Wood Fired Heating Plant in Slovakia

Energy Centre, Slovakia

Summary

This project deals with an application of wood chips as biofuel in an energy system of a small size enterprise.

The project realisation started in 1999 with boiler installation at the School Forest Enterprise (the SFE) Technical University in Zvolen under the framework of the Dutch Program for Co-operation in Central and Eastern Europe (PSO-programme). The boiler has a capacity of 605 kWth and is fired by clean wood residues from sawmills owned by the SFE. The biofuel-fired boiler replaced three old brown-coal fired boilers with low efficiency. The special furnace design ensures that woody biofuel burns in an environmentally sound way. Emissions of dust and CO are extremely low and meet the Slovak standards and European norms.

Results of project implementation proves that under local climate conditions the significant increase of current share of biofuels in PES consumption can be achieved, what would bring important benefits to national economy and help meeting Kyoto commitments.

End-user area		**Target Audience**		**Technical**	
☐	New buildings	☐	Citizens	☐	Energy efficiency
☐	Refurbishment of buildings	☐	Households	☐	Heating
☐	Transport and mobility	☐	Property owners	☐	Cooling
☐	Financial instruments	■	Schools and universities	☐	Appliances
■	Industry	☐	Decision makers	☐	Lighting
☐	Legal initiatives (municipal regulations, directives, etc)	☐	Local and regional authorities	☐	CHP
☐	Planning issues	☐	Transport companies	☐	District Heating
☐	Sustainable communities	☐	Utilities	☐	Solar energy
☐	User behaviour	☐	ESCOs	■	Biomass
☐	Education	☐	Architects and engineers	☐	Wind
☐	Other	☐	Financial institutions	☐	Geothermal
		☐	Other	☐	Hydro power
				☐	Other

Context

One of the problems often arising, whose solution is mainly the object of interest of municipalities and management of companies, is the issue of how to reconstruct out-of-dated and used-up brown coal fired boiler plants. In order to ensure that heat is produced and supplied at reasonable costs and at the same time in compliance with environmental requirements in long-term view, i.e. meeting emission standards of Slovak legislation, as well as EU legislation.

No doubt the most important incentive of current effort to look for economically optimal heat source is that in the near future the government will not subsidise heat prices of households. Users will pay fully price for supplied heat. Moreover, it looks like the "CO_2 tax" in a short time will become a reality also in Slovakia, whilst in EU countries it is already implemented for several years.

Biomass is considered as the most perspective indigenous renewable energy source, waiting for its wider implementation, mainly in the municipal sector. Based on foreign prognosis and experiences (in Austria, Denmark, Sweden etc.) it can be assumed, the biofuels based on biomass will become number one amongst fuels mainly for dwelling heating in the twenty first century.

Objectives

The aim of the project was to switch from brown coal to own wood residues (wood chips) – biofuel with significant improvement of boiler plant performance considering environmental protection.

Process

Forests cover more than 40% of the Slovak territory. Central Slovakia, where the project is being implemented, is a highly forested region with about 45% of its area covered by forests.
Wood exploitation is well developed: many forestry and wood processing companies are represented in the region. Forest sector produces about 1.5 million m3 of wood residues annually, what equals to approximately 9 PJ of primary energy. Moreover, wood-processing sector also produces wood residues of 9 PJ value annually. The massive introduction of cheap brown coal hampered the utilization of wood residues for energy purposes for a long period. However currently, as a result of the promising future market perspectives for biomass energy, there is a growing interest in the use of wood and other biomass residues in the region.

The impulse to reconstruct the boiler plant at the SFE of the TU in Zvolen was considered by several circumstances, e.g. the end of the life-time of engineering equipment, „discovery“ of possibility to use own wood „waste“ as a fuel, expected efficient performance of a new boiler plant and possibility to reduce emissions.
The decisive impulse to go into reconstruction started with the winning project of the TU in Zvolen, in the competition „Project on energy saving and energy utilisation of biomass, or how to implement ideas of Kyoto '97 Conference“, announced by the Dutch Government within the framework of the Programme PSO 1999/2001 for the SR in 1998. The winning project obtained a grant of one million Dutch guilders from the Dutch Government for its implementation in period January 1999 – June 2001 and has been realised as a pilot project using Kyoto flexible mechanism – Activity Implemented Jointly.

The used technology presents a modern bio-energy system with capacity 605 kWth, which replaced almost thirty-year-old inefficient brown coal fired boilers (3 x 250 kWth) in a boiler room at the SFE of the Technical University in Zvolen.
Boiler - Hot-water three-draught boiler KARA with heat capacity 605 kWth (Fig. 1). Fuel is supplied from next-to-boiler stock in boiler plant by hydraulic advance motion conveyer "walking floor" into screw conveyer, this one automatically batches the fuel to burning chamber, where the fuel is burned at the stage grate. Burning air is supplied by fan to several burning zones, where burning quality and air/fuel ratio is controlled by "lambda" probe.
A burning chamber is equipped by moving stage grate with hydraulic drive. Grate was specially designed for burning of fuels with high MC (up to 50 %), and of course the manufacturer provides guarantees to meet emission limits of our legislation as well as the legislation of the European Union.
A boiler is operated automatically under supervision only and they are very well regulated in range of 40-100% of capacity. In after-burning chamber the flue-gas is fully mixed up with the slight delay at the temperature above 1000°C, kept in order avoiding excessive generation of NO_x.
Flue-gas heat exchanger ensures the flue-gases are cooled down to 200 °C. The parts of flue-gas heat exchanger, exposed to increased corrosive influence in operation, can be easily and quickly replaced with minimal labour.

Flue-gas cleaning - Flue-gas fans transport flue gas via multi-cyclone dust separator into stack. Trapped ash is supplied via clamp carrier feeder into container. The parameters of flue-gas cleaned mechanically are in compliance with emission limits. Emissions achieved under reference conditions: solid particles = 80-120 mg.Nm-3 (<<150 mg.Nm-3 at the 11 % O_2), CO = 80-150 mg.Nm-3 (<<850 mg.Nm-3), NOx < 200 mg.Nm-3 (<<650 mg.Nm-3), VOC < 10 mg.Nm-3 (<<50 mg.Nm-3, it is unburned organic matter indicated as total organic carbon C in flue-gases), SO_2 does not considered because sulphur content in dendromass is negligible
Measurement and control - The boiler and the whole engineering part are fully automated from the fuel supply part to the flue-gas takeoff. Measuring devices and control system - monitors controls and optimises mainly burning process in itself.

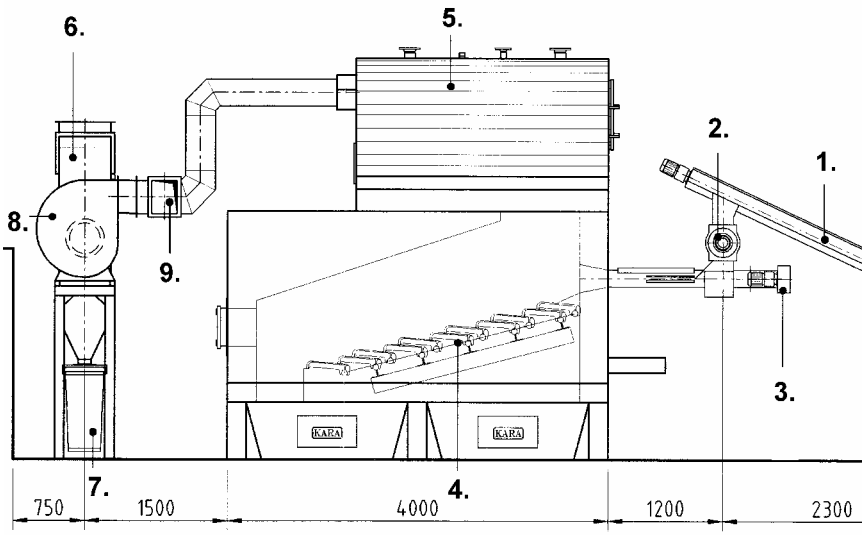

Fig.1. Hot water boiler with heat capacity 605 kWth
1 - screw conveyer feeding of wood chips, 2 – rotary valve/conveyor – turnstile, 3 – stoker screw, 4 - hydraulic moving stage grate, 5 - three-draught tube boiler, 6 – PA-cyclone filter, 7 – ash bucket/container, 8 – flue-gas fan, 9 – flue-gas off-take to stack

Financial resources and partners

The project was financed within the Dutch Program for Co-operation in Central and Eastern Europe (PSO-programme) by Senter, the agency which is responsible for the execution of grant schemes in the field of technology, energy, environment, exports or international partnerships on behalf of a range of Dutch ministries. The total investment costs come to about € 450,000.

The partners were: Slovak Centre of Biomass Use for Energy, Zvolen, Slovakia; School Forest Enterprise (the SFE) Technical University, Zvolen, Slovakia; Ministry of Environmental of the Slovak Republic; Slovak Energy Agency; ENAS – Leither, Conus, Energyr, the Netherlands; BTG Biomass technology group B.V., the Netherlands and KARA energy systems B.V., the Netherlands.

Results

It is estimated that the combustion efficiency is increased by more than 50 % and emissions of ash, dust and CO are significantly reduced.
Moreover, every saved ton of brown coal helps to reduce CO_2 emissions at 3 tons. Moreover, every ton of brown coal replaced by 3-4 tons of biomass, which otherwise would decay as wood residues. This solution will result in saving further 11 tons of CO_2. Total project result comes to 14 tons of

saved CO_2 per one ton of brown coal. Annually it will make up 3,000 tons of saved CO_2 for the boiler with heat capacity 605 kWth.
It is obvious, the energy use of biofuels in centralized heat supply plants is suitable from the environmental viewpoint and it significantly reduces emissions in environment compared to original status – brown coal heat supply.
Another result of the project is reduction of expenses for heating, as the price per one ton of wood chips is five times cheaper than the price of a ton of brown coal.

Lessons learned and repeatability

Current estimates of share of biomass – biofuels on annual primary energy sources consumption (PES) in the SR are in the range of 1,0 – 1,5 %. Under our climate conditions the significant increase of current share of biofuels in PES consumption to 6-12 % can be achieved (already a reality in Austria), which would also bring important benefit to our national economy. Increased utilisation of soil would help – mainly uncared-for soils (current estimate: more than 500 000 ha) to achieve this goal. Utilisation of biomass on a wide scale would result in creation of new jobs, what would help to solve unemployment problem in Slovakia. Moreover, significant reduction of brown coal extraction and release of harmful emissions (e.g. CO_2, NO_X, SO_2) would be gained.

Biofuel fired boiler plant as specified further can be considered as the pilot plant of its type, which can be used as the example for further similar projects in other Slovak forested regions as well as in other European countries, where there are suitable conditions for its implementation.

Contact for more information:

Organisation / Agency:	Slovak Centre of Biomass Use for Energy
Main contact:	Jozef Viglasky
Address:	T. G. Masaryka 24, 960 53 ZVOLEN, Slovak Republic
Tel:	+421 45 5206 875
Fax:	+421 45 5206 875
Email:	viglasky@vsld.tuzvo.sk
Contact:	Vladimir Hecl, Energy Centre Bratislava
Address:	Bajkalska 27, 821 01 Bratislava
Tel:	+ 421 2 582 48 472
Fax:	+ 421 2 582 48 470
E-mail:	office@ecbratislava.sk
Web Site:	www.ecb.sk

Host organisation: School Forest Enterprise Technical University, Zvolen, Slovakia
Equipment manufacturer: KARA energy systems B.V., the Netherlands
Financial organisation: SENTER, the Netherlands