2nd Oxyfuel Combustion Conference

Three years operational experiences with the Oxyfuel Pilot Plant of Vattenfall in Schwarze Pumpe

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1. Introduction

Vattenfall has decided to develop the Oxyfuel technology to the industrial maturity. To this a pilot plant with a performance of 30 MWth was erected at the location Schwarze Pumpe in Germany. In the last three years of test operation a variety of knowledge could be collected for the complete Oxyfuel process.

These experiences were the base for the planning of the next step to the large industrial application of the Oxyfuel process. The demonstration power plant is planned to the Oxyfuel- and Post combustion technology at the existing power plant location in Jänschwalde/Germany.

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2. Technical concept and operation experiences

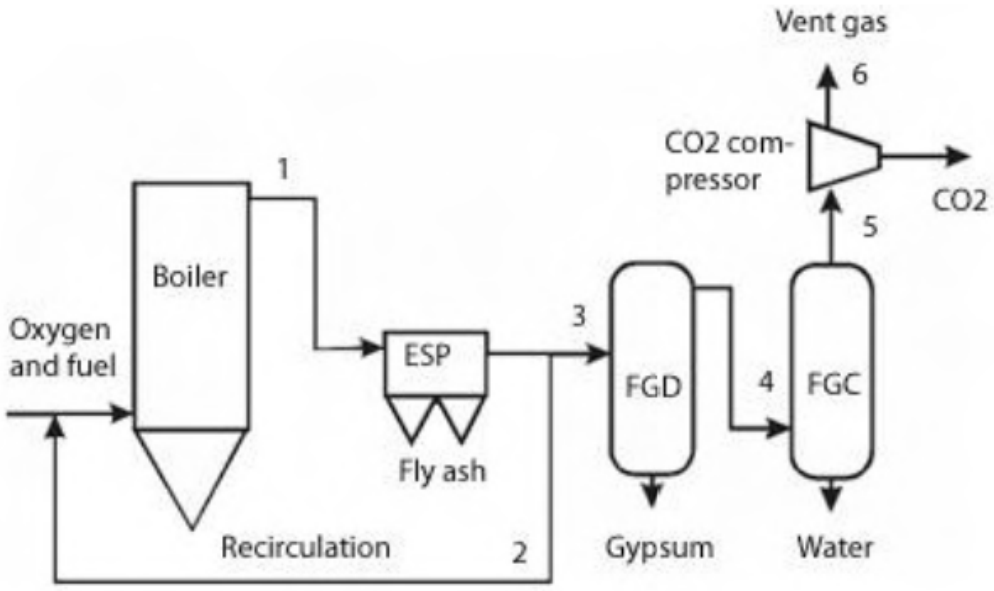
Special features of technical concept of the Oxyfuel pilot plant are:
- hot sulfur rich recirculation in front of FGD
- different oxygen input for mixtures of Oxidant (pre-mixed mode, expert mode)
- separate oxidation in the flue gas desulfurization process
- combination of spray and tray absorption in FGD
- CO2 plant with cleaning, drying and liquefaction

Three burners were tested till now (one jet burner and two spin burners) and various measuring to flame temperatures and heat transfer carried out. Variable lignite qualities and firing behavior could be tested. Special interest was for the maximum O2 in Oxidaten at minimal O2 in flue gas at compliance with all emission limits.

Further main emphasis was the flue gas scrubbing with electrostatic precipitator (ESP), wet flue gas desulfurization (FGD) and flue gas condenser (FGC). The necessary removal rates for the input quality to the CO2 plant could be reached. Captured CO2 qualities are suitable for pipeline transport and storage.

A special task is the reduction of SO3 at the flue gas scrubbing. This was realized with ESP, FGD and FGC in the Oxyfuel pilot plant. It was proved that the removal rates of ESP (~70%), FGD (~60%) and FGC (~70%) meet the requirements. This technical solution of flue gas cleaning is sufficient to protection of materials of the CO2 plant and for CO2 purity.

A special main emphasis is the reduction of NOx in the process. The influence by burner, over-fire-air/oxidant and air inleakages of NOx was tested. An optimization of these measures doesn't suffice to reach the emission limits. Besides the SCR- (1,2,3) and SNCR- (1) methods also a so-called "cold DeNOx" (5) was tested successfully in the CO2 process.



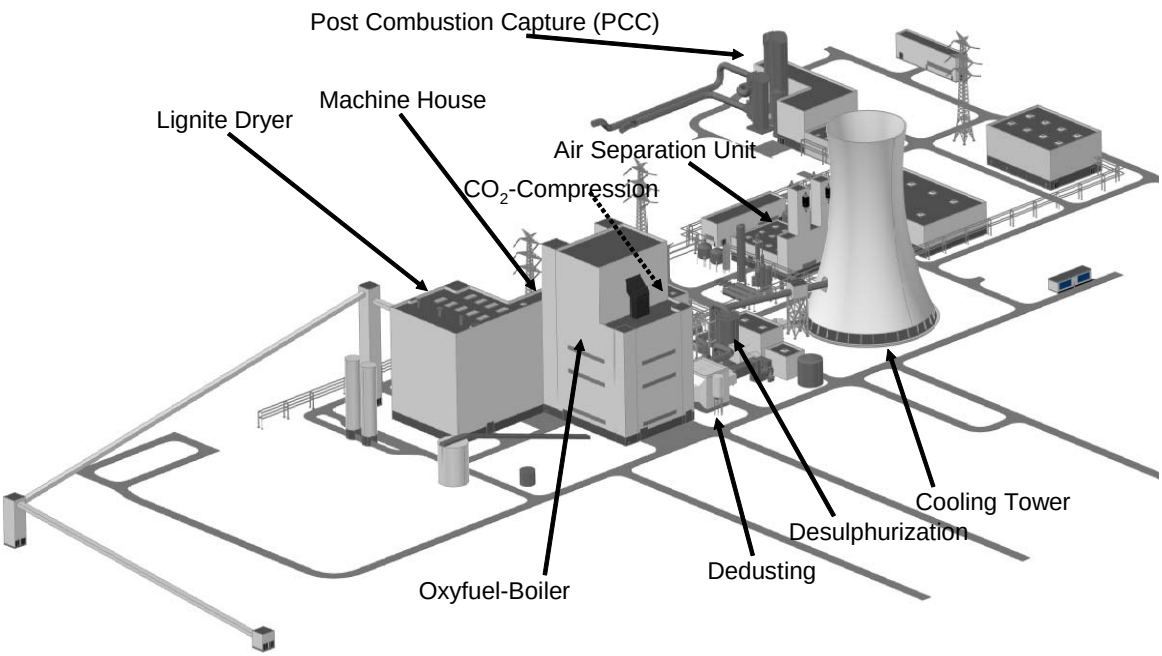
3. Outlook

Vattenfall sees further potentials for increase of efficiency to the Oxyfuel process:

- Special optimization of individual components (ASU, CO2 plant)
- Availability of materials for use of "hot sulfur rich recirculation" for large units
- Integration of Pressurized Fluidized Bed Dryer (PFBD) for lignite with vapor compression
- Application of membrane technology at the ASU and CO2 process
- combined flue gas cleaning and CO2 processes

The captured CO2 qualities from the Oxyfuel Pilot Plant correspond to a "technical CO2 quality" near to food quality. Vattenfall looks for further industrial applications in cooperation of chemical companies for this “technical CO2”. First solutions for algae cultivation and polymer production are already tested practically.

All previous experiences are used in the preplanning of demonstration power plant in Jänschwalde. There is planned a 250MWe Oxyfuel unit and reconstruction of a 50 MWe post-combustion plant. For the first time the coal drying is integrated into the complete process and the CO2 transported by pipeline to saline aquifers or gas fields (EGR).



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