



TOGETHER
for a sustainable future

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for a sustainable future

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by
P. L. ...
...
United States of America

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REPORT

CHEMICAL PROCESS 1

Chem System Co. (private)
Unit 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100

This process is a new method for producing chemical products from coal, which is different from that from which they can be produced by other methods.

In the first stage, pulverized coal is reacted with hydrogen and yields the following products: 100 lbs. of gas;

2 lbs. of oil, 12 lbs. of gas, 2 lbs. hydrogen, and 1 lb. of ash.

The crude oil is produced by conventional petroleum techniques, a 50% yield of gas being obtained.

The gas is separated into three products by pulverized coal in four stages with progressively increasing temperature, condensation,

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We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used in preparing the master. It is



... and we have the following... During the past few years,...

... for some... are... the... of... the... of...

... which... are... of... are... of... are...

Table showing financial data

CLASS	11/30/41	12/31/41	11/30/41	12/31/41
Assets	1,000	1,000	1,000	1,000
Liabilities	500	500	500	500
Equity	500	500	500	500
Total	2,000	2,000	2,000	2,000

The amount of... The... of...

... of... of... of...

erwise, all is covered by paragraph 1. The purpose of the information is to provide a clear and concise summary of the information provided in the report.

The information is derived from the data provided in the report and is only valid for the period of time covered by the report. The information is provided for your information and is not intended to be used for any other purpose.

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2. From the fact that such a mixture of reformer, methane, hydrocracking
reformer, etc., or some other process.

The use of a complete range of catalysts for producing optimum
products will be a function of all the conditions prevailing
at the time of use.

It is also possible that a mixture of reformer is entirely adequate
for the production of a certain type of product, but that the potential of
a mixture of reformer is not fully utilized.

It is also possible that a mixture of reformer is entirely adequate
for the production of a certain type of product, but that the potential of
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for the production of a certain type of product, but that the potential of
a mixture of reformer is not fully utilized.

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Refined ...
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Total ...
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Quantity ...
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Total ...
 following

Note - ...
 ...

	Quantity	Unit Price	Total Value
Inputs			
RAF Gas	6.2 tons	.21	1.30
Outputs			
Oil			
Ethylene	1120	1.25	14.00
Propylene	200	1.00	2.00
Butadiene	300	15.00	45.00
Styrene	1.5	4.00	6.00
Total Outputs	200		57.00
APPENDIX			
Gasoline	15.0	1.80	27.00
Toluene	10.0	1.20	12.00
Xylene	20.0	1.50	30.00
Cyclohexane	20.0	1.00	20.00
Feedstocks	100	0.00	0.00
Durane	40	25.00	1000.00
Isoprene	500	3.00	1500.00
Total Appendix			1677.00

Item	Rate	Quantity	Value
Item 1	0.5	2.00	1.0
Item 2	1.0	1.70	1.70
Item 3	1.0	2.00	2.00
Item 4	1.0	1.00	1.00
Item 5	1.0	1.00	1.00
Item 6	1.0	1.00	1.00
Item 7	1.0	1.00	1.00
Item 8	1.0	1.00	1.00
Item 9	1.0	1.00	1.00
Item 10	1.0	1.00	1.00
Item 11	1.0	1.00	1.00
Item 12	1.0	1.00	1.00
Item 13	1.0	1.00	1.00
Item 14	1.0	1.00	1.00
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Item 26	1.0	1.00	1.00
Item 27	1.0	1.00	1.00
Item 28	1.0	1.00	1.00
Item 29	1.0	1.00	1.00
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Item 186	1.0	1.00	1.00
Item 187	1.0	1.00	1.00
Item 188	1.0	1.00	1.00
Item 189	1.0	1.00	1.00
Item 190	1.0	1.00	1.00
Item 191	1.0	1.00	1.00
Item 192	1.0	1.00	1.00
Item 193	1.0	1.00	1.00
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Item 197	1.0	1.00	1.00
Item 198	1.0	1.00	1.00
Item 199	1.0	1.00	1.00
Item 200	1.0	1.00	1.00

DISCUSSION

The following discussion is intended to provide information to the reader regarding the following items:

Item	Value
Item 1	600
Item 2	670
Item 3	800
Item 4	1000
Item 5	660
Item 6	5470
Item 7	2670
Item 8	200
Item 9	400

PROCEDURE

1. Preparation of reagents
2. Preparation of standards
3. Determination of concentration of butadiene

4. Light
5. 100/100
6. Sulfur
7. 100
8. 100/100
9. 100/100
10. 100/100
11. 100/100
12. 100/100

Inventory

The following is a list of items on hand as of 12/31/54. The amounts are in dollars and cents.

Inventory as of 12/31/54

Item	Amount
Coal	11.0
Oil	11.0
Gas	14.4
Flour	1.0
Feed	10.0
Feed	9.7
Feed	4.4
Feed	3.0
Feed	21.5
Feed	17.5
Feed	17.1

UNIT ANALYSIS (PER UNIT) - UNIT COSTS (PER UNIT)

Direct Materials			15.0
Direct Labor			7.0
Manufacturing Overhead			21.0
Unit Cost			43.0
Materials			4.5
Labor			2.1
Overhead			4.6
Fixed Overhead			1.2
Variable Overhead			3.4
Materials			40.9
Labor			6.0
Overhead			21.0
Unit Cost			<u>67.9</u>
Overhead			43.0
Materials			24.0
Labor			12.0
Overhead			17.4
Unit Cost			53.4
Labor			2.0
Overhead			4.0
Materials			6.0
Unit Cost			<u>12.0</u>
Overhead			117.7
Materials			
Variable Overhead	100.00	Unit Profit	62.10
Fixed Overhead	100.00	ROI	12.4%
Unit Profit	100.00	Overhead	117.7
Gross Profit	100.00	Fixed Overhead	4.5

It would be instructive to review the technology being developed in the U. S. for oil recovery.

The main objective is to produce light oil... by the carbon... of... activity... solid... at... production... have... the pro-

H. S. ...

This process involves the... of a pulverized coal-oil slurry... (11, 12 lbs. of $C_1 - C_2$ gas, 2 lbs. H_2S and 1 lb. of... 100 lbs. of dry coal. The synthetic crude oil... including hydrocarbons... of dry coal process... about 50%.

PHC COAL ...

Bituminous pulverized coal is... pyrolyzed... with progressively... multi-stage... coking... 20-30 lbs. oil... 10-15 lbs. gas. The gas yield... $CO_2 - H_2S$... range from 6 to 9,000... contains useful amounts of C_2 , C_3 and C_4 hydrocarbons. The... of the pyrolysis gas from Illinois #2 coal... of 30,000 tons of coal per day would amount to... 150 million lbs. per year. The ethylene potential is about 200 million lbs. a year.

The oil product is hydrogenated to produce a synthetic crude for use as a refinery feed.

The oil is desulfurized using dolomite as an H_2S acceptor. H_2S is recoverable from the pyrolysis gas stream from the off-gas and from the hydrogenation. H_2S is recoverable from both these sources.

Atlantic Refining Company

The Atlantic Refining Company's research laboratories have studied the hydrogenation of the COED crude oil. They also have provided useful analytical data on the basic composition of the syn crude and fractions from distillation thereof. The results of this work are given in the FIC report per-534 and appendices. One conclusion of the work was that the syn crude was worth \$2.00 to \$3.00 a barrel, about the same as petroleum crude.

Consolidated Coal Company

This procedure first involves depolymerizing the coal by heating under pressure with a coal-derived solvent, filtering off undissolved coal and ash and distilling off the solvent. About 60% of the dry coal dissolves. The ash-free product is then hydrogenated. Hydrogenation via the Isomax process and by the use of a molten zinc chloride catalyst have both been studied. By-product sulfur, ammonia and tar acid recoveries are reported.

Analytical data on the naphthas obtained both by Isomax and zinc chloride catalysts have been provided. These form the bases for the yields of aromatics used in this study.

Pittsburgh-Des Moines Coal Mining Company

This procedure is similar to the above but solvation and hydrogenation are accomplished simultaneously. Practically all the carbon values of the coal are converted to soluble material and gas. The gas liberated during the pressure release from the solvation process and solvent removal is rich in hydrogen and olefins. The volume recoverable and estimated costs are given in the hydrogen and ethylene-propylene chapters.

The objective of this project is production of ash-free, low sulfur coal for use as fuel. No liquid fuel production is contemplated at present,

although the coal extract would be just as useful for gasoline production as the Concolistone Coal extract.

Bituminous Coal Research, Inc. and

IGT Coal Gasification Projects

Both these projects involve the conversion of coal to methane. No significant amount of other hydrocarbons are obtained except for some light oil coming from the hydrocracking in the IGT process. This light oil represents 2 - 4% of the weight of gas produced or contains from 12 - 15% benzene or C_{6H_6} - C_{10H_8} range material, or about 33 to 54 tons a day, 20-55 million lbs. a year. No definite processing scheme for its recovery or purification has been worked out. In any case, the volume would hardly be large enough to significantly affect the gas cost.

However, the potential volume of benzene from hydrogasification of lignite is considerably higher. The preliminary IGT work indicates the possibility of recovering about 30 million gallons of benzene a year from a 50,000 tons of coal a day operation. This is equivalent to about 1% benzene on the dry lignite grave sand.

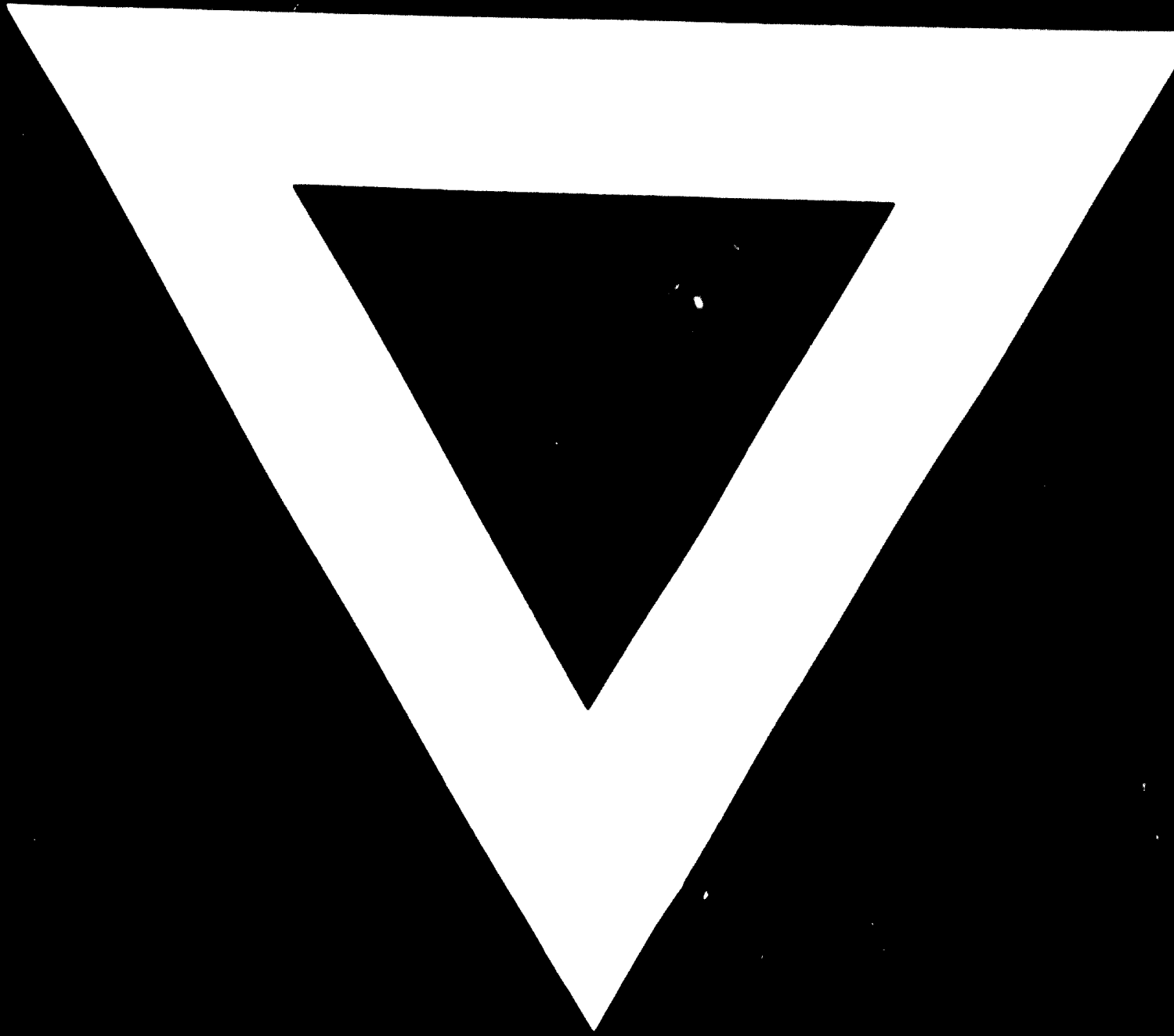
The main by-products are sulfur and ammonia, recoverable in proportion to the S and N content of the coal. Ammonia appears as ammonium carbonate which readily releases ammonia on heating. Sulfur production would be about 50,000 tons (1%) a year. At 30,000/ton, this represents 2% per 1000 cu. ft. of gas.

Enormous volumes of CO_2 are produced, but the two contractors believe that its recovery for sale would not be advantageous.

Summary

Based on the heavy consumption of crude oil on a world-wide basis, coal will ultimately become a major source for fuels and particularly chemicals. The time may still be 15-20 years distant but continued advances in technology will make coal more and more attractive with advancing years.





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