

ENERGY AND ENVIRONMENT

SENER's technology in biomass and waste to **energy plants**

SENER's technologies increase energy efficiency and reduce the costs of generating electricity in biomass and waste to energy plants, thus achieving greater profitabilities. Emissions of CO₂ and maintenance costs are also reduced.

LIMITATIONS OF THE RANKINE CYCLE

The conversion of thermal energy from fuels into mechanical and electrical energy is normally carried out by the Rankine thermodynamic cycle.

The energy efficiency of the Rankine Cycle is greater the higher the pressure and temperature of the steam that drives the turbine. In power plants, temperatures and pressures above 500°C and 100 bars, respectively, are normal. These plants currently deliver electricity with gross efficiencies of 40 – 45%.

However, when the fuel is biomass or municipal solid waste (MSW), steam temperatures are limited by the corrosion produced by the combustion gases of these

materials. Steam must then be generated generally at temperatures below 430°C and pressures below 65 bars in order to obtain a reasonable duration of boiler tubes. In these conditions the gross electrical efficiencies of the Rankine Cycle are in the order of 26 – 28%

THE SENER THERMAL CYCLES

SENER has developed several thermal cycles for the generation of electricity from biomass and waste, which improve the energy efficiency of the Rankine cycle and reduce the corrosion produced by these fuels in boilers.

These technologies provide an additional boost to renewable energies, since they help increase the operating capacity and reduce costs. In addition, SENER's technology easily allows to surpass the minimum energy efficiency values established by the EEC legislation for MSW plants.

The new SENER thermal cycles are based on generating high pressure steam (around 100 bar) at moderate

temperatures (300 – 400°C). Under these conditions, the corrosion produced by the combustion gases of the renewable energies is substantially reduced.

APPLICATIONS IN MUNICIPAL SOLID WASTE

The SENER-4 process is highly suited to for waste to energy plants. It is based on a cycle with high-pressure steam at moderate temperature that is expanded in a turbine with reheating, which raises gross electrical efficiency to values of 32 – 34%. This technology only requires auxiliary fuel in start-ups. The SENER-2 process, based on a combined



cycle with auxiliary fuel (natural gas), raises electrical efficiency to values of 40 – 50% and is more profitable the greater the difference between the electricity price and the cost of the auxiliary fuel.

The SENER technology has been used in waste to energy since 2004 in the Zabalgardi plant in Biscay (Spain), processing 240,000 t/y, and generating 100 MWe with an electrical efficiency of 45%.

APPLICATIONS TO BIOMASS

In the case of biomass, the SENER-4 technology can be combined with the SENER-1 process (overheating of the high pressure steam outside the boiler) or with SENER-3 process (combined cycle of biomass boiler with gas engine), which improve efficiencies up to above 35%.

SENER is currently developing a 27-MWe biomass project that includes the three technologies, achieving an electrical performance of close on 40%, which means producing 35% more electrical energy than would be generated with conventional technology. ■■

In the image on the left: the Zabalgardi Waste to Energy plant in Vizcaya (Spain), with SENER's technology, is an international benchmark.

