuel on a surface (grate) is achieved, and
- Correct air distribution, to ensure the correct air / fuel mixtures at the various zones of the furnace.

Standard grate configurations will ensure acceptable reliable and economic combustion, whilst meeting the required environmental limits, provided that the boiler meets these fundamental combustion considerations.

The fuel to be used in the proposed boilers is generated either as residues from harvesting operations or from milling operations. Normally this wood is either open-air burnt, disposed through landfill or burnt in a tepee or olivine burner. Each of these processes sees the generation of greenhouse gases. Therefore, the extraction of energy for a beneficial use from the combustion of the wood in a boiler is a major waste-reduction contributor. The extracted energy negates the use of a fossil fuel (natural gas, petroleum or coal) otherwise needed to provide the heat required.

Emissions of Greenhouse Gases

The principal greenhouse gases that need to be considered comprise:-

- Carbon Dioxide,
- Carbon Monoxide,
- Oxides of Nitrogen, and
- Methane

Oxides of Carbon

None of the technologies available, when used in an efficient manner, will change the amount of carbon released in combustion of the wood. The carbon is converted principally to Carbon Dioxide and comprises about 99.4% of the total greenhouse gas emissions from the boilers; Carbon

Monoxides will comprise about 0.3% of total greenhouse gas emissions.

Oxides of Nitrogen

The difference between the various boiler designs thus revolves around the minor emissions, representing about 0.3% of total greenhouse gas emissions. The major environmental effluent, which is controllable through the manipulation of the combustion process, is the formation of NOx.

This requires low combustion temperatures to avoid thermal NOx, and low Oxygen concentration in spaces where volatiles are combusting to minimize fixed fuel Nitrogen conversion to NOx. Therefore, as far as NOx is concerned, conventional grate technology, with judicious use and distribution of primary, secondary and tertiary air, can be considered to be Accepted Modern Technology (AMT) when applied to clean woodchips as fuel.

Grate Selection

The matter of the type of grate to be used is less important than the manner of feeding the fuel onto the grate.

The grate type is usually strongly driven by the ash content of the fuel:- a low-ash fuel, such as wood, will tend to overheat the grate so that, to compensate, it needs cooling if of metal or, alternatively, made of heat-resistant refractory materials. The fuel-feed mechanism is important in that mal-distribution of fuel on the grate causes uneven resistance of air-flow and, therefore, low combustion quality (high CO, NOx and excess air). In selecting the type of grate, consideration needs to be given to the load profile of the boiler. When part-load operation is frequent, good fuel distribution is even more important.

A very good combustion system combination is a moving grate with stepped and reciprocating grate tiles. Such grates allow good fuel distribution, with zoning of primary air to enable optimum rate of volatiles' release and primary combustion. These grates are proven for quite large industrial applications but are particularly suited for the range of boiler outputs required for the Rotary Peel Veneer mill and the Dry sawmill (15 MW and 5 MW, respectively). The preference to grate type is basically related to the maintenance of the grate: a low ash fuel with its associated high grate material temperatures, will result in rapid wear through oxidation; a stepped reciprocating type grate allows for water cooling of the grate tiles and, therefore, longer life.

The measures taken to minimize NOx also tend to address the production of CO because in regions of low excess air, CO generation will increase. However, the general level of excess air in a well controlled furnace is generally above that which would allow low excess air to exist; secondary and tertiary overfire air would further act to reduce the production of CO. Generally, smoke and CO will go hand in hand so a low CO will also result in a clear stack gas emission.

Fly Ash

Of course, dust and fly ash are entirely a matter of collection, both in the boiler proper and in the flue-gas passes on the way to the stack.

When considering clean woodchips, the amount of ash is so low that it can be considered to be mostly carried away with the flue and, therefore, require collection. The type of ash will impinge on the grate and furnace design around the grate. However, for this fuel, it is mainly a matter of avoiding local slagging due to ash fusion and build-up. Again, judicious surface design and fuel and air distribution in the grate region will reduce this problem to a minimum; keeping combustion temperatures low in the furnace will ensure that slagging and deposits will be minimized downstream.

Waste Minimisation

Whilst the *concentrations* of emissions can be controlled to acceptable levels, the matter of *quantities* is addressed by maximizing the utilization of the available energy from the fuel.

The most obvious way is to utilize any waste heat available to dry the woodchips prior to entry to the boiler: lower moisture content will result in reduced fuel usage and, consequently, reduced emissions.

Other ways include the recovery of most of the energy of the flue gases, including the latent heat of evaporation of the moisture in the flue gases; however, these and other processes are independent of the boiler type or the process selected for the combustion of the fuel and, therefore, apply universally and not further discussed here.

Conclusions

In conclusion, for clean woodchips, the current wood-fired boilers' grate-type designs, properly sized and laid out, can be considered to be AMT.

One should not necessarily take existing plant as the paragon of "good" or "bad" references of this technology, as it is well known that its performance can be subject to bad application of the fundamental principles and / or misapplied fuel specifications, capacity, loading ("to achieve that little bit extra"), and many other reasons. Suffice to say that where the plant does not perform there will be good reasons for this.

Accordingly, it is the process of the selection of the plant offered which is the major step in ensuring that the plant meets its expected AMT status.

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