

Integrated SO_x/NO_x and particulate removal in coal/olive wastes and leather wastes combustion in a 3.5 MW_{th} plant, Spain (2001-2005)



650 kg/h fluid bed combustor, 3.5 MW_{th} input

Project objective

The main objective of this EC funded project [BioWaRe – Contract no. ENK5-CT2001-00523] was to assess the combined removal of SO_x, NO_x and particulates from an existing 3.5 MW_{th} fluid bed combustion plant in Spain using catalytic promoted filter candles and sodium bicarbonate addition into the flue gases from the combustor. C.A.R.E. Ltd. was responsible for:

- Techno-economic assessment of the combined SO_x/NO_x/particulate removal technology for plants up to 100 MWe in comparison with conventional gas cleaning technologies;
- Review of existing co-fired and direct biomass fired power plants in EU-15 less than 100 MWe;
- Review of the environmental legislation relevant to small-scale co-firing and wastes combustion in EU-15.

Project summary

A pilot-scale filtration unit, supplied by Pall Schumacher, was operating between 2004 and 2005 to provide data on solids collection efficiency and use of the reactants. Over 80% simultaneous conversion was achieved with >99% solids recovery.

A techno-economic assessment of the two fuels, coal/olive wastes and leather wastes was made based on the available plant data. Full mass and energy balances of the processes were made, which allowed the power output to be calculated and from that the overall costs for abatement of the main pollutants SO_x, NO_x and particulates by conventional methods and for the combined filtration system developed within this work. The conclusions are presented below:

- There were cost advantages in using NO_x control for leather wastes, but these were limited for coal/olive wastes due to the lower NO_x emissions which could be

reduced more easily and at lower costs with SNCR-NH₃ and SNCR-urea and low NO_x burners.

- Particulate removal costs were still lower with commercially available electrostatic precipitation and pulse jet fabric filters for both fuels.
- SO_x abatement for a complete system installation appeared viable at 100-300 MW_{th} input for coal/olive wastes and for <100 MW_{th} for leather wastes and comparable in cost to LSFO [limestone forced oxidation] below 100 MW_{th}.
- The overall emissions reduction cost of all three pollutants should be considered, rather than each one on its own merit. On this basis, the combined system was more economically attractive for both fuels, therefore there is commercial potential for the technology.

Electricity production cost

The total plant cost was slightly higher for leather than for coal (€225M at 100 MWe for leather wastes compared to €212M at 100 MWe for coal/olive wastes). The electricity production cost was lower as the electrical output was increased, with a cost of €cent 7.5/kWh at 100 MWe for the coal/olive cost of €40/t and €5/t respectively (Figure 1). There was little cost reduction with scale as the effects of additional heat exchangers and filter boxes of 1000 candles offset the other equipment economies of scale. As leather wastes are a lower cost feedstock, the net electricity price was more competitive and was as low as €cent 6.2/kWh for a zero cost feedstock (

Figure 2). However, the estimation of costs for a leather wastes power plant is unrealistic above 5-10 MWe, as the amount of waste in most locations precludes the possibility of building large plants. The acquisition of low cost wastes would be offset by significant transportation costs.

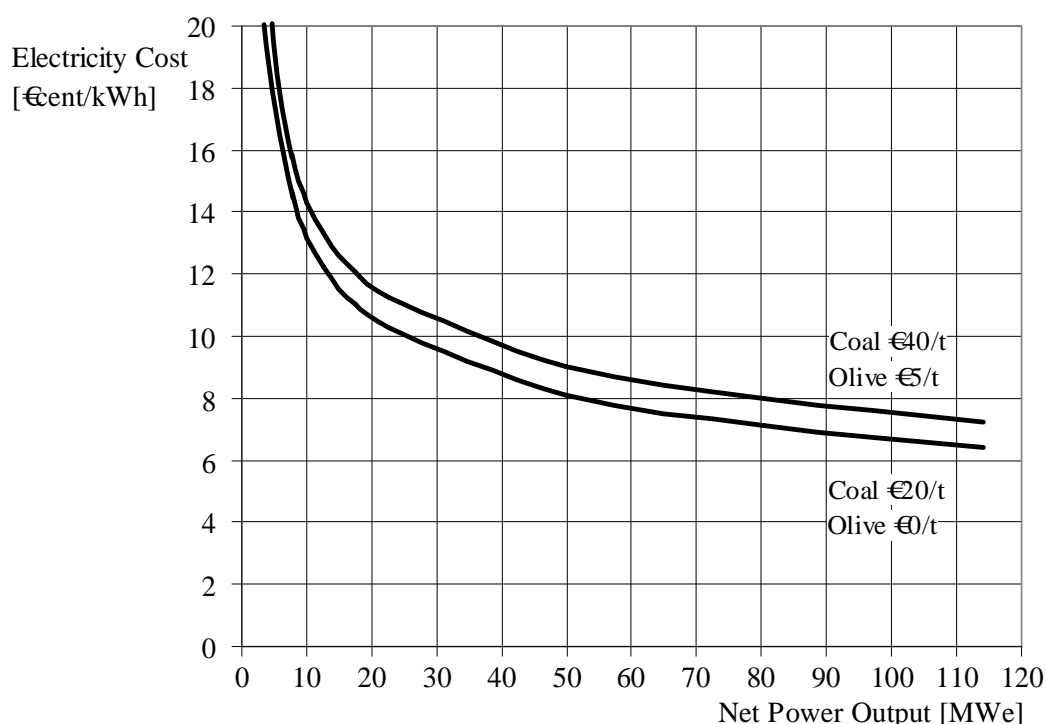


Figure 1. Net Electricity production cost v's net electrical output and fuel cost. Coal/olive wastes 60:40 (year 2002)

From the results presented in Figures 1 and 2, it appears to be little scope for systems under 100 MWe, as a comparison with industrial EU prices would indicate¹ There is more potential for domestic power sales as these tend to be higher and therefore the direct selling of electricity to domestic consumers, although more difficult, would be a more commercially viable option.

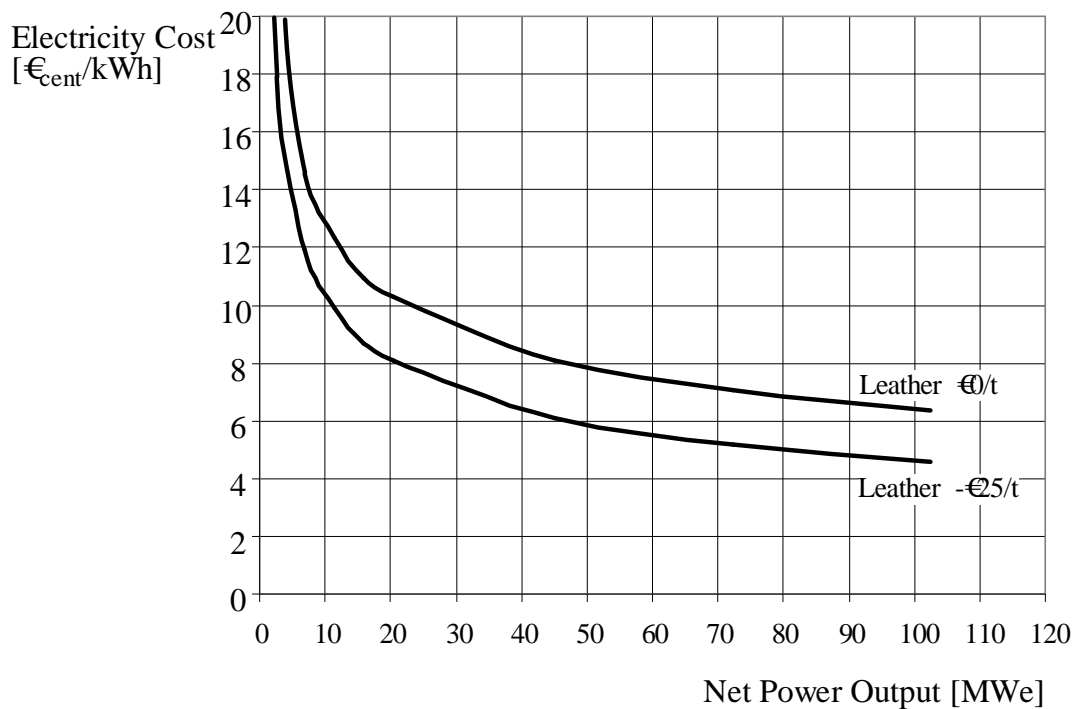


Figure 2. Net Electricity production cost v's net electrical output and fuel cost. Leather wastes (year 202)

Although there are several biomass power plants in operation in the EU-15, there is obviously potential for applications. One of the major advantages which have not been considered in this assessment is that the plant should be operated as a combined heat and power plant. This would allow the process to be more commercially viable. Assuming a heat sale price of €cent1.5/kWh, the net electricity prices could be reduced by €cent3-4/kWh, making the prospect of producing electricity for industrial applications more viable.

It is therefore a preferred commercial option to operate small-scale power plants in combined heat and power mode, which would significantly improve the overall economics of the processes.

Project status

The project was completed in 2005.

Reference

- ¹ Statistics in Focus and Energy Advice Ltd: Electricity and Gas Price Comparisons, UK DTI, 2001.