

CFB an option for Oxyfuel?

Vattenfall works intensively with the investigation and evaluation of different proposed concepts for future power plants with carbon dioxide (CO₂) capture. For us, it is important to increase the general understanding of the field and also to identify and evaluate opportunities to minimise the parasitic energy consumption in power plants with CO₂ capture and the investment costs for the necessary additional equipment, and to widen the fuel spectra for CCS.

CFB vs. PF

The Circulating Fluidised Bed (CFB) technology is a way of combusting solid fuels for power generation. The combustion takes place in a fluidised bed in which the fuel, the ashes and the sorbent (usually limestone) are recycled many times. The low operating temperature (~800-900°C), long residence times and high combustion efficiency inherent in the CFB

process result in low emissions and the possibility to burn a wide variety of fuels. Traditionally, CFB technology has not been of interest for large utility-scale power generation due to relatively small unit sizes and moderate steam data, thus limiting the existing units to sites where conditions were just right. In many cases this means low-quality coals, waste incineration and biofuel-based combined heat and power generation (CHP).

The dominating technology among Vattenfall's coal-fired power plants today is the pulverised fuel type, PF. Therefore, the main focus of our studies of the Oxyfuel technology, has so far been on this type of boiler. However, due to developments regarding both steam data and unit size in recent years, the CFB boiler technology must today also be seen as a competitive alternative for large-scale power generation.



Foster Wheeler 460 MWe, gross boiler in Lagisza, Poland. World's largest and first supercritical once-through CFB boiler.

Benefits with CFB - also for Oxyfuel?

A key advantage of the CFB technology is that pollution control is built right into the combustion process. By adding low-cost limestone into the CFB, SO_x is captured and removed right at the point where it is formed as the fuel burns. The CFB boilers' low combustion temperature, together with staged air optimisation, also minimises NO_x formation, typically below 200 mg/Nm^3 depending on the fuel. If further NO_x removal is necessary, this can quite easily be performed by means of SNCR (Selective Non-Catalytic Reduction) systems, i.e. adding urea or ammonia with the result that NO_x reacts to form N_2 , O_2 and H_2O .

Another key feature of the CFB technology is high fuel flexibility. A large variety of solid fuels can be burned, which also offers the possibility of co-combustion with biofuel, for example. As the fuel does not need to be pulverised, the fuel feeding system is also simpler. The higher parasitic electricity consumption in the Oxyfuel process, in comparison to conventional power generation, is yet an argument for high fuel flexibility as the utilisation of cheap fuels becomes more important.

The above mentioned advantages for air CFB boilers are also expected to be valid for Oxyfuel CFB boilers. In addition, the Oxyfuel CFB technology could offer some advantages such as the possibility to more easily fire with higher O_2 concentrations in the oxidant since the CFB's low combustion temperature and the turbulent bed provide good means of equalising temperature levels. This would lead to reductions in volume flows with decreased investment as a result. Another advantage is that, since the fuel feeding system is simpler, the so-called primary flue gas recycle flow necessary in pulverized coal boilers to transport the fuel to the burners can be excluded, which reduces the overall complexity of the system. It could also be easier to minimize air ingress to the system since a large part of the furnace operates at slight overpressure.

Study together with Foster Wheeler and Praxair

To investigate and further elucidate the possible features of Oxyfuel CFB firing, Vattenfall has during 2008 conducted a conceptual design study together with the leading CFB boiler supplier, Foster Wheeler. Foster Wheeler has a long tradition in the development of the CFB technology and works extensively with the development of the technology for Oxyfuel firing. Praxair, a supplier of air separation and CO_2 purification and compression units, has also participated in this project to provide the conceptual design and performance of these units.



Photo: Seppo Kaksonen, SL-Foto

You can find this issue at www.vattenfall.com/ccs

Visit www.fwc.com to learn more about innovative and environmentally responsible technologies.