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MODERN METHODS FOR MANUFACTURING SUBSTITUTE NATURAL GAS FROM VARIOUS FUEL STOCKS

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ABSTRACT

The paper discusses the various feed stocks that could be used to make a supplemental natural gas. The most likely prospects, coal and naphtha processes, are described, using as examples the Synthane coal-to-gas process and the CRG naphtha-to-gas process. Other possible processes using feed stocks such as oil shale, shale oil and wastes are discussed briefly.

INTRODUCTION

Most experts believe that a supplementary source of natural gas must be found (1, 2)[1/]. That such a source will be needed is based on two developments: the apparent decline in natural gas reserve ratios and a growing public demand for fuels such as natural gas which do not cause pollution.

Most probable raw materials to be used for substitute natural gas (SNG) are coal and petroleum fractions, with oil shale and wastes as possible sources. Each feed stock requires its own technology.

PROCESSES FOR MAKING SNG

Coal processes

A typical example of a coal-to-gas plant is the U. S. Bureau of Mines Synthane Process (3). The process flow sheet is shown in Figure 1. The main components are the gasifier, the shift converter to change the gas from about a $1.5H_2$:1CO ratio to a $3H_2$:1CO ratio, the purification system to remove most of the CO_2 and all of the sulfur compounds from the gas, and the catalytic methanator in which the $3H_2$ + 1CO feed reacts to form CH_4 plus H_2O.

FIGURE 1. - System Used to Make High-Btu Gas from Coal.

1/ Numbers in parentheses refer to list of references at the end of this paper.

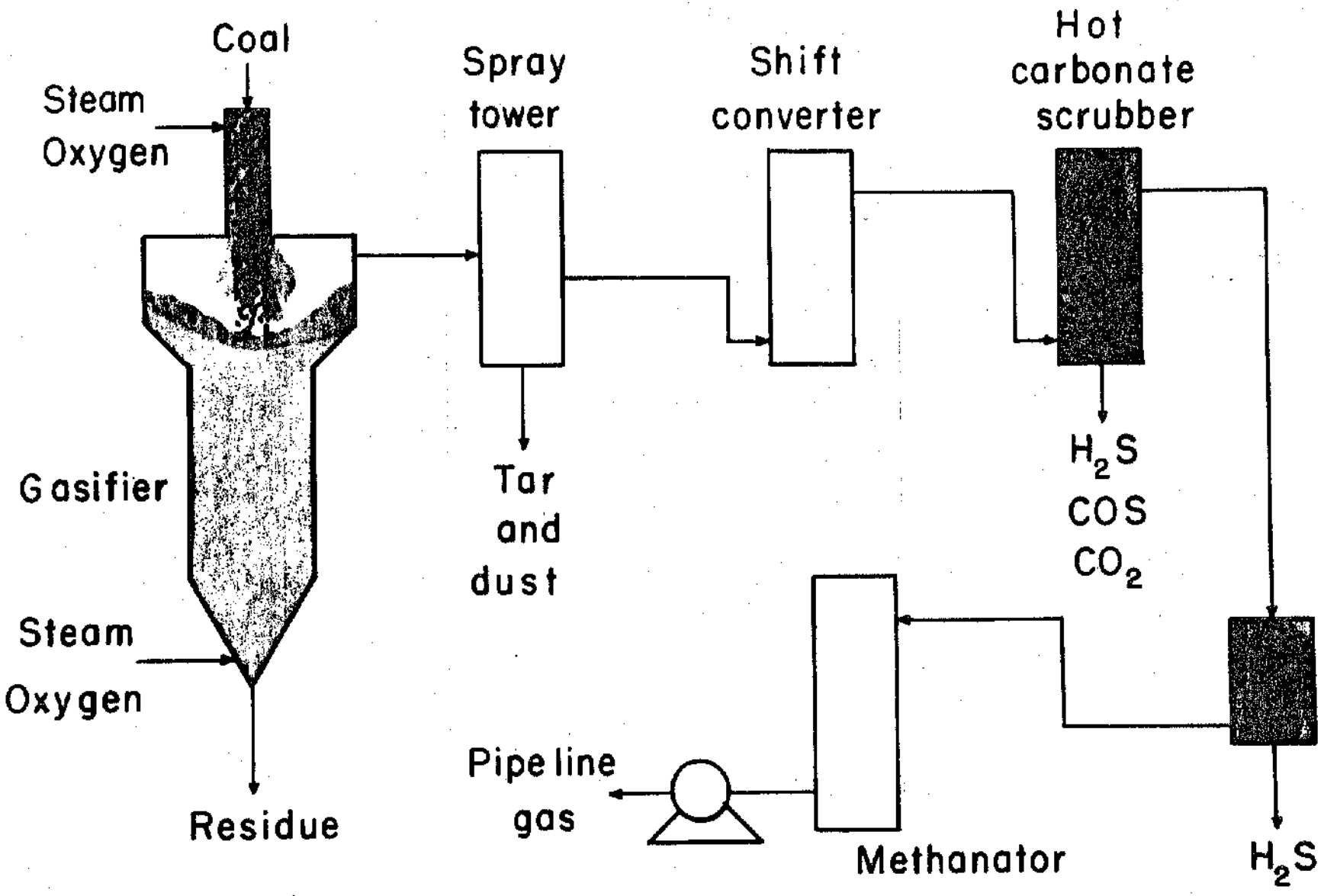

FIGURE 1. - System Used to Make High-Btu Gas from Coal.

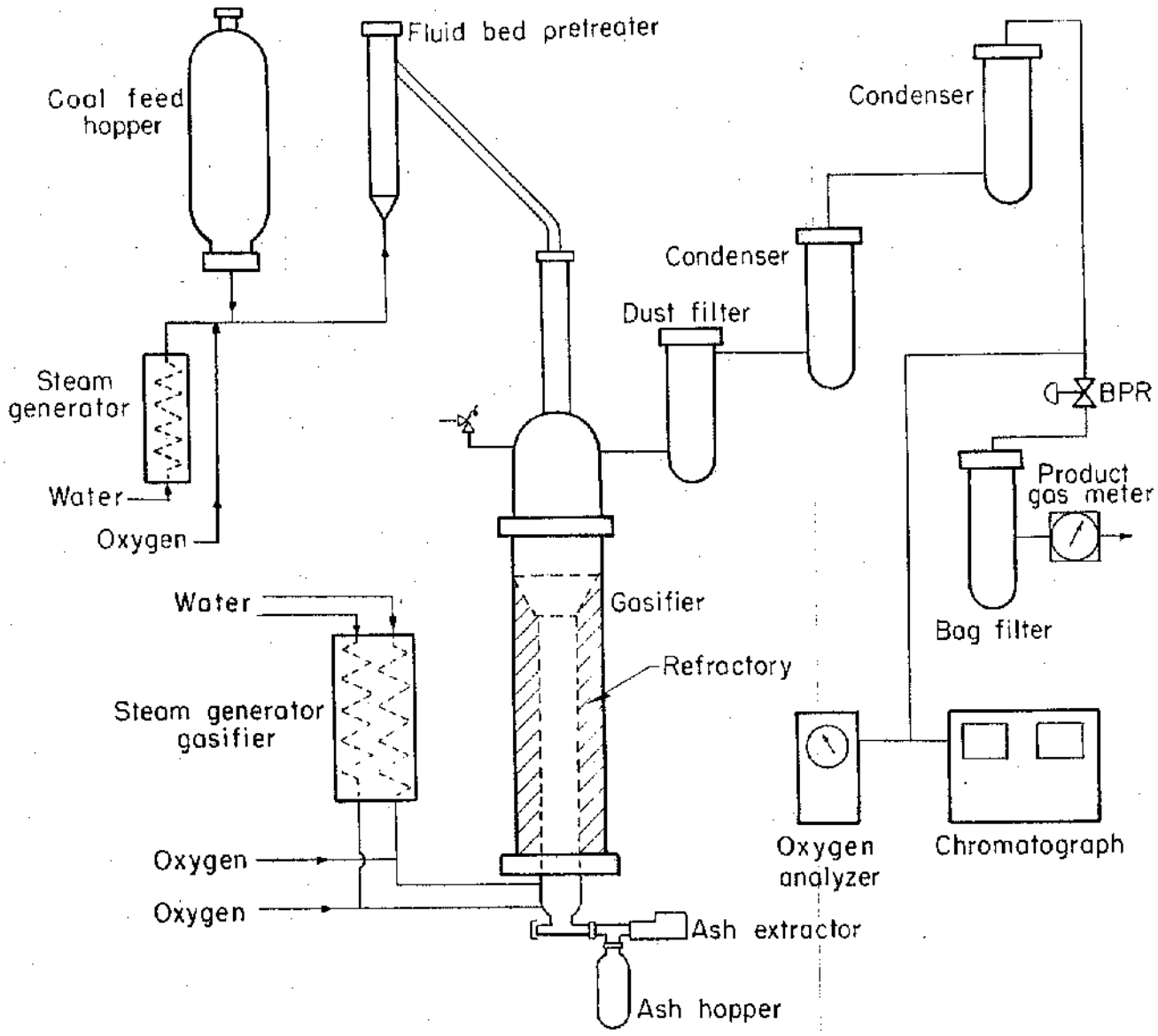

FIGURE 2. - 40 Atmosphere Fluid-Bed Gasifier.

TABLE 1. - Distribution of sulfur during gasification

Basis - ton coal feed to gasifier

Type Coal	Pittsburgh Seam	Illinois No. 6	N. Dakota Lignite	Montana Sub-bit
Lbs. Sulfur in:				
Coal	26.0	70.0	16.0	28.0
Char	2.9	8.4	4.4	4.4
Tar	1.8	1.1	0.4	0.3
Condensate	1.8	1.7	0.2	0.3
Gas	19.5	58.8	11.0	23.0
% Total S in gas	75	84	70	82

TABLE 2. - Coal to Gas Processes

Process	Prototype Operating Date	Gasification	Methanation
Bureau of Mines Synthane	Yes - 1974	Steam-O_2 1000 PSI	Tube wall, Hot Gas Recycle
BCR BIGAS	Yes - 1974	Steam-O_2 1000 PSI Slagging	Fluid Bed
Consolidation Coal	Yes - 1972	CO_2-Acceptor	None
IGT HYGAS	Yes - 1971	Hydrogasifier Steam-O_2 Gasifier	Cold Recycle
Kellogg Company	No	Molten Salt Bath	Not specified
El Paso	Commercial	Lurgi	Not specified

TABLE 3. - Liquid-to-Gas Processes as of January 1972

Company and Location	Process - Date	Raw Material	Size, Million SCFD
Texas Eastern - Consolidated Natural Gas (New Jersey)	Japanese - 1973	110,000 B/D liquid hydrocarbons	500
Consumer Power Marysville, Mich.	CRG - 1972	LPG - Naphtha	235
Columbia Gas Green Springs, Ohio	CRG - 1973	Natural gas liquids	250
Algonquin Gas Trans. Green Springs, Ohio	CRG - 1973	Naphtha LPG	120
Brooklyn Union	CRG - 1972	Naphtha	50
Northern Illinois	CRG - 1973	Natural Gas Liquids	150
Boston Gas	Japanese	Propane	40

TABLE 4. - Gasification Products from Different Processes

System	Synthane (3)	BiGas (17)	IGT (13)	CRG (8)	Lurgi (18)
Feed Stock	Pgh. Coal	W.Ky. Coal	Oil Shale	Naphtha	Sub-Bituminous Coal
Temp. °F, Max.	1800	1700[a]	1300[b]	840	2000[c]
Pressure PSIA	600/1000	1200	2000/3000	375	350
Product Gas, Mol. pct.					
CH_4	24.5	15.6	75.4	61.2	10.2
C_mH_n	0.8	--	2.1	--	0.4
H_2	27.8	24.4	9.4	17.0	40.2
CO	16.8	44.0	5.1[d]	1.0	17.1
CO_2	28.8	14.0	8.0	20.8	31.4
H_2S	0.5	1.4		--	0.3
N_2	0.8	0.6	--	--	
H.V. Btu/cu ft	406	380	827	678	295
H_2/CO	1.7	0.55	1.8	17.0	2.4
Byproducts					
	Tar				Tar
	Oil				Oil
	Water	Water	Water	Water	Water
	Char	Slag	Shale		Ash

a/ Outlet
b/ Average
c/ Estimate
d/ Incl. N_2

CONCLUSIONS

The various fuels that could be converted to a high-Btu gas are coal, light petroleum fractions, oil shale and heavy oils resulting from the development of an oil shale industry and recent developments in treating of garbage and bovine wastes. Recent events have shown the most promising and quickest routes are the processes using light oil feed stocks. However, there is a definite limitation to the amount of this material available. In the long run, the other sources show more promise for a large share of the gas market.