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Sampling at Maasvlakte Power Plant in Rotterdam

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Summary

In the commercial operation of coal-fired power stations it is essential that a constant supply of coal with known characteristics be available. Thus sampling of the various grades of coal used to make up the blending beds and also the final, blended feed is of utmost importance. The author describes arrangements used at a modern power plant in Holland.

1. Introduction

In the early seventies the Maasvlakte power-plant "GEB Rotterdam" became operational with two units of max. 540 MW each, which were fired with natural gas and oil.

However, due to increasing gas and oil prices and the related tendency to favour the utilization of coal, plans were initiated in 1981 to reconstruct this plant in order to make coal firing possible.

To this purpose the present boiler house will have to be dismantled almost completely and consequently rebuilt, including a desulphurizing plant for stack gases, a fly ash disposal system and a coal transportation system.

In July 1981 ESTS B.V., a consultancy and engineering company and a subsidiary of Hoogovens in IJmuiden, was assigned to prepare a feasibility study to determine the best suitable coal supply system.

Mainly due to the fact that this power plant is located close to the EKOM-terminal (coal and iron ore stevedores) and also near the planned MCT-terminal (Maasvlakte Coal Terminal) it appeared technically and economically feasible to make a direct transport connection between both terminals and the GEB power plant.

In January 1982 ESTS was further assigned to define the coal transport and storage systems and to execute the basic engineering, including the subsystems and components.

More than 2 million tons of coal per year must be transported from either the EKOM or the MCT terminal via a conveyor belt system with a rated initial capacity of 2,000 t/h.

Each unit will consume approximately 24,000 t/week and will operate continuously.

2. System Description

Coal to be supplied by EKOM (or later also by MCT) will temporarily be stored in a so-called holding bin. This bin is located on the MCT-property and is served by a belt conveyor with a max. capacity of 5,500 t/h.

The concrete bin, with a storage volume capacity of 4,000 m^3, has been divided into several compartments. With these compartments the stacker/reclaimers on the terminals are able to supply at high and fluctuating rates an amount of coal of a certain grade while the discharge of the compartment will be smooth and constant. Switching from one grade to another is easy to perform, since every compartment has its own discharge device.

The connection between the GEB and the holding bin will be a 2.1 km long belt conveyor, which is over 2/3 of its length laid in a subterraneous tunnel. It is remarkable that this will be the longest conveyor belt in Holland and the combination of a long belt in a tunnel is also a novelty for Holland.

Before going to be stored, the coal is sampled and accurately weighed (by trade certified belt scales). The storage facilities on GEB's land will be executed as blending beds with related machines, i. e., a travelling stacker and a bridge reclaimer. In this way GEB is able to blend various coal grades (approx. 5) in order to control the components, such as sulphur, volatiles and ash contents, for efficient firing of the boilers. Building up the blending beds will be performed by applying a certain number of "shots" of a certain weight and a certain grade.

Coal, reclaimed at max. 1,000 t/h, will be transported via belt conveyors, which are completely enclosed in housings, to the day-bins, at an elevation of 50 m, above the coal mills in the plant.

Between the reclaimer and the mill a de-ironing device, a process weigh scale and sampling equipment are foreseen.

Since each unit will consume 24,000 t/week it was decided to have a total blending bed/storage capacity of 100,000 t, consisting of two beds of 50,000 t each. In operational terms it means that while one pile is being built up, the other will be reclaimed.

3. Sampling Aspects

Both incoming coal (0—50 mm) to the GEB storage yard or blending bed and outgoing coal from the yard to the plant must be sampled in order to obtain the necessary information about coal characteristics and qualities.

The sampling requirements can be described as follows:

a) GEB wants to verify whether the delivered coal is in close conformity with the contract specifications.
   It should be noted that EKOM itself, as a stevedoring company, does not sample incoming bulk material. If necessary, a sampling firm will be hired by the client to execute the desired sampling.
b) In the case that several shots of different grades will be supplied to GEB for building up the desired blending bed, GEB must be sure that the ordered grades arrive; moreover, several characteristics of the coal may be determined to calculate the expected averages of the blending bed.
c) Coal coming from the blending bed should be sampled to check previous calculations and to determine the coal mixture qualities, and eventually, the deviations from the average values. This is also very important in order to calculate the efficiency of the coal firing part of the power plant.

It should be noted that composition control of the blended mix, in case sampling takes place just before arrival of the coal at the blending bed, is hardly possible.

The bed of 50,000 t will be built up in approx. 30 h, during which period various grades will be transported. No time will be available for the complete cycle of sampling all shots, to prepare and analyze the samples and to feed back the results in order to control the blend.

Before building up the pile the composition of the derived blended mix will already be determined from known qualities either from the contract specification or as a result of sampling when coal was discharged from the ships at EKOM (or MCT).

Based on many years of experience at Hoogovens, where several sampling stations were built and where a complete staff takes care of hand sampling, supported by fully equipped laboratories for analyses, ESTS has developed the major philosophies for the technical and operational aspects of such a system and could apply these to the GEB situation.

ESTS therefore recommended:

A. Hand sampling by a hired firm at the EKOM storage yard, during or after ship discharging according to the ISO 1988 recommendations. The samples can be prepared and analyzed by this firm or by the GEB laboratory itself. With the results obtained GEB is able to compose the blending beds.
B. A mechanical sampling device at the entrance to the blending bed. Since an accurate belt weighing device will be provided, signals can be obtained to control the sampling frequency (see Fig. 1, code MT11).
C. The same installation at the exit of the blending bed. Again a belt weigh scale has been provided which will be installed parallel to the above mentioned belt weigher (Fig. 2, code MT 21).
   Both sampling features take place at transfer points of belts which are situated next to each other.
   Transfer points, sampling devices and belt weighers are arranged in one transfer building in which also the sample preparation can take place (see Fig. 2).

The basic philosophy for sampling installations as advised by ESTS is that sample-taking should only be performed locally and that sample preparation (crushing, dividing, drying, grinding, etc.) should take place away from transfer points in a separate preparation room.

This means e. g. for incoming coal at a capacity of 2,000 t/h and 20 shots of 2,500 t of coal (re B):

1. From each shot n samples can be taken in order to check whether the right grade has been delivered by making a quick analysis of e. g. volatiles content. Each sample will approximately be 170 kg ($Q \times S$: 3,600 x V with S = 3 x 50, V = 0.5 m/s), which is far too much; from this sample a secondary sample cutter will take 5 small samples of say 3 kg each (according to ISO 1988).
   If n = 1, approximately 15 kg per shot will be sampled; thus, if n = 5 (samples after 500 tons —1.250 tons — 2.000 tons, i. e., every 15 min) 75 kg will be obtained.
   It was advised that this amount has to be gathered in small bins or containers, enabling the personnel to transport these gross samples to the preparation room.
   Precautions must be exercised before taking the first sample of a new shot, that this sample is not contaminated by "left-overs" of the previous shot. Therefore, the sample taking device must be cleaned by "purging" it first with material from the new shot, i. e., the first few samples should be discarded.

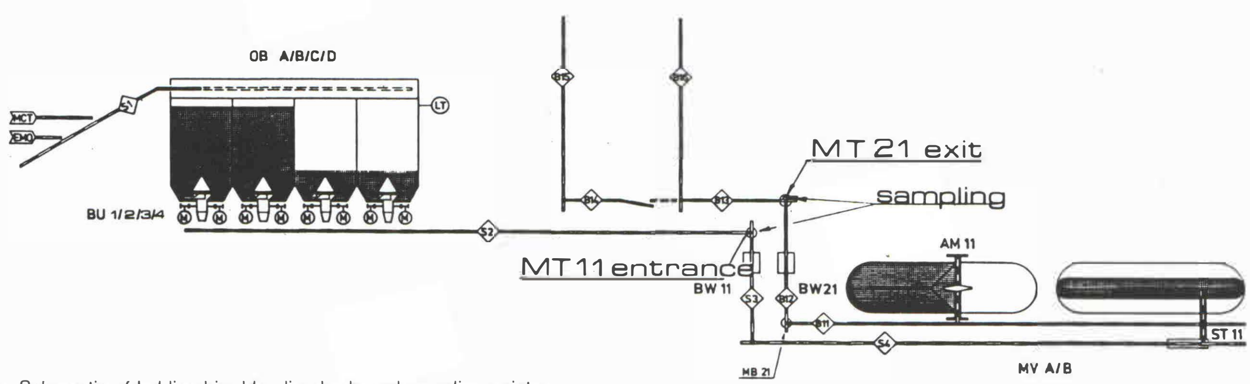

Fig. 1: Schematic of holding-bin, blending beds and sampling points

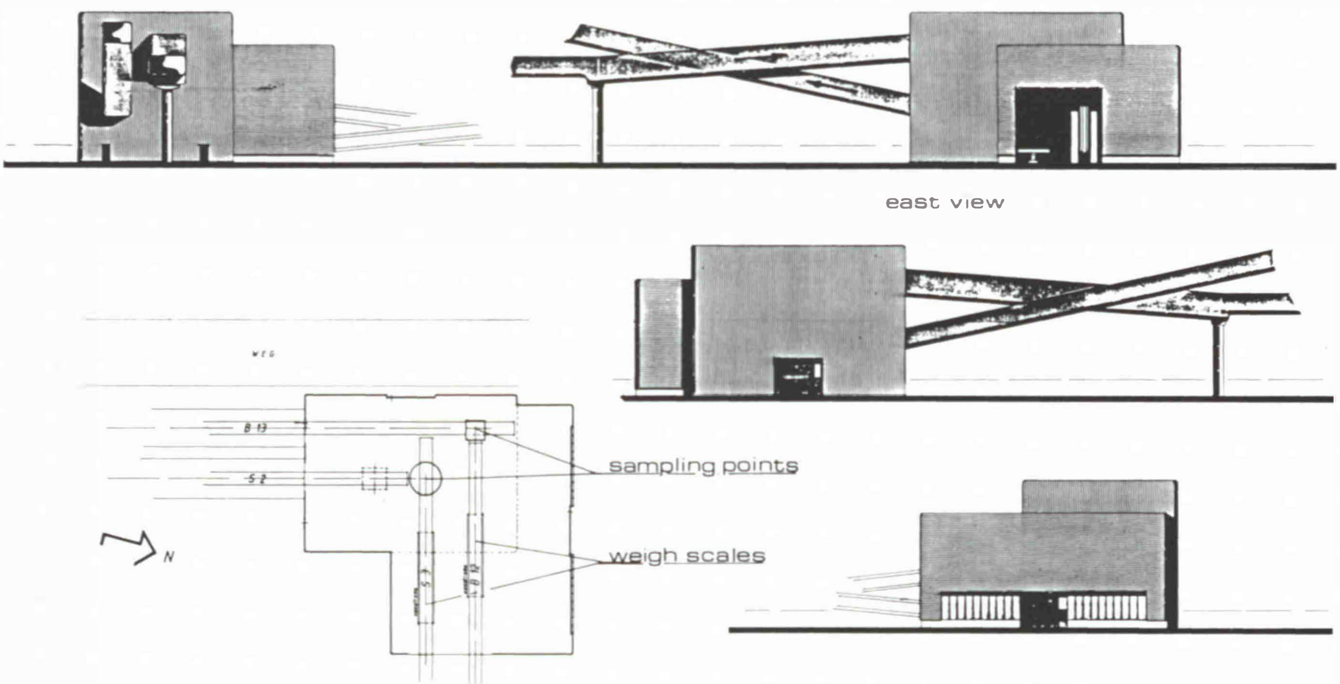

Fig. 2: Sampling/weighing building

2. In this way every shot may be sampled and gross samples of the same grade can be sequenced. Finally it can e. g. result in:
   6 containers of 75 kg each of grade A
   5 containers of 75 kg each of grade B
   10 containers of 75 kg each of grade C
   4 containers of 75 kg each of grade D.

   Depending on available time and equipment each container can be prepared and analyzed separately (25 pieces in our example) or through combining the containers with the same grades this number may be brought down to 4.

   In this way either hand calculated or analyzed mixture-qualities can be obtained to predict within certain limits the total bed properties. The available time to execute analyses and calculations will in this particular situation be three days on average.

3. The same sampling procedure has been proposed for outgoing coal from the blending bed. It was advised to start with taking 10 samples, consisting of 3 subsamples, of each pile.

   If a certain consistency in the blend occurs, this amount may be reduced to 3 (x 3). In terms of time this means 10 samples per 7 days (reclaiming time), i. e., once per 17 hours.

   In the same way as described under 1. the samples can be transported and prepared. There will be enough time to execute this properly and the results can be used to verify the prediction and also to determine the efficiency of the power plant later on.

With the above mentioned arrangement the sampling equipment, including transportation and secondary sampling devices at both transfer points, can be identically executed (the same devices, only installed at different levels and working with different intervals). The preparation equipment in the laboratory is therefore single.

Finally it should be mentioned that in this case a higher reliability and better performance will be obtained by applying well-trained "labour" rather than applying sophisticated, automatically controlled sampling preparation "towers". This is mainly because

- men can make use of common sense;
- men can be motivated and can take responsibility;
- sampling stations too often break down and get contaminated, which requires much supervision, clean-up and maintenance.

Acknowledgement

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