"AN APPROACH TO THE CORRELATION OF BOILER PERFORMANCE WITH COAL BLEND COMPOSITION"

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SUMMARY

Background

The increasing use of world-traded coals, often in combination as blends, on boilers fitted with low NOx burners, has created a situation for equipment suppliers in which burnout prediction is becoming more and more difficult. A technique has been developed in which a rapid assessment of the reactivity of the coal can be made. This measurement, which involves the automated determination of the light reflectance of a block of the coal, has already been validated using a 1MW combustion rig. The single parameter that this test produces may be used to estimate the likely unburnt carbon during the combustion process. This paper discusses the application of the procedure to a set of 300MW wall-fired boilers recently fitted with low NOx burners and firing blends of imported coals. Selection criteria based on these test results have enabled the unit guarantee performance to be met. Major differences in reactivity shown by the new tests were not apparent from conventional analysis.

Plant Description

The work described relates to a 1,250MW power plant in Portugal located on the west coast of Portugal known as Sines. The plant, which was commissioned between 1985 and 1989, consists of 4 x 314MW wall-fired boilers. The firing configuration is 5 rows each containing 4 burners and each boiler is supplied with pulverised coal from 5 mills. The units burn blends of imported bituminous coal and at full load each consume about 106 tonnes per hour. The boilers have recently been fitted with ABB's low NOx RoBTAS burners.

Commissioning of First Retrofit Unit

It was during the commissioning of the first retrofitted unit, (#2), in 1997, that unexpected UBC figures were obtained. It appeared that three different coal blends had been used to obtain performance data. Conventional analysis, such as proximate analysis, showed only a small variation in properties with the fuel ratio ranging from 1.65 to 1.82. Likewise, ash content on a dry basis was in the range 12.7% to 13.2%. Under identical operating conditions two of the three coals showed an acceptable LOI figure of between 4.0% and 4.3% over an excess oxygen content of 3% to 4.25%. The third coal, over a narrower and higher excess oxygen content of 3.75% to 4.75% gave LOI's in the range 6% to 8.5%. The challenge was to understand and explain the differences in the behaviour of the coals in question.

Improved Burnout Evaluation Technique

Although it has long been recognised that the combustible fraction of coals are visually different and behave differently on combustion, no simple and quick method has existed to quantify these differences. Work has, however, been done in recent years by Nottingham University in the U.K. [1-3], to provide such a method. Gibb presented a paper in 1996 at this conference describing the technique, [4]. What has been produced is the Reactive Assessment Program, (RAP). This test procedure, which takes less than 30 minutes to complete, makes the assumption that the combustion behaviour of any coal component is associated primarily with its light reflectance and not its type. The technique measures the relative reflectance of the whole coal sample. The cumulative volume percentage that falls below 190 grey-scale units is called the Reactive Number. The parameter used to relate coal reactivity to performance, (the % Unreactives), is obtained by subtracting the Reactive Number from 100%. The % Unreactives was found to correlate well with burnout for 16 world coals when tested on

the 1MW Combustion Test Facility, (CTF), of PowerGen in the U.K. This paper describes the application of this technique for the first time to the performance of coals in a full-sized boiler.

New Application of Reactive Assessment Program

Samples of the three coals used in the commissioning of low NOx burners in Sines unit #2 were subjected to RAP testing. It was found that the % Unreactives for the two coals, which gave acceptable burnout, were 11.6% and 13.0% whereas the figure for the high LOI coal was 21.1%. The highest % Unreactives was found in a coal which had a fuel ratio of 1.78, whereas one of the other coals which showed a higher fuel ratio of 1.82 had a much lower % Unreactives at 13.0%. This confirmed that the observations seen in the PowerGen 1MW CTF appear to be valid in full-sized plant.

The next step was to subject the whole range of coals used at Sines to RAP testing and to look at results for blends of these coals. Following the production of this data it has been possible to advise the plant operators which coals and blend compositions are likely to be troublesome and hence should be avoided. This approach has been used in the commissioning of the remaining retrofitted units; the last of which is having its outage this year.

Work is continuing on this technique to refine it and also to try to understand what are one or two anomalous results. However, it is felt that this relatively simple and quick technique has a great deal to offer in the prediction of carbon burnout in pulverised coal combustion.

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