

Coal gasification at Nuon Magnum

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Nuon is developing a new power plant at Eemshaven, in the Province of Groningen: Nuon Magnum. The concept consists of a gas-fired power plant combined with a gasification unit and a CO₂-capture unit. The gasification unit makes it possible to use coal and biomass as raw material, as well as gas.

Better environmental performance

There are two ways of using coal as a fuel for the production of electricity. Combusting coal in pulverised coal power plants is the most commonly used technology. In this conventional type of power plant coal is ground to dust. The pulverised coal is then blown into the steam boiler and combusted under high pressure to generate electricity. In the 1990s a new technique was developed in which coal gasification was integrated with a steam and gas turbine. The combination of coal gasification followed by the generation of electricity in a steam and gas turbine is known as IGCC (Integrated Gasification Combined Cycle).

In a coal gasification power plant the coal is first converted into synthesis gas, or syngas for short. This gas is cleaned and desulphurised to a purity similar to that of natural gas. The cleaned gas is then suitable for combustion in an IGCC unit, where it is converted into electricity. Coal gasification is significantly cleaner than the conventional combustion of coal. It has lower emissions of dust, sulphur dioxide (SO₂), nitrogen oxides (NO_x) and metals. Moreover, coal gasification makes it possible to co-fire biomass on a large scale. Finally, gasification technology enables CO₂ to be captured with a relatively low loss of output. All in all this results in considerably

better environmental performance than a conventional coal-fired power plant.

On the way to a new global standard

Nuon's power plant at Buggenum in the Province of Limburg achieved a world first in 1993. It was here that, for the first time, gasification technology was successfully used on a large scale for the production of electricity. Since that gasification unit came into service Nuon has carried out many improvements to optimise the technology and ensure that the power plant runs profitably. Having gathered 15 years of experience, Nuon is now ready for the next step by building a bigger power

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plant based on the same technology: Nuon Magnum.

Nuon is convinced that the technology of coal gasification, with co-gasification of biomass and in combination with CO₂-capture, will become the new global standard for the use of coal for electricity production.

Explanation of the production process

- A. Coal is delivered from the port to the plant, where it is milled and dried to form pulverised coal. Then the pulverised coal is blended with milled biomass. It is stored under nitrogen to prevent the risk of explosion, brought up to pressure with nitrogen and transported to the gasifier.
- B. Oxygen is added to the coal, which is converted into syngas under pressure and at high temperature. The non-combustible part of the coal (minerals) solidifies and is removed as slag. This slag does not leach and can therefore be reused as a certified product. The syngas

consists primarily of carbon monoxide and hydrogen and at this stage still contains various pollutants. These pollutants are removed step by step. The syngas, which is combustible and poisonous, is then cooled in the syngas cooler. The heat that is released is converted into steam.

In the air separation plant, oxygen and nitrogen are drawn from the atmosphere at very low temperatures. These gases are used in the process.

- C. Then in two steps the fly ash - fine particles that also contain non-combustible materials from the coal - is removed from the gas. The fly ash can be used in the building industry.
- D. Next the gas is washed with water. This removes the soluble compounds present in the coal, such as chlorides and fluoride, extracting them from the gas.
- E. During the subsequent sulphur removal process, the toxic H₂S (hydrogen sulphide) is extracted from the syngas. In this process over 99% of the sulphur

from the coal is bound and converted into pure sulphur. This is reused in the chemical industry. A very small part of the sulphur goes into the air via the flue gas burner as SO₂.

- F. In the CO₂ capture plant steam (H₂O) is added to the syngas. Using a catalytic converter a chemical reaction takes place, giving rise to a syngas with more H₂ and CO₂. This CO₂ is separated and transported for storage. The cleaned syngas then goes without CO₂ to the gas turbine.
- G. The gas is combusted here, driving the gas turbine. The hot flue gases from the gas turbine are cooled in the heat recovery steam generator. The heat released is used to produce steam, which drives the steam turbine. The ultimate electricity production takes place in the generator, driven by the steam and gas turbines in tandem.

More information needed?

Go to www.nuon.com/magnum

