

# Comprehensive performance testing on a routine basis

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## SYNOPSIS

The purpose and frequency of comprehensive performance testing, and the types of tests to be included, are discussed. The results obtained from a series of such tests are reviewed.

## SAMEVATTING

Die doel en frekwensie van omvattende werkverrigtingtoetse en die soorte toetse wat ingesluit moet word, word bespreek. Die resultate wat met 'n reeks sodanige toetse verkry is, word in öenskou geneem.

## Introduction

Modern methods of mechanized mining and the necessity for the utilization of total reserves have resulted in the inclusion of more and more impurities in run-of-mine coal. This, together with a demand for products to more stringent specifications, has made some form of beneficiation obligatory at all times.

Detailed washability studies are essential for the assessment of the cleaning possibilities of a coal. The most suitable relative density at which to wash the coal and so ensure that it will be beneficiated in the most profitable way can be determined from its washability characteristics.

However, this type of washing requires a highly efficient coal-preparation plant, and, when a difficult coal has to be washed, the efforts to produce high-quality products are even more intensive and complex.

## Need for Performance Tests

A loss in production due to unsuccessful operation, poor maintenance, or some other reason, obviously affects the income of a mine, as well as having a cumulative or indirect effect. Coal that has been misplaced because of inefficient washing has to be dumped at a cost of at least 10 cents a ton, which could amount to an appreciable financial loss. Such financial losses should receive immediate attention. The source of the trouble should be isolated, and remedial action taken immediately. Before taking such action, management requires information, which can be obtained from comprehensive performance testing on a routine basis.

Harper has stated that 'to manage a business well is to manage its future; and to manage the future is to manage information'<sup>1</sup>. The question arises as to how the problems of managing an office differ from the problems of managing a coal-preparation plant. The answer without any doubt is 'Not at all!' If this is true, then one must bear in mind that, as generally accepted, the three dominant objectives of any business are 'long-run profit, service to society, and continuity of life of the enterprise'<sup>2</sup>.

Hence the purpose and value of comprehensive performance testing on a regular basis become obvious. Thus, no mine manager or plant manager can really

manage his mine or plant without regular performance testing.

## Performance Testing

Any test to provide information on the general performance of a plant must cover all the important aspects of preparation efficiency.

Analytical results of the final products as transferred, together with reliable information on what is happening in the crushing, screening, washing, drying, and other steps in the preparation programme, play an important part in the successful operation of a preparation plant. Although these product-control data are very useful to anyone attempting to increase a plant's performance and efficiency, it is impossible to determine the efficiency of any cleaning device without detailed float and sink analyses.

Therefore, when efficiency tests are being conducted, samples of the products and the medium (where applicable) must be taken in such a way that the following analyses can be made.

- (1) Chemical and physical analyses of the product including proximate analyses, and analyses of calorific value, sulphur content, and coking properties. The analyses required depend on the nature of the product and its end use.
- (2) Detailed float and sink analyses of all the washed products and discards, so that the operational performance of the washing units can be assessed. The following parameters are considered to be important: partition density, écart probable, organic efficiency, and percentage misplaced material in products.
- (3) Detailed float and sink analysis of the raw coal (washability of the raw coal). This enables the operator to determine whether the coal is still washed at the most suitable relative density for maximum recovery.
- (4) Analyses of the circulating medium for magnetic material, and the size grading of the magnetic material. From these, the operator can establish whether the size distribution is suitable for the particular washing operation.
- (5) Determination of the feed rate to the plant, which, together with the size distribution of the feed, very often affects the efficiency of all the equipment employed.

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## Frequency of Testing

Very often a performance test is conducted as an acceptance test shortly after the plant has been commissioned, and is never repeated. This is bad management, and definitely not management of the future as suggested by Harper.

In 1974 Horsfall<sup>3</sup> recommended that such a performance test should be repeated after a fairly short time, say two or three months. He also made very definite recommendations regarding the observations and notes that mine management should make during such tests, the idea being to relate deterioration in plant performance to changes in plant operating characteristics, and then to take the necessary action to restore the efficiency of the plant.

Also in 1974, the author<sup>4</sup> advocated the use of routine day-to-day testing, monthly or weekly testing, and annual testing. He stressed that, although he had used the term *annual testing*, tests of this nature could be conducted at shorter intervals, especially when shown to be necessary by careful scrutiny of the monthly or weekly results. He also stated emphatically that such tests should be comprehensive performance tests of the plant as a whole, and that the efficiency of the plant should be assessed in detail.

It should therefore be quite clear that there are no hard-and-fast rules, but that these tests should be conducted at frequent and regular intervals. With present plant costs exceeding ten million rands, the relatively low cost of providing sufficient analytical data to substantiate plant results and efficiency is money well spent.

## Results of Performance Tests

During the past three years, the Fuel Research Institute of South Africa conducted performance tests on well over seventy different washing units. In this way, it obtained a mass of invaluable information regarding the normal operating efficiency of coal-cleaning units throughout the country. It is unfortunate that these operating data still have to be treated as confidential, and that acceptance tests had not been conducted when most of these plants were commissioned. Table I shows the type and number of plants tested during 1977.

TABLE I  
NUMBER OF PLANTS TESTED BY THE FUEL RESEARCH INSTITUTE<sup>5</sup>  
DURING 1977

Washers for large coal			Washers for small coal
Dense-medium	Jig	Chance	Dense-medium
20	4	1	20

The results obtained in 1977 reveal alarming facts that can be summarized as follows.

- (i) Dense-medium washers treating large coal operated satisfactorily on coal larger than 30 mm in size, but for coal smaller than 30 mm the results were poor in five tests.
- (ii) The Chance washer that was tested separated satisfactorily.

- (iii) Four dense-medium washers for small coal gave poor results.
- (iv) All the tests on jig washers gave disappointing results.

When this survey has been completed, the results will be processed and published in a comprehensive report without revealing the identity of the collieries or other confidential information.

The tests conducted during 1978 substantiate these results; that is, about 25 per cent of the dense-medium baths treating coal finer than 30mm are operating at low efficiencies. The treatment of small coal is not much better, and most of the jigs are disappointing. This means that more than 20 per cent of all coal-preparation units operating in the country are not operating satisfactorily.

Even more alarming is the finding that only a few mines seem to be taking progressive action to rectify the position on their plants. However, some plants have taken action, and some of the collieries have benefited from the information received.

## Management and Training

It was noticeable from the survey that, when management knows the basic principles of coal preparation and when it takes an interest in the preparation plant, the plant operates at higher efficiency than otherwise. Also, plant efficiency depends on the attitude and knowledge of the plant managers or superintendents. An understanding of the capability of coal-preparation equipment, and a knowledge and ability to implement the available techniques results in high efficiencies.

Training is the only way to provide plant operators with a knowledge and understanding of a plant operating at high efficiency. This type of training is available and should be exploited. With a fully qualified team who have the backing of a management with an understanding of their problems on a plant, the plant will operate at optimum efficiency and, when deficiencies are reported on their plants, they will be in a position to rectify them. Under these circumstances, the results obtained from regular performance testing will be of value to the plant team, and they will probably conduct their own tests at regular intervals on a routine basis.

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