

28. 23.

Bureau of Mines  
Report of Investigations 5038



## OPERATION OF A POWDERED-COAL GASIFIER AT LOUISIANA, MO.

BY R. G. DRESSLER, H. R. BATCHELDER, R. F. TENNEY,  
L. P. WENZELL, JR., AND L. L. HIRST

—United States Department of the Interior—April 1954

LIBRARY

LOUISIANA STATE UNIVERSITY

MAY 12 1954

# OPERATION OF A POWDERED-COAL GASIFIER AT LOUISIANA, MO.

BY R. G. DRESSLER, H. R. BATCHELDER, R. F. TENNEY,  
L. P. WENZELL, JR., AND L. L. HIRST

\* \* \* \* \* \* \* \* \* Report of Investigations 5038



UNITED STATES DEPARTMENT OF THE INTERIOR

Douglas McKay, Secretary

BUREAU OF MINES

J. J. Forbes, Director

---

Work on manuscript completed March 1953. The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is made: "Reprinted from Bureau of Mines Report of Investigations 5038."

April 1954

# OPERATION OF A POWDERED-COAL GASIFIER AT LOUISIANA, MO.

by

R. G. Dressler,<sup>1/</sup> H. R. Batchelder,<sup>2/</sup> R. F. Tenney,<sup>3/</sup>  
L. P. Wenzell, Jr.,<sup>4/</sup> and L. L. Hirst<sup>5/</sup>

## CONTENTS

	<u>Page</u>
Summary and conclusions.....	1
Acknowledgments.....	2
Introduction.....	3
Description of equipment.....	6
Operations.....	6
Initial heating.....	6
Preliminary tests.....	7
Initial operations.....	9
Study of process variables.....	9
Ratio of oxygen to coal.....	11
Method of adding steam.....	14
Coal mesh size.....	14
Length of burner nozzles.....	15
Ratio of steam to coal.....	15
Data and calculations for a typical run.....	16
Extended gasification run 43.....	22

1/ Formerly chief, Gas Synthesis Demonstration Plant, Synthetic Fuels Demonstration Plant, Fuels Technology Division, Bureau of Mines, Louisiana, Mo.; now with Atlas Powder Co., Wilmington, Del.

2/ Formerly chemical engineer, Synthetic Fuels Demonstration Plant, Fuels Technology Division, Bureau of Mines, Louisiana, Mo.; now at Battelle Memorial Institute, Columbus, Ohio.

3/ Formerly chemical engineer, Synthetic Fuels Demonstration Plant, Fuels Technology Division, Bureau of Mines, Louisiana, Mo.; now chemical engineer, Anthracite Research Laboratory, Anthracite Subregion, Bureau of Mines, Schuylkill Haven, Pa.

4/ Formerly chemical engineer, Synthetic Fuels Demonstration Plant, Fuels Technology Division, Bureau of Mines, Louisiana, Mo.; now with Celanese Corp. of America, New York, N. Y.

5/ Formerly chief, Synthetic Fuels Demonstration Plant, Fuels Technology Division, Bureau of Mines, Louisiana, Mo.; now chief, Synthesis Gas Branch, Bureau of Mines, Morgantown, W. Va.

CONTENTS (Cont.)

	<u>Page</u>
<b>Operations (Cont.)</b>	
Miscellaneous auxiliary studies.....	24
Gasifier heat losses.....	24
Heat losses to water-cooled elements.....	24
Heat losses from shell.....	25
Heat radiation losses to water-cooled elements...	27
Inspection of gasifier lining.....	28
North cone.....	28
Cylindrical section.....	29
Ash legs.....	29
South cone.....	29
Slag and ash.....	29
<b>Appendix A.</b> .....	31
Tabulated data.....	31
<b>Appendix B.</b> .....	34
Purpose of runs and alterations of operating conditions....	34

TABLES

1. Conversions and temperatures - base runs.....	10
2. Materials requirements and economic factors - base runs.....	10
3. Summary of data from runs made with varied steam addition...	11
4. Summary of data from runs made with various lengths of burner nozzles.....	15
5. Summary of data from runs made with various steam-coal ratios.....	16
6. Summary of gasifier heat-loss data.....	26
7. Heat loss to water-cooled elements.....	27
8. Analysis of samples from ash-settling basins.....	30

ILLUSTRATIONS

<u>Fig.</u>		<u>Follows</u>
		<u>page</u>
1.	Block flow diagram of coal-gasification unit.....	2
2.	Schematic flow diagram of oxygen system.....	4
3.	Gasifier sections.....	4
4.	Effect of oxygen-coal ratio on carbon conversion - base runs.....	10
5.	Effect of oxygen-coal ratio on gasifier temperatures - base runs.....	10
6.	Effect of oxygen-coal ratio on coal requirements - base runs.....	10
7.	Effect of oxygen-coal ratio on oxygen requirements - base runs.....	10
8.	Relation between economic factor and oxygen-coal ratio - base runs.....	10
9.	Effect of varied steam addition on basic relation be- tween carbon conversion and oxygen-coal ratio - points from table 3.....	10

## ILLUSTRATIONS (Cont.)

	<u>Follows page</u>
<u>Fig.</u>	
10. Effect of varied steam addition on basic relation between coal requirements and oxygen-coal ratio - points from table 3.....	10
11. Effect of varied steam addition on basic relation between oxygen requirements and oxygen-coal ratio - points from table 3.....	10
12. Effect of burner length on basic relation between carbon conversion and oxygen-coal ratio - points from table 4	10
13. Effect of burner length on basic relation between coal requirements and oxygen-coal ratio - points from table 4.....	14
14. Effect of burner length on basic relation between oxygen requirements and oxygen-coal ratio - points from table 4.....	14
15. Effect of steam-coal ratio on basic relation between carbon conversion and oxygen-coal ratio - points from table 5.....	14
16. Effect of steam-coal ratio on basic relation between coal requirements and oxygen-coal ratio - points from table 5.....	14
17. Effect of steam-coal ratio on basic relation between oxygen requirements and oxygen-coal ratio - points from table 5.....	14
18. Effect of steam-coal ratio on basic relation between cone temperatures and oxygen-coal ratio - points from table 5.....	14
19. Schematic diagram of flow to water-cooled gasifier elements.....	24
20. North gasifier cone.....	28
21. Cylindrical section of gasifier, southeast view.....	28
22. Cylindrical section of gasifier, southwest view.....	28
23. Cylindrical section of gasifier, northwest view.....	28
24. Top center section of gasifier, south view.....	28
25. North section of gasifier floor at entrance of north ash leg.....	28
26. Center section of gasifier floor at entrance of center ash leg.....	28
27. South section of gasifier floor at entrance of south ash leg.....	28
28. South gasifier cone.....	28
29. Relation between carbon conversion and noncombustibles in ash.....	30