dispatch it in light corrugated-iron drums, so that irksome
transport in barrels is not necessary. This tar is not used
for preliminary treatment, only for surface treatment in hot
weather. On account of its bitumen-like character, it is
especially useful for use (1) in shady, dark places and (2)
where there is much agricultural traffic, etc. It found its
chief use in tar macadam coverings, where it has proved
satisfactory. The production process has been patented by
V. F. T.

Sulfuric acid from coal pyrites. - A special report was also prepared
by Dr. Weller on the use of coal pyrites for sulfuric acid manufacture, the
original of which is filed in Technical Oil Mission (T.O.M.) microfilm reel
No. 70 (original designation No. 25B), item 2 (two pages), and of which the
following is a translation:

The maximum amount of coal pyrites used by us was about
7,300 tons in 1942. The average moisture content was 3.9 percent,
carbon 5.26 percent, and sulfur 41 percent. The sulfur and car-
bon contents vary widely, so that a large amount of coal pyrites
must always be kept in store to avoid manufacturing difficulties
caused by fluctuations in these contents. The minimum sulfur
content is 35 percent, carbon maximum 8 percent, and water maxi-
mum 6 percent. The use of coal pyrites presented great diffi-
culties in the beginning as a result of variations in sulfur and
water contents. The coal pyrites were treated mainly in water-
cooled Wedge furnaces and some in normal Lurgi L.C. 5.5 furnaces.
Coal pyrites develop higher combustion temperatures than normal
fine pyrites. The heat in the furnace must therefore be espe-
cially carefully controlled so that the purging gases are not so
hot that the electro dust separator is damaged. The higher heat
production in roasting coal pyrites makes repair work in the
furnaces all the more difficult, especially the furnace rollers
of the Wedge furnace. The interchange of the arms, too, is
made very difficult as a result of the powerful heat radiation.
The stirring arms and prongs are particularly powerfully attacked
at the high temperature. Cast-iron prongs, which normally last
up to 3 months with normal fine ore, were destroyed in 8 days by
coal pyrites. For this reason, special prongs made of chromium
alloy must be used, with additional expense. Despite mixing
the individual grades of pyrites, the fluctuations of the grades
are still considerable, and this has an adverse effect on the
system following the roasting furnaces, on the through-put, and
on the nitric-acid consumption. In the same way, the greater
amount of gas produced by the combustion of the coal contained
in the pyrites shows itself to be detrimental. It is not pos-
sible to obtain the same through-put of sulfur in the roasting
furnaces when burning coal pyrites as with other grades of
pyrites. The reason is the extraordinarily high heat output of
the carbon in the coal pyrites. (The heat of combustion of the
sulfur in pyrites can be fixed at about 2,000 cals., whereas

that of the carbon content is about 6,000. A 20-percent decrease in production has to be reckoned with in the production with pyrites from coal if additional furnace capacity cannot be installed. This decline in output results in an increased cost in production. The nitric acid consumption of the plant at the outlet side of the furnace must be fixed 25 percent higher than normal. The reasons for this are:

1. The dilution of the roasting gases by the CO_2 content, which results from the combustion of the carbon in the coal pyrites.

2. The contamination of the roasting gases by the products of distillation of the coal from the coal pyrites.

With coal pyrites, one has always to contend with an insufficiency of oxygen in the roasting gases, because the addition of air to the furnace must be limited to avoid too high a temperature in the upper stories (in den oberen Etagen) and in the outlet gases. The yield obtained corresponds to the sulfur content of the pyrites.

We had considerable difficulty in the operation of the tower cooling system connected to the outlet side caused by separation of sulfur in the condensers. After we had learned to control the difficulties presented in the use of coal pyrites, the result of roasting the coal pyrites was satisfactory at the prevailing prices, but it depended mainly on the possibility of utilizing the roasted ores, since the proceeds from selling roasted ore reduced the price paid for the sulfur in the pyrites. Experiments have been carried out on the treatment of pyrites by the addition of pyrites previously roasted to prevent excessive heating of the furnaces. Especially at the beginning this was the only way of mastering the difficulties,- but of course it was very detrimental to the output. Experiments were later carried out on treating the coal pyrites mixed with Meggen pyrites. No particular success was achieved in this way. One of the great difficulties in this process was the utilization of the roasted ores, as the roasted ores of the coal pyrites, which are comparatively free from the impurities that disturb smelting, were then mixed with ore from the Meggen pyrites, which contains a large quantity of zinc.

Filtering Diesel fuel oils. - Dr. Weller also prepared a paragraph on filtering Diesel fuel oils, which was considered by A.C.K.V. to have novel features. The original German text is filed in Technical Oil Mission (T.O.M.) microfilm reel No. 70 (original designation No. 25B), item 4 (1 page), and the following is a translation:

The German army required that Diesel fuel oils have a certain filterability when determined in a specific apparatus

developed by the military authorities. In this apparatus a
certain quantity of the fuel oil was cooled and forced through
a standard filter medium by pressure, and the time required
for passage of a determined volume was determined. Because
of precipitation of paraffin, a series of fuel oils from the
Fischer-Tropsch synthesis often failed to meet this require-
ment, although the pour point (Stockpunkt) was sufficiently
low and lay considerably below the temperature at which the
filterability was determined by the specifications. Other
fuel oils, on the other hand, with a high paraffin content
and a less favorable pour point showed a satisfactory filter-
ability. It was suspected that those fuel oils that showed
poor filterability did so because the paraffin in them preci-
pitated out in an amorphous state and clogged the pores of the
filter. This idea was shown to be correct by adding hard
paraffin from the Fischer-Tropsch synthesis to the fuel oils
to precipitate all the paraffins in a crystalline state. Only
small quantities of the hard paraffin must be added to permit
the Diesel fuel oils to meet the filterability test completely
satisfactorily.

Interaction of sulfur compounds and lead tetraethyl. — The sulfur com-
pounds in motor fuel derived from coal were said to cause precipitation of
lead compounds in leaded gasolines, and this had to be avoided through re-
fining with loss of fuel or by some other means. Dr. Weller prepared a spe-
cial report on a method developed by A.G.K.V. for this purpose, the original
of which is filed in Technical Oil Mission (T.O.M.) microfilm reel No. 70
(original designation No. 25B), item 3 (1 page), a translation of which
follows:

During the African campaign, the German army used a mixture
of benzine and benzene for motor fuel that was treated with tetra-
ethyl lead. This motor fuel differed from those used in other
theatres of war solely in the more stringent requirements for
avoiding vapor lock. Chemically, the African fuel was identical
with other motor fuels. It was shown that this motor fuel decom-
posed to such an extent that lead-sulfur compounds, among which
lead sulfate was identified, precipitated. The disturbance was
not so much the decrease in the anti-knock action of the lead
tetraethyl as it was the formation of insoluble and hence inactive
compounds of lead and sulfur. It was assumed that some sulfur
compound was the source of trouble and preliminary experiments
showed that carbon disulfide, which is present in small quantities
in motor benzol, was the cause of the decomposition. Pure, sulfur-
free hydrocarbons treated with lead tetraethyl showed the same
phenomenon after addition of carbon disulfude. It was also demon-
strated that the reaction was very sensitive to temperature, which
explained why the decomposition did not occur in the theatres of
war outside the tropics.

The trouble could be avoided either by complete removal of the carbon disulfide or by the addition of some unknown substance that would stop the reaction or retard it to such an extent that no harm would be done. It was found that additions in small amounts, especially of aminophenol, completely stopped the reaction. Other reducing compounds showed similar effects. At the same time, a test was developed for testing the behavior of motor fuels: The motor fuel was put in a glass pressure vessel in a drying oven at 110 degrees and the time was determined for the appearance of turbidity due to precipitation of compounds of lead and sulfur.

Gaseous motor fuels. - As distributors of motor fuel, A.G.K.V. were largely responsible for the supply of the following compressed gases:

1. Natural gas from Austria, Belgium, and the Netherlands.

2. Methane from coal mines in the Saar and elsewhere.

3. Town's gas from coke ovens.

4. Methanized town's gas.

The mechanization process was developed by Ruhrgas and Ruhrchemie for increasing the calorific value of coal gas and for decreasing its damaging effects upon pressure storage vessels. The process involves the use of a nickel catalyst for converting carbon monoxide and hydrogen to methane at 350 atmospheres pressure, but details were not known to A.G.K.V., who merely expected to operate the small plants at roadside filling stations. They had been building three of those plants.

Dr. Haver produced a drawing of a large plant, but he did not know whether this design had ever been used. This colored drawing is marked "DEMAG Permagas-Anlage Entwurf 3 Em 801696" and is reproduced in Technical Oil Mission (T.O.M.) microfilm reel No. 70 (original designation No. 25B), item 5, obtained during the investigation of the fuel-research activities of this company.

COAL CARBONIZATION RESEARCH OF CARL OTTO & CO., G.m.b.H., DAHLHAUSEN, ESSEN[21]/

Conclusions

Facilities for testing coals to determine their suitability for coal carbonization were available, and evidence of considerable development work on new designs of ovens, particularly for low- and medium-temperature carbonization, was found.

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[21]/ Prepared from Combined Intelligence Objectives Subcommittee report "Coal Carbonization Research of Carl Otto & Company, G.m.b.H., Dahlhausen, Essen," by H. H. Lowry and H. J. Rose, 1945. (C.I.O.S. Evaluation Report No. 366. Solid Fuels No. 17).

Report of visit. — The chief of the laboratory, Dr. W. Oppelt, was not present, and it was reported that his present whereabouts were unknown, as he had not been seen for several months. His assistant, Dr. Münz, was present and claimed to have no first-hand experience with the coal-carbonization work. The figures given below may therefore be regarded only as approximate. The chemical laboratory appeared well-equipped for usual tests on coking coals, including expansion tests by the Bunte-Baum-Hauser method. The Micum drum test was the only one used for physical testing of coke.

Besides the chemical laboratory proper, which also served the refractory plant, separate installations of producer gas-heated coke ovens of various sizes were available in another part of the plant. Three experimental ovens were used for evaluating coals for new contract guarantees: One of 25 kilogram coal capacity, one of 50 kilogram capacity (200 millimeters wide and about 1 meter long and 60 centimeters high), and one of 100 kilogram capacity (400 millimeters wide and about 1 meter long and 60 centimeters high). With this equipment was a gas-heated rotating drum about 1 meter in diameter and 1.5 meter long for oxidation of strongly expanding coals to decrease the coking power of a part of the charge; the oxidized coal was blended with un-oxidized coal to produce furnace coke. The process was said to give satisfactory results but was not known to have been used commercially, with the possible exception of a coke plant near Osnebruck, the name of which Dr. Münz did not remember.

Until recently, development work on oven design for low-temperature carbonization has been in progress. Current opinion was stated to be that LTC of bituminous coal was not economic except in special locations, as the Saar, where it might be used advantageously to produce a blending material for use with high-volatile coals for manufacture of blast-furnace coke, and except for production of fuel for mobile gas producers. Dr. Münz considered medium-temperature coke to be much better than low-temperature coke for house-heating purposes.

Low-temperature carbonization development has been carried on for many years. In 1934, an OTTO-LTC battery of three horizontal ovens of standard design but of smaller dimensions was built at Dahlhausen. The daily throughput amounted to several tons. This development was discontinued in 1937 or 1938, and the ovens were dismantled. Experiments were then begun on modification of their standard vertical oven as built for small gas plants. The principle chosen to increase the heat transfer was adding iron "double-T" inserts loosely in the vertical chamber, thus dividing the chamber of 1 meter width into cells about 5 to 6 centimeters wide. The total coal capacity of all cells in a chamber was 150 to 200 kilograms. This modification increased the coke capacity by 150 percent over that when the iron double-T's were not used and the vertical oven was used for standard high-temperature coke, in spite of the fact that a considerable fraction of the oven volume was occupied by the iron members. The coking time with flue temperature of 600° to 650°, using producer gas firing, was about 4 hours. From a 30-percent volatile coal, a 78-percent yield, based upon the dry coal, of coke containing 11 to 12 percent volatile matter was obtained as thin slabs, as the walls were somewhat movable and the charge from each cell was recovered almost as

a monolith. The yields per ton of dry coal of byproducts were stated to be: Tar, 7.5 percent; light oil, 0.8 percent; ammonia, 0.1 percent; and gas, 110 cubic meters. The gas had a gross heating value of 6,600 to 7,300 kcal per cubic meter (700 to 780 B.t.u. per cubic foot). This development was discontinued because of the failure of the iron inserts, which were said to be continuously decarburized. No drawings of this abandoned development were available. Most recent emphasis was on ovens for medium-temperature carbonization using chamotte wall construction. All work is at present at a standstill.