TOM Reel 42, frames 237-240

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POWDERED FUEL GASIFICATION INSTALLATION AT ZEITZ

The purpose of the installation will be the gasification of powdered l.t.c. coke with oxygen-steam, and the conversion into water gas of the off-gases by heated oxygen-steam mixtures when the gasification of powdered fuels fails.

Powdered Fuel Gasification

The powdered l.t.c. coke to be used is of the following composition:

water	5. %
ash	20.0%
C	69.0%
H	2.0%
N	0.6%
S	0.5%
C	2.9%

the oxygen will contain 98% O_2 and 2% N_2. When the steam is heated to 1250°C, the following reaction will take place:

1 kg l.t.c. coke + 0.510 nm^3 O_2-gas + 1.6542 nm^3 H_2O = 2.1859 nm^3 producer gas + 1.060 nm^3 steam + 0.200 kg slag.

The composition of the producer gas will be:

CO_2	18.61%
CO	40.25%
H_2	40.25%
N_2	0.75%
H_2S	0.16%

An installation to gasify 300 te l.t.c. coke per day would require:

1. 1 pair of gas heaters, 5000 m^2 heating surface each.
2. 3 gasifiers
3. 3 steam boilers 350 m^2 heating surface each.

A safety precaution against a defficiency of powdered fuel must be installed between the gasifier and the boiler, which may consist of a layer of lump coke, through a thin layer of which the hot gases are made to pass. A small amount of non-superheated steam with some oxygen must be fed to the burner to regulate the temperature of the flame or to regulate the CO : H_2 ratio, because coal may be directly converted in the flame by the steam, while the superheated steam as well as the CO may react in some unpredictable manner in the whole volume of the reaction chamber.

2. The use of Similar Equipment for the Conversion of Off-Gases into Water Gas.

According to our proposal of August 30, 1941 the off-gas will have the following composition:

CO_2	1.82%
CO	2.58
H_2	38.18
CH_4	31.00
C_2H_6	18.80
C_3H_8	2.35
C_4H_{10}	0.24
C_5H_{12}	0.08
N_2	4.95

If a mixture of oxygen and steam be heated to 1250° C and this mixture be burned with the off-gas in the reaction chamber, until the temperature of the final gases is at 1000°C, the reaction will proceed according to the following equation:

1 nm^3 off-gas + 0.3836 nm^3 O_2 - gas + 2.0540 nm^3 steam = 2.7939 nm^3 converted gas + 1.889 nm^3 steam.

The composition of the converted gas would be:

CO_2	9.22%
CO	19.75
H_2	68.99
N_2	2.04

An installation producing 18,000 nm^3 of converted gas per hour will require 6,450 nm^3 off-gas per hour, which would be converted with 2,470 nm^3 oxygen gas per hour. We will need:

1. 1 pair of gas heaters, 4,270 m^2 heater surface each,
2. 3 gasifiers,
3. 3 steam boilers of a total heating surface of [illegible] m^2.

If the sizes arrived in the first computation be adopted, they will prove sufficient for the conversion of the off-gas. A comparison of the two cases gives the following:

	l.t.c. coke 20% ash	conversion of off-gas
1. CO_2	18.61%	9.22%
2. CO	40.25%	19.75%
3. H_2	40.25%	68.99%
4. N_2	0.73%	2.04%
5. H_2S	0.16%	-
6. Lower heat value	2,249 Kcal	2,361 Kcal
7. Concentration	80.50%	88.74%
Hourly Operation Figures:		
8. Fuel	12,500 kg; l.h.v. 6051	6,450 nm^3 l.h.v. 7,223 Kcal
9. O_2 gas, 98%	6,330 nm^3 O_2	2,470 nm^3 1250°

	l.t.c. coke dust 20% ash	T-399 off-gas conversion
10. Steam	20,700 nm^3 100°/1250°	13,250 nm^3 1250°
11. Convert. gas	27,300 " 1350°	18,000 " 1000°
12. Steam	13,250 " 1350°	11,600 " 1000°
13. Slag	2,500 kg. 1400°	-
14. Gas heater	Steam	O_2 + Steam
15. Heat transfer	9.10 x 10^6 kcal/hr	7.67 x 10^6 kcal/hr
16. Heating surface	5,000 m^2	4,270 m^2
17. Heat. surf. used	5,000 "	5,000 "
18. Fuel gas	11.30 x 10^6 kcal/hr	9.50 x 10^6 kcal/hr
19. Steam boiler	20.15 x 10^6 " "	10.90 x 10^6 " "
20. Steam Production	20,150 kg/h	10,900 kg/h
21. Steam consumption	18,000 " "	12,000 " "
22. Req. total heat. surf.	1,000 m^2	730 m^2
23. Selected total heat. surface.	1,050 "	1,050 "
24. Selected total heat. surface	3 x 350 "	3 x 350 "
25. Circ. water for gas cooler	500 m^3/h	400 m^3/h
26. Make-up water	50 "	40 "

Heat balance per nm^3 converted gas:

Sensible heat of O_2	-	62 kcal.
" " " Steam	358 kcal.	391 "
Chem. bound heat	2780 "	2582 "
	3138	3035
Sensible heat of gas	474 "	343 "
" " " Steam	276 "	264 "
Chem. bound heat	2249 "	2361 "
Loss	88 "	67 "
Slag	51 "	-
	3138 "	3035 "
Fuel Gas	414 "	528 "
Steam Production	0.738 kg.	0.606 kg.

/signed: Linder/

foreign grades of coal, such as the lean coal fines, fat coal fines, flame coal fines, etc., could be gasified in an experimental gasifier with a shaft cross section of 1 m^2 with a production of 2000 m^3 per hour, producing either water gas or synthetic gas.

The Winkler process has a specific advantage of permitting the production of various gases, depending on the choice of the gasifying agent and the operations (cf table 2).

Low BTU gas is produced when the gasification is done with air as the only gasifying agent.

Water gas, such as used in large amount for the preparation of hydrogen in hydrogenating plants is obtained in a continuous process by simultaneous introduction of oxygen and steam in definite proportion. The low nitrogen content is very remarkable.

Mixed gas, - hydrogen enriched with nitrogen for the synthesis of ammonia, - is obtained by blowing a properly proportioned mixture of air, steam and oxygen. The proportion of air must be measured to obtain the proper proportion of H_2 to N_2 (3:1) for the ammonia synthesis, after the conversion of the CO and the removal of CO_2.

Synthesis gas with a definite proportion of CO and H_2, required, i.e. for the synthesis of gasoline or methanol, can be obtained by corresponding changes in the methods of operation. It is possible in such cases to use different hydrocarbon-containing gases, such as coke oven gas, l.t.c. gas, off-gas of the hudrogenation, etc., if desired, and convert them directly without the need of any special arrangements.

II. Development of the Process.

The Winkler method was developed primarily to obtain a method to gasify efficiently small size higher ash grades of fuel. The finely ground raw gasification material is served to the gasifier has a particle size between 0 and 6 mm, and with a low moisture content, preferably not exceeding 8% (cf tables 1a and 1b). When the fuel contains more water it is preferably first dried, while lump fuel or coarser grained must first be ground.

In the accompanying sketch the major parts of the Winkler producer unit are shown, omitting all the equipment needed for the preliminary or subsequent treatment.

The finely ground fuel, stored in a bin is fed by a worm drive to the bottom of the producer. The producer proper is in most cases a walled-in cylindrical shaft, the bottom connection of which is used for the introduction of the gasifying agent. The usually horizontal grate secures the same thickness of the fuel bed and the same resistance at every point. Regulation of the amount of fuel supplied by the screw conveyor will affect the height of the layer and therefore also the loss of pressure in the fuel layer. A regularly