Oxyfuel Combustion Technology

Official Opening of the OxyCoal™ Clean Combustion Test Facility
Technical Seminar

David Sturgeon
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**Air Firing Technology**

Pulverised fuel combustion under air firing operation produces a flue gas CO$_2$ concentration of typically 15%v/v dry basis.

**Oxyfuel Firing Technology**

Pulverised fuel combustion under oxyfuel firing operation produces a flue gas CO$_2$ concentration of typically >75%v/v dry basis.
Air Firing Technology vs. Oxyfuel Firing Technology

Pulverised fuel combustion under oxyfuel firing operation produces a flue gas that requires minimal treatment prior to storage.

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Doosan Babcock’s Oxyfuel Combustion Technology Roadmap

For over 15 years, we have been a leading player in the development of low carbon technology.

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The OxyCoal-UK: Phase 1 collaborative project addressed critical technology gaps and was led by Doosan Babcock and supported by the Technology Strategy Board.

- **Combustion Fundamentals**
  - Characterisation of coal ignition, devolatilisation, char burnout and nitrogen partitioning behaviour under oxyfuel firing conditions.
  - Development of kinetic parameters from test data and application in CFD models of OxyCoal™ burner and oxyfuel boiler.

- **Furnace Design and Operation**
  - Investigation of the performance of the oxyfuel process and its key impacts on utility plant operation and performance.

- **Flue Gas Clean-Up**
  - Development and testing of novel flue gas clean-up system for NOx and SO2 removal from oxyfuel derived flue gas.

- **Generic Process Issues**
  - A desktop study to investigate the key process issues associated with an oxyfuel installation on a large utility plant.
OxyCoal-UK: Phase 1 – Fundamentals and Underpinning Technologies

Pilot-scale testing of the oxyfuel combustion process on Doosan Babcock’s 160kWt Emissions Reduction Test Facility (ERTF).

OxyCoal-UK: Phase 2 – Demonstration of an Oxyfuel Combustion System

The OxyCoal-UK: Phase 2 collaborative project is led by Doosan Babcock and supported by the Department of Energy and Climate Change.
OxyCoal-UK: Phase 2 – Demonstration of an Oxyfuel Combustion System

During Summer 2009, Doosan Babcock Energy has commenced its 40MW, OxyCoal™ demonstration, the world’s largest demonstration of an oxyfuel combustion system.

• Demonstrate operational envelope of the OxyCoal™ burner
  – Flame stability
  – Turndown
  – Start-up
  – Shutdown
  – Transition between air and oxyfuel firing

• Demonstrate successful performance of the OxyCoal™ burner
  – Flame stability
  – Flame shape
  – Furnace heat transfer characteristics
  – NOx
  – Carbon in ash

Testing a burner of the type and size applicable to new build and retrofit coal-fired boilers.
OxyCoal-UK: Phase 2 – Demonstration of an Oxyfuel Combustion System

Full-scale testing of the oxyfuel combustion process on Doosan Babcock’s 90MWt Clean Combustion Test Facility (CCTF).

- Start-Up / Light-Up
- Air Heavy Fuel Oil Firing
- Air Coal Firing
- Transition
- OxyCoal Firing
- Shutdown

- Heavy Fuel Oil
  - 3000 litres
- Kellingley Coal
  - up to 50 tonnes
- Liquid Oxygen
  - up to 100 tonnes

Optimised OxyCoal Combustion

The Optimised OxyCoal Combustion project is led by Doosan Babcock in collaboration with Air Products and is supported by the Technology Strategy Board.

- Investigate advanced oxyfuel burner concepts, using mathematical modelling, to exploit the potential of the oxyfuel process (efficiency, fuel flexibility).
- Define burner designs suitable for full scale testing and commercial exploitation.
Impact of High Concentrations of SO2 and SO3 in Carbon Capture Applications and Mitigation

The OxySOX collaborative project is led by Doosan Babcock and supported by the Technology Strategy Board.

- Establish the impact of oxyfuel firing on SO2/SO3 and mercury behaviour.
- Determine the performance of in-furnace and post-combustion SO3 sorbent injection under air firing and oxyfuel firing conditions.
- Establish a predictive capability for SO3 sorbent injection and mercury behaviour in oxyfuel firing conditions.
- Determine the impact of oxyfuel firing conditions on fireside corrosion and low temperature corrosion.

Doosan Babcock’s Oxyfuel Combustion Roadmap

Through our investment in R&D we continually look for innovative ways to create a low carbon future.

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E.ON Combustion Test Facility
Concluding Remarks

Doosan Babcock is developing the capability to provide competitive oxyfuel firing technology suitable for full plant application post-2010.

• Doosan Babcock has established a dedicated Carbon Capture Business Group to commercialise Carbon Capture technologies.

• We are undertaking a front end engineering design (FEED) study for a utility client for a 100MWe oxyfuel power plant.

• We aim to design, supply and construct an oxyfuel power plant of similar scale that will be operational by 2015, and a 1000MWe oxyfuel power plant by 2020.

Commercial Contact Details

Doosan Babcock is committed to delivering unique and advanced carbon capture solutions.

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