Bottom ash post-combustion in an innovative dry extraction system at Megalopolis Power Plant, Unit # 3 (Greece)

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Abstract

Solid fuel-fired boilers sometimes produce bottom ash rich of combustible material, that is generally wasted if no post-combustion takes place immediately after the combustion chamber. The corresponding energy can be relevant, as in the case of low-grade coals like pet-coke and lignite. Until now, post-combustion grates have been the only systems used to recover this energy otherwise lost, but their success has been limited by their high cost and the need of additional fans, air ducting and lot of space under the boiler. With the Magaldi dry bottom ash extraction system (MAC), a simpler and more effective technology has become available.

In the MAC system bottom ash is extracted from the boiler on a steel belt conveyor, installed inside a closed housing, and cooled with ambient air that is drawn in from the outside by the boiler negative pressure. In this way, ash is not only efficiently cooled, but the heated oxygen-rich cooling air also facilitates the post-combustion of unburned carbon (UBC) in the ash. In fact, in MAC systems already in operation UBC content in bottom ash is strongly reduced in all cases where post-combustion process can be completed in few seconds, thanks to the combination of high temperature and oxygen reach conditions, *i.e.* exactly the conditions that exist in the room between the boiler hopper and the Magaldi belt conveyor.

In those cases where the post-combustion process requires minutes instead of seconds, because of the characteristics of the bottom ash, a complete post-combustion of UBC is not reached in the MAC system alone. Nevertheless, in those cases a complete re-use of UBC can be achieved by re-circulation of the dry ash to the boiler, as is successfully done in Ptolemais Power Station (Greece). The present paper describes the first in-field results of a new configuration of the MAC extractor, called Magaldi Ash Postcombustor (MAP), which provides for substantial UBC reduction in bottom ash also for those ashes that have a slow post-combustion process. Its design has been made possible after a series of tests performed in laboratory and pilot plant scale, whose results are shortly reported.

The first full-scale implementation of this new configuration is presently in operation in the 300 MW$_e$ Unit #3 of Megalopolis Power Plant (Greece), since December 2000. The boiler burns lignite extracted from nearby mines, with an average heating value of 4000 kJ/kg and 15-25 % ash, requiring a feeding rate of app. 800 t/h of lignite to reach the full power. The average bottom ash production is 20-25 t/h. Previously, with the original wet extraction system, the bottom ash from Unit # 3 had a typical UBC content of 20 %. Presently, with the MAP system the average value of UBC has dropped to app. 10 %, while system optimisation still has to be executed. This efficiency recovery has made it possible to increase the Unit's power output by around 5-6 MW. At the end of the testing period, the UBC is expected to drop further, with a corresponding efficiency and power generation increase.

Optimization of MAP operating parameters is made possible thanks to an innovative microwave instrument, named MITER, specifically developed by ENEL to treat and measure lignite bottom ash UBC on-line. This instrument gives a real-time UBC value, enabling the control system to set out the optimum values of the system operating parameters continuously.