JUPITER OXYGEN CORPORATION

Jupiter Oxygen is a privately held Illinois company that has developed and pioneered a revolutionary technology that makes it both practical and cost effective for electric power plants to capture CO_2, have ultra low emissions and save fuel. Unlike most clean coal technologies being developed, Jupiter's patented process can be either designed into new plants or used to retrofit existing plants. Plus, Jupiter's technology can also be used on gas powered electric power plants, which results in virtually no emissions for NOx.

BACKGROUND

Jupiter Oxygen is a recognized leader in the development, application and use of oxy-fuel. Jupiter's expertise lies in its continued research, development and everyday use of oxy-fuel combustion. Experimenting and developing the patented oxy-fuel process began in the mid-1990's as a way to cut fuel costs and lower emissions at Jupiter Aluminum, an aluminum recycling and manufacturing business and a patent licensee. Jupiter's technology has been in use at the aluminum plant since 1997, and is now emerging as the most promising environmental control technology for use in both coal and gas powered eletric power plants.

INITIAL TECHNOLOGY DEVELOPMENT

Since 2001, Jupiter has taken its technology from industrial furnaces to fossil fuel steam boilers and electric power plant test applications. In 2002, the company tested its oxy-fuel technology in a steam boiler using oxygen instead of air, and firing with both natural gas and coal. These successful trials were followed by additional testing in 2004 that proved that it is both practical and cost effective to capture CO_2. The test were done in cooperation with the US Department of Energy (DOE) and it's National Energy Technology Laboratory (NETL). In 2004, Jupiter Oxygen's technology was also certified by Canada's Environmental Technology Verification Program.

Throughout its history, Jupiter Oxygen's development goal for its patented oxy-fuel technology has been reduced NOx emissions, prove that CO_2 can be effectively and economically captured, and improve boiler energy efficiency in order to save fuel. The 2004 tests were coordinated with the US Department of Energy and showed that a clean coal techonology based on Jupiter's patented high flame temperature oxy-fuel combustion process, combined with the NETL's Integrated Pollutant Removal System, is the path to a cost effective clean coal future for both retrofits and new electric power plants.

HAMMOND TEST FACILITY (2006 – 2012)

From 2006 through 2012 Jupiter Oxygen operated an oxy-combustion test facility built around a 15 MWth (5 MWe equivalent) steam boiler first operated on natural gas and then on coal. A pilot scale demonstration of CO_2 capture system was developed with USDOE NETL. Parametric studies performed at the facility demonstrated the feasibility of Jupiter Oxygen's high flame temperature oxy-combustion technology for boiler firing and generated technical data necessary for scale-up and optimization. In addition, the test facility provided a platform for high flame temperature burner development.

The Hammond Test Facility produced a series of significant accomplishments. Based on the outcome of tests and developments at the Hammond Test Facility, the DOE has deemed Jupiter Oxygen's high flame temperature oxy-combustion and carbon capture technologies ready for a commercial scale demonstration. Empirical test results and modeling studies show CO_2 recovery of 100% can be achieved with a net energy penalty of approximately 20% for oxygen generation and CO_2 capture if there is an external source of electricity to power the capture system during boiler start-up and shutdown. Without the capture system fully operating during boiler start-up and shut-down, the overall CO_2 capture rate falls to 95%.

SOME OF THE OTHER SPECIFIC TECHNICAL ACCOMPLISHMENTS ARE:

- Compared to air firing, the JOC high flame temperature process can produce equivalent superheated steam with a fuel savings of 4.6% or more.
- Slagging and fouling performance with the JOC approach will be fundamentally the same as for the air-fired case.
- Flue gas recycle being introduced only outside of the combustion zone is critical to maintain high flame temperature except for recirculated flue gas to move coal into the burners.
- Corrosion tests support the suitability of commonly available stainless steel for IPR™ construction.
- Spectral irradiance data collected in the tests provide a useful and unique resource for future studies and design.
- An improved technique was demonstrated for flame temperature determination, contributing to the high quality of data collected.

SUMMARY

Jupiter Oxygen Corporation together with NETL operated the Hammond Test Facility between 2006 and 2012 with both internal and Department of Energy sponsorship. Through careful experimental work performed at the facility, the performance and practicality of the JOC high flame temperature process combined with CO_2 capture was demonstrated. In 2011 Jupiter Oxygen was granted a patent on the jointly developed carbon capture technology.

Source: Schoenfield, Mark K., et al, Oxy-Combustion Burner and Integrated Pollutant Removal Research and Development Test Facility, DE-FC26-06NT42811, December 2012.