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EFFECTS OF AIR OXIDATION ON THE PLASTIC PROPERTIES OF COALS AS MEASURED BY THE GIESELER PLASTOMETER

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The Illinois Geological Survey has studied for many years the plastic properties of coals, particularly in connection with its research program on the use of Illinois coals in blends for making metallurgical coke. The Gieseler plastometer has been used for determining these properties. It was built in the Survey's machine shop and, with the exception of certain modifications, is similar to that described by Soth and Russell.[1]

Basically, the Gieseler plastometer provides a means of heating the coal sample in the plastometer proper. Inside the plastometer, in intimate contact with the coal, is a stirring shaft with rabble arms to which is applied a constant torque through appropriate pulleys. When a coking coal is heated, it softens and permits the stirring shaft to turn. By means of a dial mounted on one of the pulleys, the rate of turning may be measured. A thermocouple in the heating bath permits temperature observations to be made.

Values determined with this instrument are as follows:

Softening temperature — The temperature at which dial-pointer movement reaches 0.5 dial divisions per minute.

Fusion temperature—The temperature at which dial-pointer movement reaches 5.0 dial divisions per minute.

Maximum fluid temperature — The temperature of maximum rate of dial-pointer movement.

Setting temperature—The temperature at which dial-pointer movement stops.

Maximum fluidity—The maximum rate of dial-pointer movement in dial divisions per minute.

It is well known that the freshness of the sample is important in analysis and testing of coal. Therefore, it was necessary to obtain some information on the effect of time of sample storage (air oxidation) on results obtained in the Gieseler test. Accordingly, determinations were made on three coals, representing high-volatile bituminous A, B, and C ranks at increasing intervals of storage time.

High-Volatile Bituminous A Coal

About 50 kilograms of this coal, 2 by 3 inches, were stored in a 10-gallon can with a hermetically sealed top. For each Gieseler determination about one kilogram of coal was withdrawn from the can, air dried over night, and pulverized to minus-40-mesh size for test. Results for this coal are shown in table 1.

High-Volatile Bituminous B Coal

A sample of this coal was crushed to minus-4-mesh size, air dried, pul-

[1] G. C. Soth and C. C. Russell, Proc. Am. Soc. Testing Mats. *43*, 1176 (1943).
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TABLE 1.—EFFECT OF AIR OXIDATION ON PLASTIC PROPERTIES HIGH-VOLATILE BITUMINOUS A COAL.

Storage time in days	Softening temp. °C.	Fusion temp. °C.	Max. fluid temp. °C.	Setting temp. °C.	Max. fluidity dial div./min.
0	398	414	442	475	2000
8	397	418	441	476	1714
20	398	417	443	475	600
29	395	415	443	475	1034
49	394	414	438	471	313

TABLE 2.—EFFECT OF AIR OXIDATION ON PLASTIC PROPERTIES HIGH-VOLATILE BITUMINOUS B COAL.

Storage time in days	Softening temp. °C.	Fusion temp. °C.	Max. fluid temp. °C.	Setting temp. °C.	Max. fluidity dial div./min.
0	400	446	452	477	7.6
1	405	436	440	479	6.1
2	405	445	445	479	5.0
5	406	...	435	479	2.5
6	406	...	440	474	2.2

TABLE 3.—EFFECT OF AIR OXIDATION ON PLASTIC PROPERTIES HIGH-VOLATILE BITUMINOUS C COAL.

Storage time in days	Softening temp. °C.	Fusion temp. °C.	Max. fluid temp. °C.	Setting temp. °C.	Max. fluidity dial div./min.
0	344	382	409	451	1250
8	341	385	415	459	896
29	...	387	412	451	347
82	328	386	411	447	77

verized to pass a 40-mesh sieve, and stored in an 8-ounce bottle with a closely fitting rubber stopper. As each portion was withdrawn for test, the bottle was closed immediately to limit contact of the coal with air. Results of tests on this sample appear in table 2.

HIGH-VOLATILE BITUMINOUS C COAL

The procedure for preparation and storage of this sample of coal was the same as for the high-volatile bituminous B coal. Results are shown in table 3.

In summary, reference to the data in tables 1, 2, and 3 indicates that oxidation of samples through increased periods of storage does not greatly affect significant temperature values determined in the Gieseler test. However, maximum fluidity values appear to be definitely reduced by oxidation. For this reason, it is necessary to make Gieseler tests as soon as possible after sampling.