



# Influence of lignite composition on thermal power plant performance

## Part 2: Results of tests

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### Abstract

The results of measurements and experiments on two power plant units are presented. The treated coal is lignite with lower heating values ranging between 9 and 10 MJ/kg and with contents of ash about 20% and moisture about 38%. The influences of significant lignite composition components on heating value, boiler losses, boiler specific production of steam, own consumption of electric power, power consumption for coal grinding and flue gas desulphurisation etc. are discussed. The results of analyses and measurements are graphically presented. © 2000 Elsevier Science Ltd. All rights reserved.

*Keywords:* Coal; Lignite; Power plant; Flue gases; Energy losses

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### 1. Introduction

The theoretic examinations of the effects of coal quality and changes of coal composition on power station operating efficiency are presented in Part 1 of this paper.

The present paper describes the influence of some significant lignite parameters on power plant performance. The results are derived on the basis of data obtained by performance measurements and tests conducted on units 4 and 5 in the power plant Šoštanj in Slovenia. All

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the five units of the power plant are fired exclusively by lignite with lower heating values from 9 to 11 MJ/kg, dug in the nearby coal mine Velenje.

The 275 MWe unit 4 was completed in 1972, the supplier of the boiler being the company Babcock. The boiler is a tower type, once through unit with forced circulation of the Benson system with steam reheating. The capacity of the boiler is 860/810 ton/h of steam with parameters 184/43 bar and 540/545°C. The boiler has pulverised coal firing with six combined hammer-fan impact pulverisers, 617 rpm, type DGS 70. The 335 MWe unit 5 was completed in 1977 and the supplier of the boiler was the Sulzer company. The tower type boiler has the Sulzer system of forced circulation and one step steam reheating. The capacity of the boiler is 1005 ton/h of steam with parameters 183/41.5 bar and 540/545°C. The boiler has pulverised coal firing with six fan pulverisers, type KSG N 270. In order to improve the operating parameters, to increase the efficiency and decrease the specific energy consumption of all kinds on both the boiler and the unit, performance tests were conducted out on both units. Thermal and performance tests of thermal power plants enable quality assessment of the energy transformations of individual parts as well as the unit as a whole. First tests on each unit were performed during the acceptance procedure: in 1974 on unit 4 and in 1978 on unit 5. Experiments and tests were performed later in the years 1995 [1–3] on unit 4 and in 1996 and 1998 on unit 5 [4]. The calculations of boiler losses were performed according to DIN 1942. In order to obtain more reliable data, the examined plant required an independent measuring equipment as well as a data acquisition and processing system.

This paper discusses the influence of the composition of coal on plant operation units and deals with those properties of coal that affect the performance of a power plant unit. Only the results which are generally relevant for operation of other thermal power plants are presented in the paper.

## **2. Data acquisition and processing system**

In order to perform reliable and independent measurements of boiler and unit performances, an independent measuring system with special testing instruments has been installed. The capacity of the applied system was over 100 channels available on five multiplexers connected with a multimeter. The measured analogous quantities are transformed to digital form and led to a PC. The calculations were performed simultaneously during the measurements, considering the supposed chemical composition and heating value of the actually used coal. During the tests, sampling of coal, slag and ash was performed in order to perform chemical analyses and, subsequently, to determine their mass flows. Final calculations were obtained after values of the laboratory analyses had been re-entered into the computer program. The main program applied for calculating the boiler losses and efficiency was elaborated on the basis of the standard DIN 1942 procedure. During the tests, measurements of power on the generator terminals were performed, together with measurements of the electric demand of the unit, where the consumption of the electric power of the mill pulverisers and the desulphurisation device were measured separately.

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