

Opportunities for Thermal Coal Research

Introduction

A review of research supported by ACARP, NERCCDC and the coal CRCs on Australian thermal coals has revealed that the effort has slowed in recent years. In this period new technologies and novel analytical techniques for coal, its products and impacts have emerged which provide the need and opportunities for research. This conclusion applies equally to coal-to-hydrogen and other coal-to-chemical research.

Significant emerging trends include the increased use of Australian coals in HELE (High Efficiency Low Emission) power plants; an increasing emphasis on improved control of power plant emissions with improvements to burner design, additional flue gas treatments, and more advanced combustion and control system tuning; increased use of PCI injection into blast furnaces; and the introduction of more stringent regulations in power generation, coke manufacture and steel making.

In response, ACARP is supporting the construction of a test furnace at the University of Newcastle suitable for combustion research relating to HELE coal power plants; development of new tools such as advanced Mass Spectroscopy (LDI-TOF-MS) for characterising coal and associated combustion and pyrolysis products: Coal Grain Analysis (CGA), Optical and Scanning Electron Microscope (SEM) techniques for char; and SEM – Energy Dispersive Spectroscopy (EDS) for mineral matter in coal and coke.

The purpose of this document to provide guidance by outlining a number of opportunities for coal research that are aligned to ACARP’s mandate and objectives.

Relating coal quality to its utilisation

Thermal coals are utilised to generate electricity by direct combustion and steam raising in large utility boilers as well as in smaller industrial units. The combustion process involves high-temperature devolatilization of the coal followed by char burn-out to produce high-grade heat for steam raising and the production of electricity. In addition, the combustion process yields Ash (sintered and fine alumino-silicate materials) that are increasingly being used as a cement additive, feed stock for aggregates and other engineered materials, low cost fill and agricultural applications; as well as gaseous products and waste water that must be controlled to within statutory limits. The schematic pictured on Fig 1 illustrates the associated processes with operational and regulatory impacts.

Thermal coals are also increasing being used to make synthesis gas (comprised mainly of CO + H₂) and other hydrocarbons through coal pyrolysis, partial combustion, hydrogenation and other chemical engineering processes. These products in turn provide feed stocks for a range of liquid fuels, chemicals and other carbon-based industrial products.

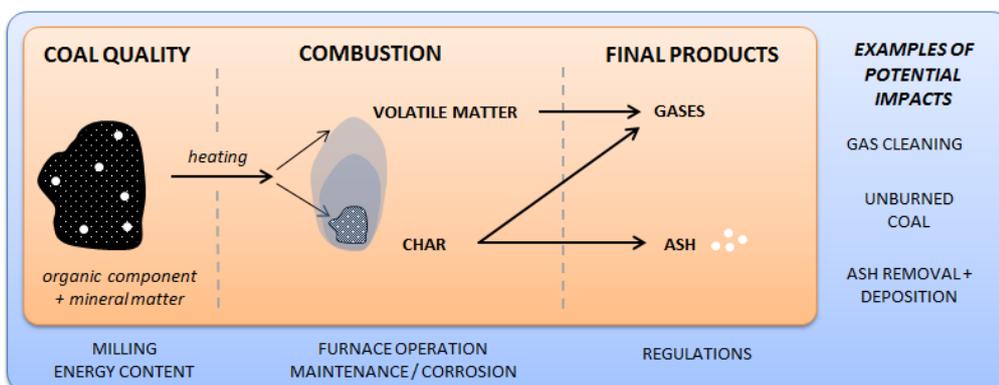


Fig 1: Combustion mechanisms linking coal quality on impacts



Opportunities for Thermal Coal Research cont...

Gaps and opportunities for future research

Following interviews of stakeholders involved in the export and local use of Australian thermal coals, researchers, consultants and laboratories a number of study areas have been identified which may lead to a better appreciation of the impact of coal quality on its value and use, including

- Critical review on coal quality impacts on High Efficiency Low Emission (HELE) power plants and prospects for uptake of HELE units considering the effects on associated steam conditions and furnace metal requirements;
- Advanced combustion testing utilising facilities such as the new ACARP HELE test furnace at the University of Newcastle
- Assessing coal analysis techniques associated with regulations and standards for Australian thermal coal utilisation, including those determining acceptable export quality and ISO standards
- The use of advanced analytical techniques as characterisation tools for coal utilisation
- Blending Australian thermal coals with international coals, including alleviating issues with troublesome local coals, blending with biomass, bio-char and wastes, and as blending partners with Indian and Indonesian coals. What coal quality best suits the blending partners?
- Utilisation of secondary thermal products from coal preparation plants, including by-products and recovered wastes from the washing (beneficiation) of export coals
- Emerging competitive coals to Australian coals, by comparative studies to establish rational economic value Emerging utilisation options and markets
- Future markets for thermal coal and prospective coal reserves, particularly for low volatile coals, for coals from new basins being developed and for new potential markets
- ACARP white papers and State-of-the-art reviews similar to those existing on the ACARP TMS page at www.acarp.com.au/reports, in particular
 - Updating existing but dated white papers
 - New white papers on coal quality techniques or coal utilisation technologies

Abbreviations

CGA – Coal grain analysis

CRCs – Cooperative Research Centres for Black Coal Utilisation, and for Coal in Sustainable Development

EDS – Energy Dispersive Spectroscopy

HELE – High Efficiency Low Emissions

ISO – International Standards Organisation

LDI-TOF-MS – laser desorption/ionisation time of flight mass spectrometry

NERDDC – National Energy Research, Development and Demonstration

PCI – pulverised coal injection

SEM – scanning electron microscopy

TMS – Technical Market Support

