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# Noise emission of powerstations. Biomass as an alternative fuel.

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## Abstract

Along with the saving of energy, the reduction of greenhouse gases (like carbondioxide) is an environmental issue nowadays. This also concerns (electricity) powerstations. In order to meet national and European regulations for minimizing impact on the environment and also the growing demand for "green electricity", the electricity production companies use biomass as a fuel on an ever-increasing scale.
Biomass is used today in a wide variety of processes. There are three primary types of biopower systems: direct fired and cofired systems, and gasification. Each of these techniques require specific components which can have their influence on the noise emission of the powerplant.
Research shows that especially the (road) transport of the biomass can affect the noise emission of the entire powerplant. Biomass is mostly transported by road while conventional fuels like coal are mostly transported by ship. Compared to the transport of coal, the transport of biomass requires many transport-movements per unit of produced energy.
The conclusion can be drawn that the total noise emission of biomass fired powerplants will be larger (up to 3 – 5 dB) then comparable conventional (coalfired) powerplants, particularly due to the transport of the biomass.

## 1. Introduction

Climate change is a growing concern worldwide. Human activity, primarily through the combustion of fossil fuels, has released hundreds of millions of tons of so-called 'greenhouse-gases' into the atmosphere. Greenhouse gases include such gases as carbondioxide ($CO_2$) and methane ($CH_4$). The concern is that all of the greenhouse gases in the atmosphere will change the earth's climate, disrupting the entire biosphere which currently supports life as we know it. Biomass energy technologies can help minimize this concern. Replanting harvested biomass gives the opportunity of returning $CO_2$ to the cycle of growth and also leads to a renewable resource.

# 2. The application of biomass in powerstations

## 2.1 Modern coal fired powerstations

Considering the fact that in the combustion process of coal more $CO_2$ is produced then in the combustion process of (natural) gas (per unit of produced energy), it is obvious that the use of biomass will be focused on replacing coal as a fuel.
Powerstations are often located nearby a river where cooling water is available and transport over water is possible. Due to the lack of coal-mining in The Netherlands and the fact that large quantities of coal are required in the modern powerstations, the supply of coal is always carried out over water.
During the combustion of coal residue like bottom-ash, fly-ash and sulphurdioxide ($SO_2$) is produced. By means of a chemical reaction between the $SO_2$, limestone and water, lime is formed. All the residue (bottom-ash, fly-ash and lime) can be carried off by ship or road transport.

## 2.2 Biopowered systems

Currently the most important types of biopowered systems are cofired, direct fired and gasification systems.

### 2.2.1 Cofiring systems

For power generating companies with coal fired capacity, cofiring with biomass may represent one of the least-cost renewable energy options. Cofiring involves replacing a portion of the coal with biomass at an existing power plant boiler. This can be done by either mixing biomass with coal before the fuel is introduced into the boiler or by using separate fuel feed for coal and biomass. Depending on the boiler design and the fuel system employed, biomass can replace up to 20% of coal in a cofiring operation.

### 2.2.2 Direct firing systems

Direct fired systems are similar to most fossil-fueled powerstations. The biomass fuel is burned in a furnace and the heat is used to produce high-pressure steam.
The flue gas of the biomass furnace can be led to the existing coalfired boiler or a separate boiler can be applied.

### 2.2.3 Gasification

Gasification is the newest method to generate electricity from biomass. Biomass gasifiers operate by heating biomass in an environment where the solid biomass breaks down to form a flammable gas, which can be used in a furnace or a boiler to produce steam.

# 3. Acoustical aspects

## 3.1 Additional provisions

In all the biopower systems which are mentioned in chapter 2, some additional provisions have to be realized like, for instance, a reception hall and installations for shredding, drying and blending the biomass. All this equipment must be recognized as additional sound sources related to the use of biomass as fuel. In most cases the equipment will be placed inside a building due to dust and odour aspects. This also has benefits for the emitted sound power levels of the different sources. The sound pressure levels inside the buildings should be

limited (if possible) to 80 or 85 dB(A) at most, due to labour-legislation aspects. If appropriate sound isolating materials are designed into the construction of these buildings, the noise emission can be negligible compared to the noise emission of the entire powerstation. In case a separate air-intake or a separate stack is applied for the biopower system, the noise emissions of these components can be minimized by the application of appropriate sound silencers.

## 3.2 Transport

Biomass can be supplied by means of road transport, by ship or by train. To restrict the noise emission to the vicinity, ship-transport is preferred. It should be noticed that the number of biomass transports which are required, highly depend on the kind of biomass which is applied. Taking into account the specific gravity and also that the calorific value of the biomass is relatively small, it means that per unit of produced energy approx. 4 times as many transport movements for fuel supply are required compared to a coal fired system. This leads to the conclusion that, in case biomass is transported by ship, the capacity of the cranes, conveyorbelts etc. has to be increased fourfold, therefore increasing the sound power level by 6 dB. The supply of biomass is usually limited due to the lack of possibilities for the contractors to tranship the biomass into a ship (location at water, availability of a harbour etc.). Considered that biomass is produced relatively nearby the powerstation, its supply usually takes place by means of road transport. It is obvious that the influence of the biomass-supply on the noise emission of the entire powerstation can be substantial.

As mentioned before, in modern coal fired powerstations $SO_2$ is converted to lime and mostly carried off by road. In general biomass contains no sulphur. Therefore no $SO_2$ is produced during the combustion process. As a result of this a small reduction of transport movements can be achieved. It is obvious that this reduction is negligible compared to the increase of the number of transport movements due to the supply of biomass.
The amount of other residue, produced during the combustion process, depends on the specific mix of different biomass products. Normally these quantities are approximately equal to the quantities which are produced during the combustion of coal.

Figure 1 shows an example of the sound power levels (PWL) of the different components of a 100% coal fired powerstation (1200 MW) compared with the PWL's of the components of a powerstation in which 20% of the coal is replaced by biomass.

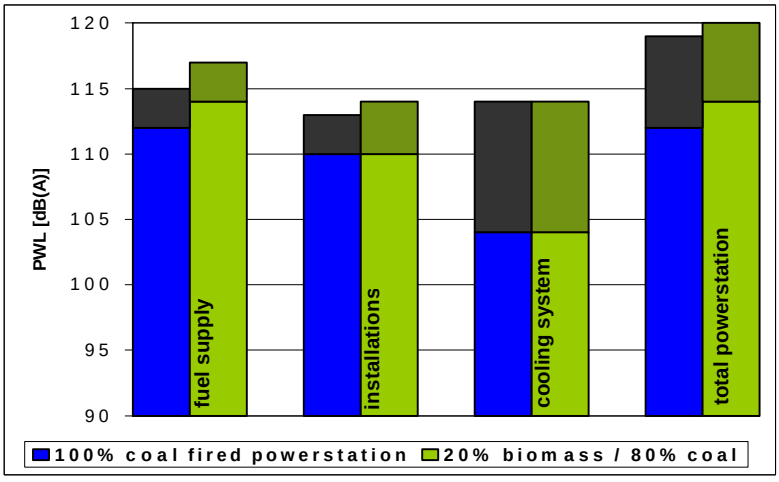


Figure 1: PWL of the different components of a coal fired and a 20% biomass fired powerstation.

It's obvious that the difference in the total PWL's (approx. 1 – 2 dB(A)) particularly is caused by the fuel supply.

Figure 2 shows the difference in the total PWL's between a 100% coal fired powerstation and a (partial) biomass fired powerstation in relation to the share of biomass as a fuel.

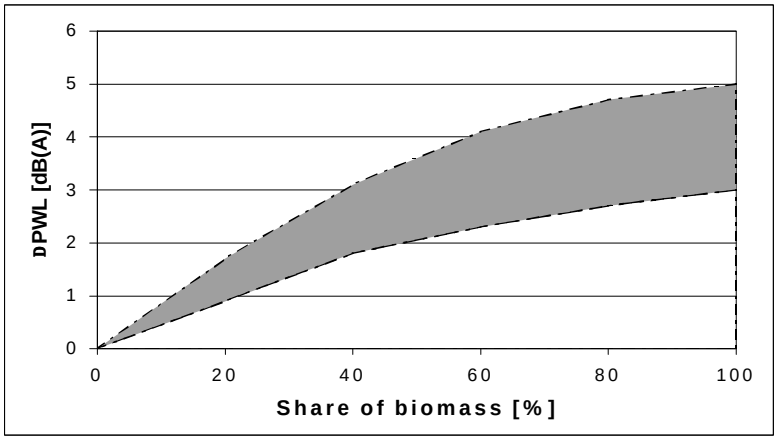


Figure 2: ΔPWL between a coal fired powerstation and a (partial) biomass fired powerstation.

The figure shows that the difference in PWL may increase up to 3 - 5 dB(A) when the powerstation is completely fueled by biomass.

# Conclusions

Depending on the way biomass is applied (direct firing, cofiring, gasification) and the way it is pre-treated, the application of biomass as a fuel in powerstations introduces additional sound sources. Most of these sound sources will be placed in a building for several reasons. Therefore the impact of these sound sources on the noise emission can be restricted to a negligible value.

However, due to the large number of road transport movements, which is required for the supply of the biomass, the total noise emission of the powerstation will increase to a certain degree.

Research shows that the PWL of the fuel supply component may increase up to 6 dB(A), depending on the share of biomass. The total PWL of the powerstation may increase up to a maximum of 3 – 5 dB(A) if the powerstation is completely fueled by biomass.

It is obvious that the PWL of the powerstation determines the noise immission in the environment at large distances. It should be noticed that the difference in noise immission at a short distance to the powerstation may be even larger than 5 dB(A), particularly near the entrance road.

In dense populated areas the share of biomass as a fuel in powerstations will in some cases be restricted due to noise immission aspects.

# References

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