

Coal Sample Bank & Database



www.energy.psu.edu

Key Contacts

Jonathan P. Mathews
(814) 863-6213

Bradley Maben
(814) 865-3899

csb@ems.psu.edu

Overview

For nearly 60 years, various federal and state government agencies have funded the operation and gradual expansion of a sample bank collection of coals from around the United States. These grants and contracts helped to provide detailed characterization of each coal, making the collection an extremely valuable asset to Penn State's coal research programs. Subsamples of these coals are made available, upon request, to any researcher in need of coal. For a small reimbursement, samples and analytical data have been provided to many thousands of governmental, university and private researchers throughout the world.

The EMS Energy Institute maintains a suite of 38 well-preserved Department of Energy Coal Samples (DECS) and a corresponding computerized database for distribution. Our collection also includes nearly 500 historical samples (PSOC) and data on some 1270 samples. A uniform collection of coals and data was accrued over 60 years by applying ASTM standard practices for sample collection, handling, and analyses. In the past twenty years, inexpensive procedures have been developed and implemented to protect coals from deteriorating in storage.

The coals represent a wide spectrum of the major coalfields of the United States, and were selected in order to achieve a useful distribution of important coals by rank, geologic province, maceral composition, sulfur content and forms, and ash yield and composition. Consideration was also given to the economic importance of the samples prior to their use by researchers. Most were collected as full-seam channel samples; however, drill cutting, working section of seam, bench, lithotype and run-of-mine samples were also acquired.

Background

The Penn State Coal Sample Bank was initiated through the U.S. Office of Coal Research. Throughout its 60 years of existence, the Sample Bank has worked with numerous U.S. coal producers and provides well-preserved and characterized coal samples to researchers throughout the world.

DECS series samples are the newest and best-preserved samples in the collection, and should be chosen, when possible, for research requiring moderate quantities of coal. They were collected in 180 kg (400 lb.) quantities from recently exposed areas of active mines, where they were placed in 113 L (30 gal.) argon-purged steel drums with high-density gaskets. After collection, processing was performed as soon as possible in order to obtain representative subsamples. These were sealed under argon in foil multilaminate bags, which have been shown by annual monitoring to preserve samples very well, and are kept in refrigerated storage (3°C). DECS samples are available in packages for three nominal sizes: 50 g (2 oz.) at minus 0.25 mm (-60 mesh), 250 g (0.55 lb) at minus 0.85 mm (-20 mesh) and 2.3 kg (5 lb) at 6 mm (-1/4 inch). The 250g containers are the ones most often requested by research agencies. Also, some non-representative blocks of coal, sealed in argon and refrigerated, are also available for certain coals in the Sample Bank.

Results

In 1988 an extensive evaluation of current coal storage practices was undertaken that involved the testing of storage containers, methods and practices. At the time, coals were stored in various bulk and subsample containers under a variety of conditions, i.e., large, bulk storage of coarse coal in polyethylene drums sealed with gasketed lids and sparged with argon or nitrogen gas, smaller bulk storage buckets of relatively finer coals with gasketed screw-type lids sparged with argon or nitrogen, and relatively fine particles of coal placed in polyethylene bags and sealed in steel cans.

Evaluation of the gaseous contents of a series of different coals and container types by gas chromatograph, demonstrated that the bulk storage techniques were ineffective at protecting coals from invasion of atmospheric oxygen. Following these tests, a variety of other sample container types and techniques were evaluated that included the military specification Mil B-131 foil laminate bags, which had been shown by other researchers to protect coals from moisture loss. After a year of evaluation of these new storage practices, it was determined that the foil laminate bags were effective at preventing invasion of atmospheric oxygen and that the stored coal showed no statistical change in properties that are largely influenced by oxidation, i.e., decreased thermoplastic properties and calorific value and increased sulfate sulfur.

Concurrently, coal samples from the Argonne National Coal sample collection were placed in foil laminate bags. Testing showed that the thermoplastic properties of these coals were maintained up to a year in storage. Consequently, foil laminate bags were adopted as the new technique for storage of bulk coarse samples as well as finer particles sizes. These specimens were designated as DECS samples and a small subset of coals were monitored over a period of 14 years. Although some subsamples did show minor deterioration over the period, these appeared to be random occurrences. No statistical trend of deterioration was observed.

Analyses

Each of the Sample Bank coals has been subjected to the following analytical procedures: proximate analysis, ultimate analysis, sulfur forms, calorific value, maceral analysis, mean maximum vitrinite reflectance (VR_o), ash fusion determination, free swelling index, Hardgrove grindability, major inorganic and trace elements, equilibrium moisture, and CO₂. Gieseler plastometry and a standardized liquefaction test were performed on appropriate samples. NMR, py/gc/ms and additional trace element results were obtained on selected DECS samples.

Sample Availability

Coal samples from the Sample Bank are available to all members of the coal research community. Assistance can be given in identifying samples that match specifications or that best suit the research needs of the requestor. A nominal cost plus shipping and handling is charged for samples up to 1 kg of -0.85 mm (-20 mesh) coal or 50 g of -0.25 mm (-60 mesh) coal. Beyond this limit and for larger quantities or special preparation of samples, provision will be at cost to the requestor for preparation, mailing and handling.

Penn State currently maintains a Sample Bank that contains over 500 samples in addition to the 38 coals discussed above. If a researcher's needs cannot be met from the 38 coals, then suitable samples can be provided from the larger bank; there is a charge for this service.



Key Publications

- Glick, D.C.; Mitchell, G.D.; and Davis, A., 1991, "Monitoring the Oxidation of Coals in Storage," American Chemical Society Division of Fuel Chemistry Preprint v. 36, no. 3, pp. 861-868.
- Davis, A. and Glick, D.C., 1993, "Establishment and Maintenance of a Coal Sample Bank and Data Base," Final Report DOE/PC/79997—1 to U.S. Dept. Energy under Contract No. DE-RP22-87PC79997, 266 pp.
- Scaroni, A.W.; Davis, A.; and Glick, D.C., 1999, "Maintenance of the Coal Sample Bank and Database," Final Report DOE/PC/93051--23 to U.S. Dept. Energy under Contract No. DE-AC22-93PC93051, 192 pp.
- Glick, D.C.; Mitchell, G.D.; and Davis, A. 2005, "Coal Sample Preservation in Foil Multilaminate Bags," *International Journal of Coal Geology*, v. 65, pp. 178-189.