FUEL RESEARCH INSTITUTE OF SOUTH AFRICA

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NOTES ON THE INSTITUTE'S COAL PREPARATION PILOT PLANT

BY

DR. P. J. VAN DER WALT

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OBJECTS OF THE PLANT

Up to the present, all coal washing processes have originally been developed overseas, to meet overseas requirements. Contractors have in the past, largely designed coal preparation plants for South African collieries on the basis of their experience overseas, principally in the United Kingdom and Europe. Unfortunately, the washability characteristics of South African coals are quite unlike those of coals encountered in the United Kingdom and Europe. The coals of these countries consist generally, of a mixture of good coal and shale, stone etc., and there is a relatively large difference between the specific gravities of coal and impurities. In South Africa, there is usually a substantial proportion of material having a specific gravity close to that of the desired separation, and this fact makes the separation more difficult. It is not surprising, therefore, that processes which have proved satisfactory overseas, have often been installed in South Africa with disappointing results.

In South Africa, the profit margin on coal is relatively small, and, as in other countries, the cost of a washing plant, may be quite substantial (of the order of $\frac{1}{4}$ to $\frac{1}{2}$ million pounds). It is imperative, therefore, that a colliery should choose wisely when purchasing a washing plant, and that

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its efficiency should be high. It is one of the objects of the Pilot Plant to carry out research which may lead to improvements in existing processes, and thereby render them more suitable for South African conditions. Another is to carry out extensive practical scale tests, on the coal of a colliery considering the installation of a washing plant, and thereby to obtain reliable data which will assist in deciding on the best treatment for the particular coal and in choosing the best equipment.

It is well known that there is a shortage of coking coal in South Africa, and that methods of producing suitable coking coal from sources hitherto considered unsuitable, is receiving considerable attention. The Pilot Plant will be an invaluable asset in bringing these investigations to a successful conclusion. Not only will it be possible to study the merits of alternative methods of treating these coals, but it will also be possible to prcduce sufficient quantities of the final products for full scale carbonisation tests.

The preparation of coals to meet the special requirements of other consumers, will also be investigated in a similar manner.

Although of lesser importance, the Pilot Plant will be a valuable tool in solving various problems encountered in practice and in training personnel both for the Institute and for the coal industry, there being a shortage of technicians adequately trained in coal preparation at present.

While the plant has primarily been designed with a view to investigational work in connection with coal cleaning in the first instance, ancillary equipment is available for studying problems arising in the mechanical handling, crushing, screening and storage of coal, all of which have an important

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bearing on the efficiency of a coal preparation plant as a whole.

Adequate provision has been made for extending the plant in order to accomodate further equipment which may be required in the future.

CHOICE OF THE PRINCIPAL COMPONENTS OF THE PLANT

The washing processes mainly used in modern coal preparation, may be calssified as follows:-

(1) Dense medium washers for treating coal between the size limits of approximately 8 inches and ¼ inch.

(2) Dense medium washers for treating coal between the size limits of approximately ½ inch and ½ mm.

(3) Baum Jigs for treating coal between the size limits of approximately 8 inches and ½ mm.

(4) Froth flotation for treating coal smaller than about ½ mm.

Dense medium washers for treating large coal may further be sub-divided into:-

(a) Vessels capable of separating the raw coal into two products only (i.e. washed coal and refuse)

(b) Vessels capable of separating the raw coal into three products (i.e. washed coal, middlings and refuse)

(c) Deep vessels

(d) Shallow vessels

A number of dense medium processes for treating small coal, have been proposed, but at present the cyclone washer is the principal one used in practice.

While the makers of dense medium separators invariably favour a particular medium, in fact both magnetic and non-magnetic medium can be used in any separator, the choice depending mainly on technical and economic considerations.

Baum jigs are all basically similar, differing mainly with respect to the type of refuse extractor fitted, and the design of the air valves causing the pulsation. In the past, the nature of the pulsations etc. differed somewhat, but the present tendency is for all jigs to operate on similar cycles.

While froth flotation machines differ in mechanical design, the basic principles are the same, and there is little to choose in their performance.

When selecting washing processes for the Pilot Plant, the object was to include as far as possible, seperators representative of each type commonly used in practice as explained above. In this way the Institute would be in a position to study the treatment of all sizes of coal ranging from some upper size limit to zero, and to give advice on the technical suitability of the various types of separator, mechanical features being excluded. It is considered that this object has largely been achieved, by installing only 5 different cleaning units.

The Drewboy separator was selected as being representative of the shallow two product type for large coal.

The Barvoys separator was selected as being representative of the deep three product type for large coal. By blanking the middlings tube, this unit can be converted to a deep two product type.

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There being no other choice, the cyclone washer was selected for treating small coal in a dense medium.

Both magnetic and non-magnetic medium circuits are provided for the above three separators, and any medium can therefore be tested.

A specially designed Baum jig has been provided. This unit can readily be adapted for treating either large or small coal and the air valves and refuse extractors can readily be converted from one type to another. In this way, it is considered the unit can be made reasonably representative of the various jigs on the market.

The froth flotation cells provided are typical of the type normally used in practice.

As a result of the range of cleaning equipment provided and their versatile design, the Institute's Pilot Plant is unique and has aroused considerably interest throughout the world.

With the exception of the Froth flotation cells, each unit is nominally of 20 tons per hour capacity, but provision is made for treating a substantially greater quantity should this be necessary. The capacity is relatively large for two main reasons.

(a) This is the smallest capacity which will yield results comparable with commercial practice.

(b) A reasonable capacity is required in order to produce large quantities of prepared coal for subsequent carbonisation tests, combustion tests, etc.

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The plant as a whole has been designed to treat coal having an upper size limit of 3 inches. This was necessary

(a) in order to minimise the size and hence the cost of mechanical handling equipment and

(b) because the large coal separating units had to be scaled down from their normal size and the upper limit of the coal size had to be reduced accordingly.

This is not a serious limitation because experience has shown that data relating to the cleaning of 3 inch coal applies equally well to the larger sizes. Further more, industrial consumers rarely use larger sizes and research work in connection with consumer problems will not therefore be affected materially.

ANCILLARY COMPONENTS OF THE PLANT

Provision is made for unloading large quantities of coal from railway trucks or lorries, for feeding it into the plant and for crushing it to any predetermined size up to a maximum of 3 inches.

Classifying screens are provided for dividing the raw coal (or intermediate products), into a maximum of 4 fractions of any desired size. Approximately 100 tons of screened or unscreened coal can be stored in the plant in 4 storage bins and the contents of any 2 of these can be blended in any desired proportions.

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All end products or intermediate products can be weighed in order to establish their proportions accurately. Provision is also made for crushing any product to any predetermined size prior to retreatment or subsequent utilisation.

Facilities are provided for loading the final products rapidly into trucks or lorries for disposal.

In selecting ancillary equipment, the main principle was to follow the most modern practice.

ARRANGEMENT OF THE VARIOUS COMPONENTS

The arrangement of the various components was very carefully studied in order to provide the maximum possible flexibility of operation. Mainly with a view to economising in mechanical handling and other equipment, and building space, the principle was adopted that only one separating unit would be operated at any one time. In this way, several items of equipment could be made to serve more than one purpose and as a result, the cost of the plant was minimised.

Despite the decision to operate only one unit at one time if necessary, skillful layout on the part of the designers has made it possible in several circumstances to operate two or more units simultaneously.

PRINCIPAL FEATURES OF THE FLOW SHEET

The coal is unloaded into a track hopper from which it is drawn by means of a feeder and is elevated on a conveyor belt to the primary crusher. Material larger than 3 inches, passes through the crusher and joins the undersize material on a second conveyor belt which elevates it to classifying

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screens consisting of four frames. The products from the screens are stored in 4 bins. Two controllable feeders are provided which can draw from any of the bins as desired, and which can deliver to either of two conveyor belts, each provided with an automatic weigher. These belts discharge to the bottom of a twin bucket elevator and thence into two scraper conveyors. The scraper conveyors deliver the coal to any one of the separating units, to any bin, to the classifying screens or to the coco pans outside the plant.

In practice only one side of the elevator and one scraper conveyor will normally be used to feed the separating units. The other pair will be used to deal with one or more of the products as will be explained, or to provide additional load on a separator if high feed rates are required.

The coal passes through the separator selected via a wet screen or feeder as the case may be, and ultimately over dewatering or rinsing and medium draining screens.

The washed coal may either be loaded directly into trucks, or into bins, or may be recirculated.

Discard or middlings may pass either into bins or may be recirculated.

Products in the storage bins are drawn off into coco pans and may be weighed on a weigh bridge prior to disposal (or recirculation through the plant).

Products for recirculation may be crushed or uncrushed as desired, and pass via one of the belts situated below the main bunkers and the elevator to one of the scraper conveyors. The scraper conveyor may discharge to the same separator or any other or back into the main storage bins etc. as required.

Clearly the variety of circuits is virtually unlimited. If any particular operation can not be accomplished

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in the plant itself, one or more products can be recirculated via the track hopper.

THE COST OF THE PLANT

If the plant had been ordered from a contractor in the normal way, the price would probably have been of the order of £250,000. However, by negotiating with suppliers of equipment, services etc. for special prices, the actual cost is substantially lower. A number of firms have made outright gifts of items of equipment, while others have allowed substantial discounts both on services and equipment. It is estimated that the actual cost to the Institute will not exceed £135,000.

TECHNICAL ADVICE AND ASSISTANCE

The Institute has been fortunate in securing the services of an eminent coal preparation engineer who is acting as consultant. During the early design stages of the plant, a number of leading international authorities on coal preparation collaborated with the Institute's consulting engineer, and gave invaluable advice on the choice and arrangement of equipment. It is considered therefore, that there is every prospect of the plant proving ideal for its purpose when it is put into commission towards the end of 1956.

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ASSISTANT DIRECTOR

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