A collaborative project for the improvement of combustion efficiency in utility boilers

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Summary

This presentation will report the progress on a major UK project to develop tools for the prediction of combustion efficiency (or carbon burnout) of coals in pf-fired utility boilers. The overall aim is to develop new tools that are faster to run and more reliable than existing methods. This will give the ability to improve fuel selection and chose the most appropriate burner/boiler design for a given fuel. Benefits of the project include smarter coal purchasing, which will enable lower price coals to be used, and improved plant design for lower emissions and improved combustion efficiency.

The project involves several UK-based utilities, namely Innogy, PowerGen, Scottish Power and TXU Europe, who are providing data from tests on full-scale power stations and on combustion test rigs and a drop tube furnace. Innogy are also the project managers. It involves two UK manufacturers (Alstom Power and Mitsui Babcock). They are reviewing available data, developing a generic computer program to estimate carbon-in-ash, and providing a link with universities. Three UK universities are connected with the project. Imperial College, London and Nottingham University are providing data from a range of laboratory-scale tests, including high temperature heated wire mesh (HTWM), tests for particle heterogeneity, TGA reactivity measurements, image analysis techniques and char characterisation. The third university (Leeds) is developing a more fundamental approach to the modelling of carbon burnout.

A database is being generated for existing information on carbon burnout for specific coals, both on large scale rigs and actual power stations. This is being supplemented by the power station, rig and laboratory tests being conducted during the project. It provides a vital source of information for the validation of computer models. It also enables the assessment of fuels similar to those included in the data base.

To allow for timely decisions on fuel purchase, the prediction of fuel performance needs to be rapid (1-3 days) and accurate. It also needs to make allowance for both coal and boiler-specific effects. Advanced modelling techniques using computational fluid dynamics (CFD) require the creation of detailed plant-specific models. To obtain a reliable prediction is both time consuming and expensive. A more empirical approach is being developed which is based on a sound understanding of plant, fuel behaviour and uses station data. The basic strategy is to use a fairly simple furnace model that will provide the variation of temperature and oxygen with time along each flame track. This information is then input into more detailed coal combustion codes such as CPD and CBK8. It will be comparatively simple to generate validated station models. Once this is done, the overall method can be quickly and easily run on a PC. It will include the ability to allow for specific plant problems, and quantify combustion improvement from proposed plant modifications.

The project started by collecting the data available from a range of earlier projects and from the open literature. Most of the power station and rig tests and laboratory work have been completed and are being analysed. A large range of data is available, and includes a number of key coals that have been burnt across a range of scales. This will enable coal rankings from laboratory and rig tests to be compared with full-scale behaviour. The development of the generic carbon-in-ash predictor is in progress. A summary will be given of progress to date, and of the work planned to complete the project (completion due November 2002).

The work is being conducted via a collaborative project partly funded by the UK Department of Trade and Industry.