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ORIGIN, COMPOSITION, AND PROPERTIES OF COALS

Inspection, Sampling, and Analysis

Coals, particularly those of high grade, continued to be scarce throughout the year owing, in part, to export demand and, in part, to domestic

activity. As a result, Government agencies had difficulty in obtaining enough coal to meet requirements and in many cases had to either extend contracts made in previous years or accept such coals as were offered. The Office of Indian Affairs, whose requirements are almost entirely in the western fields, was able to purchase its coal supply on a guaranteed analysis basis. The Department of Justice purchased a part of its supply and the War Department purchased a limited part of its supply in the Sixth Army area on this basis. Other purchases were made at a fixed price not subject to adjustment for coal quality. Coal requirements of Federal agencies for the fiscal year were estimated at approximately 7,000,000 tons, the War Department being the largest purchaser and the Navy Department the second largest. Recommendations were made for awards of contracts for some agencies and furnished other agencies with analyses for use in evaluating coal bids and for use when substitute coals were offered.

Upon the request of the Navy Department, the Bureau instituted a program at Naval Stations for sampling coal and acting as technical advisor on its inspection and sampling. Two engineers, detailed for this work, made 150 visits to Naval Stations during which sampling procedures were set up and recommendations made for installing sampling equipment and for the storage and handling of coal.

For the use of various Government agencies in making coal purchases and for public information, tipple and face samples were collected at 160 mines in various States. Special samples for research on washability, carbonization, and gasification properties and miscellaneous tests were taken in 70 mines.

Analyses of Arizona, California, Idaho, Nevada, and Oregon Coals

The analyses of coals from five Western States - Arizona, California, Idaho, Nevada, and Oregon - have been published in a technical paper 7/ as another in the series describing coals of various States. Descriptions of the coal fields, including geology, occurrence, nature, and thickness of beds, were included and supplemented by maps showing location of beds in four of the States. Production, distribution, and use of coal in these States and the relationship of mine samples to commercial shipments were discussed. Descriptions of mine, tipple, and delivered samples included chemical analyses, calorific values, classification by rank, agglomerating indices, and fusing temperature of ash. The location and description of a number of operating mines were included, with data on nature of roof and floor and on thickness of coal and partings in the beds.

7/ Fieldner, A. C., Andrews, D. A., Hendricks, T. A., Huddle, J. W., Bell, C. H., Anderson, R. L., Snyder, N. H., Cooper, H. M., Abernethy, R. F., Tarpley, E. C., and Swingle, R. J., Analyses of Arizona, California, Idaho, Nevada, and Oregon Coals: Bureau of Mines Tech. Paper 696, 1947, 83 pp.

Data on Coals in Districts 12, 14, and 16

A data book[8] giving information on rail shipping and truck mines having a daily capacity of 50 tons or more located in Coal-Producing Districts 12, 14, and 16, covering the bituminous-coal-producing areas in Iowa, Missouri, Kansas, Arkansas, Oklahoma, and Texas, was published. This book contained descriptive tables giving names of mines and producers, location, coal veins or seams worked, and originating railroads for those mines served by rail. Mines were indexed and their locations shown on maps. Tables of specimen analyses and of the usual range of analyses produced in the districts were given.

Laboratory Lists

A set of four lists[9] of commercial laboratories equipped to make various types of coal and coke analyses, determinations of free silica, and gas analyses was published. The Bureau of Mines does not make commercial analyses, and these lists of laboratories were compiled for the information and convenience of inquirers. They comprise partial lists of laboratories using methods recommended by the American Society of Testing Materials for analysis of coal and coke in the Eastern States (List 1), the Southern States (List 2), the Middle Western States (List 3), and the Western States (List 4).

Analyses were made of 3,666 coal samples from purchases of coal and tipple and breaker inspections taken in connection with Government fuel purchases. Of these, 71 percent were for the War and Navy Departments, and the remainder were for nine other departments and agencies. The Bureau's research and test work relating to the mining, preparation, and utilization of coal and coal products required analysis of 6,353 samples, and 360 samples of marine sediments from drill cores taken from the floor of the Gulf of Mexico were analyzed for the Geological Survey.

An increased number of coal-dust samples from a larger number of mines were required this year than in the previous year to assist the Federal coal-mine inspectors in determining whether safe conditions existed in mines and to assist in formulating recommendations in connection with mine inspections. In all, 6,623 samples of road, roof, rib, and gob dusts from 1,085 mines in 18 States were analyzed.

The analytical services given to aid the various research and service programs in the Bureau and to other Federal agencies required analysis of 18,045 samples and making 174,325 determinations.

8/ Fieldner, A. C., and Sweeny, H. P., Typical Analyses of Bituminous Coals Produced in Districts 12, 14, and 16: Bureau of Mines Data Book, vol. 7, 1946, 74 pp.

9/ Laboratory List 1, Eastern States, May 1946, 4 pp.; Laboratory List 2, Southern States, May 1946, 2 pp.; Laboratory List 3, Middle Western States, May 1946, 4 pp.; Laboratory List 4, Western States, May 1946, 2 pp.

Constitution, Properties, and Analytical Methods

Extractable Waxes from Lignitic and Subbituminous Coals of the United States

The investigation to determine whether montan wax similar to that extracted commercially in Germany from certain brown coals can be obtained from low-rank coals of the United States was continued with extraction tests of lignitic and subbituminous coals from Arkansas, California, Colorado, Montana, North Dakota, Oregon, Texas, Washington, and Wyoming. Table 1 gives results of these tests, using benzene and a benzene-alcohol mixture, the solvents reported to have been used in Germany for extraction of montan wax from brown coal. The results show that the highest yields of extract were obtained from certain Arkansas and California lignites. The coals examined from the other sources do not yield enough extract to make them appear attractive as commercial sources of montan wax. Higher yields were obtained using the benzene-alcohol mixture than with benzene alone.

TABLE 1. - Yields of extract from air-dried coals, calculated to dry ash-free coal basis, percent

	Benzene	80 percent benzene, 20 percent ethyl alcohol
Lignitic coals		
Arkansas	8.8 - 10.8	13.6 - 16.6
California	8.2 - 9.9	15.1 - 15.3
Montana	-	2.6
North Dakota	1.5 - 2.2	2.9 - 4.5
Texas	2.1 - 2.3	5.6 - 5.7
Washington	2.7	4.4 - 5.7
Subbituminous coals		
Colorado	-	2.6
Montana	-	2.0
Oregon	-	3.0
Wyoming	-	2.9 - 5.4

Physical and chemical tests of the extracts from the Arkansas and California lignites examined showed that their properties were similar in many respects to crude commercial montan wax. The solvent used in the extraction had some effect on both yields and properties. The "resin" content of the extracts was in most cases somewhat higher than that reported in the literature for montan wax of commercial grade.

Analyses of Miscellaneous Materials

Chemical analyses were made of 123 samples of a wide variety of materials taken in connection with investigations concerned with the utilization of coal and health and safety in mines.

Twenty boiler-water compounds and 19 boiler scales or water-formed deposits were analyzed in connection with studies of boiler-water treatment

in Government heating and power plants as part of the fuel-engineering service furnished by the Bureau of Mines to other Government agencies. Analyses were made of 10 samples of deposits from air heaters of boiler furnaces as part of a study of the properties of these corrosive deposits. Ten samples of external deposits from boiler tubes at several power stations and samples of iron pyrite and ferrous sulfide were analyzed in connection with an investigation of the mechanism of formation of corrosive deposits on boiler surfaces.

Analyses were made of 17 samples of slag and ash from tests of a slagging gas producer using Rhode Island anthracite as fuel for the direct production of mineral wool.

An analysis of ash of Takamatsu coal from Japan showed a composition somewhat similar to ash of some coals in the United States, but this ash contained a comparatively low Fe_2O_3 content of 4.1 percent.

Analysis of one soot remover showed it to be essentially common salt with a small quantity of magnesium sulfate and ultramarine blue coloring material, while another contained salt with some sodium chlorate and the same blue coloring material.

Eleven samples of rock-dusting materials were examined to determine their suitability for use in coal mines to prevent the propagation of coal-dust explosions. Limestone or dolomite dusts are preferred because they are generally low in silica and combustible matter, do not cake excessively when exposed to moisture, and are available in most coal fields of the United States. Gypsum dusts are seldom recommended, because they usually form a hard cake when wetted with water and dried, thus losing their effectiveness. Four of the samples examined were from Missouri and consisted of two limestones that would be suitable for rock dusting and two mixtures of limestone with sodium bicarbonate. The bicarbonate had been added on the theory that carbon dioxide would be liberated by heat in an explosion, creating an inert atmosphere that would add to the effectiveness of the rock dust. However, these mixtures when wetted with water and air-dried formed relatively hard cakes; therefore, they were not considered desirable for rock dusting. One sample of gypsum from Utah and three from Colorado showed high caking properties when wetted with water and were unsuitable for use in wet mines. One limestone from Colorado was of sufficient purity for rock dusting.

Five catalysts from coal-hydrogenation plants in Germany were analyzed for main constituents in connection with the Synthetic Liquid-Fuels Program. These analyses included determinations of silica, iron, aluminum, molybdenum, zinc, and chromium. Tin and total halogen were determined in three residues from coal-hydrogenation tests in which tin sulfide and iodoform had been used as catalysts. Tap water from the Synthetic Liquid-Fuel plant at Bruceton, Pa., was analyzed and found to be suitable for drinking, as it contained not more than 0.02 part per million of lead.