U.S. BUREAU OF MINES
HYDRO. DEMON. PLANT DIV.

April 13, 1943

BRABAG-ZEITZ POWDERED COAL GASIFICATION

Discussions on the above subject have taken place in Bohlen on April 8 and 9, 1943. The participants included representatives of Brabag-Bohlen, Brabag-Zeitz and the Koppers Company.

Schwarzheide was discussed on April 8 and the discussions reported in a separate report.

The consideration of the gas producer unit at Schwarzheide was to be postponed in accordance with Speer's decision not to start any construction work which could not be put in operation prior to the end of 1943. Opportunity has presented itself, however, to thoroughly discuss the basic questions.

We based our discussions on a comparison of the coal and oxygen requirements of our process with the coal and oxygen requirements of the Winkler process and used this comparison in the decision on economy of our process in comparison to that of the Winkler process.

During these discussions Dr. Mott furnished us in confidence for comparison with our figures the operating results of the Winkler process during the gasification of brown coal dust from his report to the management of Brabag. It must be emphasized here, that in so far as the Winkler process is concerned, the comparison is only of theoretical interest, because no powdered brown coal can be gasified in the Winkler producer because of the low gasification temperatures necessitated by the process.

Mr. Mott suggested never-the-less to base the comparison on powdered brown coal gasification, because this was the only fuel for which we had operating data by our process. We have given in the appendix to this report the operating costs of the raw powdered coal gasification from Dr Mott's report. According to them the production costs per nm^3 of $CO + H_2$ are,

for the Winkler process	2.11 Pfg
for the Koppers process	1.82 Pfg

The saving by our process will amount therefore to 0.29 Pfg per nm^3 of $CO + H_2$, which will figure on the strength of the daily production of 646,000 nm^3 $CO - H_2$ to a daily saving of RM 1870.-, and a yearly savings of RM 682,000.-.

Dr. Mott points out in his report, that there are, in addition to the greater economy of production of the Koppers process, also the following advantages in the use of the gas:

1) The $CO + N_2$ concentration in the Koppers process is 85%, against 72.5% by the Winkler process, requiring lower compression costs in the preparation of the gas.

2) The Koppers installation produces gas free from hydrocarbons, while the Winkler gas contains 1.2-1.5% methane, which results in considerable savings by using our gas in hydrogenation in terms of hydrogen consumption per te of hydrogenation product.

Dr. Mott said in his summary that the Koppers process is superior in economy and technically to all the other known powdered coal gas producers.

During the discussion on April 9, Dr. Willie and Dipl. Ing. Lackner stated first, that the Zeitz construction was being decided upon, and nothing definite about it could be said for two weeks. While permission was being sought for it in view of the fact that 50 million Reichmark have already been spent for the Zeitz plant. Dr. Willie emphasized however, that when the construction work in Zeitz is resumed, our system will be used, and one unit will at first be installed capable of being enlarged to the four aggregates as designed by us. He emphasized the extreme importance of testing our process for the production of water gas in Brabag, because of the impossibility of doing so in Schwarzheide because of the absence there of an oxygen unit.

We have submitted our bid of the project B for a powdered coal gasification unit at Zeitz with one producer aggregate of a capacity corresponding to one Cowper unit, for a price of RM 1,480,000.

Dr. Willie is of the opinion that the preliminary construction of a small Cowper unit can not be avoided, and suggest breaking down the four aggregates provided for the large Cowper group into aggregates for two smaller Cowper groups, to have the installation consist of two gasifier aggregates with a capacity corresponding to the Cowper unit. In this way, a single aggregate would be built for the Cowper group, which will be tested, and if approved, a second aggregate put in, and if needed a second Cowper group added with two producer aggregates. He requests that this proposition be tested and price bid made.

Economy was discussed next without reference to Dr. Mott's confidential information. It has been stated by the gentlemen, that it would be difficult to make a comparison of our process with the Winkler process, because we had limited ourselves to operating data on powdered brown coal gasification, which can not be gasified in a Winkler producer. A correct comparison only becomes possible after we give operating data on the gasification of grude coke. Dr. Lockner has given the approximate composition of grude as:

Water,	about	3%
Ash,	"	20
C	"	71
H	"	2
O+N+S	"	4

Dr. Lackner called attention to the fact, that in the Winkler process about 250 g multiclone coal dust with 50% O is collected per nm^3 of gas. The heating value of the dust is 4200 kcal per kg and it can be used as boiler fuel, and must therefore be evaluated RM 5. - per te in the economic balance.

We have also been requested to prepare a design and bids for an installation for one producer aggregate, composed of two aggregates, with two aggregates per Cowper group, and to give operating data for gasification of powdered grude in this installation Zeitz. Dr. Mott gave us in confidence the operating data of Winkler producer operating on powdered grude.

The composition of the powdered grude is:

Water	2.09%
Ash	24.68%
C	69.63%
H	2.52%
O + N + S	1.08%
	100.00%

(I have only subsequently found that the sum of O + N + S could not actually add up 1.08%).

Composition of the gas:

CO_2	24.39
CO	28.81
H_2	44.42
CH_4	1.25
N_2	0.54
H_2S	0.59

Minimum heating value	2152 kcal/nm^3
Grude consumption/nm^3 gas	0.561 kg
C yield	68.58%
Efficiency of gasification	58.05%
Oxygen consumption	0.237 nm^3/nm^3 of raw gas
Steam consumption	0.608 kg/nm^3 " " "
Ash produced	12.1 kg/nm^3 raw gas, contains 54.1% C
Multiclone dust	180-200 g per nm^3 gas, " 43.1 "

Heating value	4041 kcal/kg
Steam production	0.622 kg/nm^3 raw gas
Power consumption	28.44 kwh/1000 nm^3 raw gas
Water consumption (circulating cooling water)	17 liters/nm^3 raw gas

We must count on RM 1.50/million kcal as operating cost with outside gas. This is the off-gas to be furnished us from the heating of the Cowpers.

In conclusion of our discussion, Dr. Mott has given us an opportunity to visit the Winkler plant.

There are three producers in Bohlen with a theoretical capacity of 30,000 m^3 of raw water gas. The unit can not, however, be used to capacity, and is usually operated only to 25,000 m^3 capacity. The impression created by the examination of the plant was very good. Anyway it is clear why the Winkler installation costs but one half the cost of ours per m^3 water gas. One may remark the following:

The oxygen-steam mixture is supplied underneath the stationary grate, set up of different pieces. A rotating stirrer revolves at a relatively high speed (abt. 2 rpm) above the grate. The fuel is supplied by two worm drives to the outside of the lining of the shaft. There is therefore no mechanical distribution of the powdered fuel in the shaft proper. The fuel is introduced about 700 mm above the grate. The secondary oxygen, with some steam is introduced above 500mm about the fuel supply. (The steam is used for cooling of the tuyeres). The temperature in the fuel bed underneath the secondary oxygen addition is around 800°C. The temperature is carefully maintained, as slag formation is otherwise likely to occur. The temperature in the cupola of the gasifier, i.e. above the inlet of the secondary oxygen, is around 900°, and the water gas produced leaves the producer at that temperature. The ash formed is forced by the stirrers into two chutes located between the grate and the casing. The ash is carried out from these dropping chutes, by two worm conveyors located at the opposite sides, and is carried out into the dump from which it is removed periodically in cars at a temperature of 800°. This ash does not burn in the car, in spite of the 50% C it contains. The grain size of the ash is around 2 mm, and rather uniform.

The water gas produced enters a double pass vertical tubular boiler from above, goes downwards, enters through a partition wall into the second pass, leaves it above at a temperature of 400°, enters the steam superheater and finally the heat exchanger. Dust collecting bins are placed underneath the boiler and the heat exchanger from which the dust is withdrawn a temperature of 350° to 300° C. From the heat exchanger the gas enters the multiclone dust separator. 80% of the dust still remaining in the gas is separated here. The temperature in the multiclone is around 250°. From the multiclone the gas enters a gasholder with hydraulic seal, and from there through a collector main for all three producers into the final cooler with wooden baffles, where the gas is cooled to about 30° C. The gas is finally purified in Theisen scrubbers.

The pressures in the unit are as follows:

Underneath the producer grate – 2000 to 3000 mm water column; in the producer shaft – about 1500 mm water column.

The loss in pressure in the subsequent treatment is around 500 mm, in the collector main the pressure is reduced by further 200 mm, in the final cooling – 30 mm, and the gas pressure in front of the desintegrator (sic) is about 600 mm, i.e. the unit operates with no blowers from the desintegrator directly from the water gasholder.

The fuel is blown with carbon dioxide to the operating bins of the producers. The operating bins of each producer hold 200 te grude. Attention is paid to the contents of fines in the grude, by having it contain the least possible amount of sizes under 0.5 mm, which do not gasify and are carried over by the gas into the rest of the equipment. The dust content of the gas varies between 200 and 300 g/nm^3, depending on the dust content of the fuel. 80% of this dust , with a C content of 50% is used as fuel in the boiler installation. The balance goes into the washwater of the final cooler and into the desintegrator.

The construction of the producer is very compact, without making supervision difficult, i.e. with a relatively large gasification capacity per unit area. The shut-off and control equipment for all the three units are housed in a common room about 5 m above the floor.

The service of the installation, aside from the dust and ash removal, is limited to the supervision of control and measuring instruments. As soon as the instruments indicate irregularities in the fuel, oxygen, or steam supply, the producer is disconnected from the producer gas main and a blow-off valve opened until the difficulty is overcome. The amount of labor for the whole installation is extraordinarily small.

It must be admitted, that the process and the construction of the installation represent a real accomplishment.

We later went on a trip with Dr. Mott through a distillation installation erected by us in Bohlen and through the Linde-Frankel air separation plant. The latter, which supplies oxygen only for the Winkler installation, occupies practically the same ground space, as the Winkler installation. One may judge from the size of the equipment and machines, that a 98% oxygen must cost at least 3 Pfg/nm^3, when the price of power is 1.5 pfg/kwh.

Section I/designs

/s/Undecipherable.

W.M. Sternberg