

Coal, Possible Clean Energy

Billions of years ago, plants converted carbon dioxide into organic matter for storage by photosynthesis. With fundamental changes of nature, the organic matter was converted into coal – the energy we currently use the most. The massive use of coal has significantly promoted the progress of human civilization and industrial development; however, the pollutants generated by coal burning and the emission of green house gases have also opened a Pandora's Box of air pollution and climate change.



Although the massive use of coal has brought environmental problems like pollution, people are striving to find other relatively clean energy; as a traditional energy, coal is currently playing, and will play in the future, a primary role in energy. Currently in China, 60% of the energy comes from coal, and over 70% of the power supply is generated by coal burning. However, for the United States that uses less coal, proven coal reserves are sufficient to last 250 years without the use of other energy. Therefore, how to utilize coal resources in a cleaner manner are the common topic different countries have when facing the current and future problems in relation to resource situation.

In recent years, Integrated Gasification Combined Cycle (IGCC) technology, which combines gasification technology and combined cycle technology, has begun to provide us with the solutions that utilize coal resources for power generation in a clean manner.



The essence of IGCC, the advanced power system, is to combine a set of coal gasification and purification equipments based on a completely mature gas-steam combined cycle in order to convert coal into clean synthesized coal gas and to further achieve the objective of clean power generation with coal as the fuel in the power generation equipments with gas-steam combined cycle. The most important thing is that, compared with the capture of carbon dioxide from flue gas of traditional power plants, it will be more easily to capture carbon dioxide from synthetic gas for IGCC.

IGCC power generation technology is more advanced than the coal power generation technology currently in common use. People started to use coal gasification technology in the early 20th century. Such technology has already been applied to the petrochemical

industry and oil refining industry for many years. At present, the advanced gasification equipments of GE have been used in chemical plants. Currently, there have been four large-scale IGCC power stations with a capacity of 250-300MW put into operation in the world, namely the Wabash River and Tampa in U.S., Demkolec in Holland and Puertollano IGCC in Spain. It is estimated that by considering CO₂ capture, IGCC power plants obviously excel over traditional power plants in terms of cost-effectiveness, whose cost will further decrease when reaching certain scale. At the same time, with the improvements of design level and used materials, their efficiency will be further improved. In addition, the captured carbon dioxide is used to inject into oil field to improve oil output, which has also a promising prospect with view to its market application.

Obviously, IGCC is a kind of mature technology that can bring significant benefits and reduce carbon dioxide emission. Then, why is such advanced technology not yet widely applied?

First, it is because of economic cost and gasification efficiency. The first step of gasification is the preparation of a coal water slurry. The existing technical difficulty for the preparation of a coal water slurry is how to increase the concentration of the coal water slurry and thus improve gasification efficiency.

At the Chinese Research & Development Centre of GE, the scientists of Coal Poly-generation Laboratory adopt two methods to solve the problem. The first method is particle size distribution; that is, to mix the coal of different particle sizes for the preparation of a coal slurry. As small coal particles can enter the void between large coal particles, by mixing the particles at a certain percentage, it not only further improves the concentration of coal slurry, but also enables good fluidity of the coal slurry to facilitate its transmission into gasification furnace through pipes. The second method is to add appropriate additives to change the viscosity of coal water slurry so as to maintain good fluidity of coal water slurry at a relatively high concentration.

In addition, the reserves and quality of coal vary all over the world. It is impossible for a low ranking coal of poor quality to produce a coal water slurry at high concentration, so it is difficult to apply IGCC technology. The scientists from the Chinese Research & Development Centre of GE developed advanced “Dry Powder Transmission” Technology for low rank coal - to grind coal into coal powder and then transmit it into the gasification furnace under high pressure. At present, the Chinese Research & Development Centre of GE has established a whole set of large-scale high-pressure transmission testing facilities for this study.

Another key step for clean coal technology is to capture carbon dioxide emitted after coal burning for further utilization or storage. Only in this way is it possible to provide a fundamental solution against the emission of green house gases. Another team from Coal Poly-generation Laboratory under the Chinese Research & Development Centre of GE is working on the development of new solvents and processes used for the absorption of carbon dioxide.

The efforts made by the scientists from GE on IGCC technology are not limited to the above-mentioned areas, but also include apparent analysis for coal, development of new materials for refractory bricks in a gasification furnace and coal cinder modeling analysis. In the Chinese Research & Development Centre of GE, the scientists are creating a cleaner blue sky for human beings with their imagination and hard work.