

# COAL RESERVE EVALUATION

## COAL EXPERTISE AND CAPABILITIES

Whether your company is delineating new coal reserves, upgrading probable coal reserves or evaluating a new or existing mine plan, SGS can provide you with independent and expert reserve evaluation services. Reserve evaluation services include:

- Drill program design.
- Core logging by experienced geologists.
- Core splitting and sampling.
- Complete accredited laboratory analysis.
- Geostatistically-based resource modeling.

SGS can provide you with computer generated mining simulations to assist you in developing a mine plan that will optimize your operations and subsequent cash flow.

### DRILL PROGRAM DESIGN

Properly planned drill programs are the primary exploration tool of the coal industry. Drill programs provide most of the raw data upon which resource maps are generated and they are the framework upon which crucial mining decisions are based. It is essential that the initial drill program is designed by professional geologists with an understanding of the complexity of the geology. Ideal drill-hole placement, orientation and density optimize your drilling budget. SGS has the expertise and knowledge to properly design your drill program.

### CORE LOGGING

SGS can assist you with all aspects of core logging. Whether your program includes fully cored, part cored or open holes, SGS personnel will use its international expertise to ensure that all the logging data is collected systematically and accurately. We will ensure that the entire hole is thoroughly logged for geotechnical as well as current and future exploration purposes. Logged core is boxed and securely routed to accredited SGS laboratories for analysis. SGS will ensure that the entire chain of custody is managed efficiently so that you receive the results from your drilling program in a timely fashion.

### GEOSTATISTICAL MODELING

Geostatistical resource modeling is the practice of creating rigorous block models of the in-situ coal resource using geology drilling and grade data and geostatistics. Geostatistical modeling can be used to create the high-level production forecasting program required for a coal preparation plant. Geostatistical modeling weights each sample in your database using deposit-specific parameters and then generates a spatial model contrived by location coordinates. This approach uses the same block structure as the resource model, and will assign an uncertainty to a circuit design or forecast. A more rigorous and reliable production forecast will result of applying geostatistical modeling to your production optimization.

SGS uses geostatistical analysis to generate coal quality (iso-quality maps) and overburden maps based on information from the drill program and analysis of the core samples.

SGS geostatistical resource models take into account variability throughout a coal deposit and are used to quantify the uncertainty associated with reserve estimations. Once the iso-quality maps are completed, they can be used to develop or update a mine plan resulting in a consistent quality coal feed.

### CONDITIONAL MINING SIMULATIONS

Conditional mining simulations are computerized simulations that virtually mine the coal reserve. Calculating block-by-block based on the anticipated mine plan, simulations not only determine the run-of-mine quality, but also generate data that will enable you to:

- Determine storage requirements.
- Design an optimized mine-plan.
- Optimize and design a preparation plant.
- Determine preparation plant yield.
- Understand future resource requirements.

Useful conditional simulations are the result of a valid drill program design, reliable core analysis and effective geostatistical modeling. Each step in the process must be done with care and precision by professionals with years of experience, and who have access to the right technological services. SGS can provide both the personnel and the technologies to do the job right.

## LABORATORY ANALYSIS

### SGS LABORATORIES

Core analysis is an essential component of resource definition and is the basis of your economic model and mine plan. SGS has complete coal analysis capabilities at laboratories around the globe. Our qualified technicians operate from independent facilities using recognized global standards such as ASTM and ISO to provide you with accurate, impartial coal analysis. Our labs use concepts of Total Quality Management (TQM) to ensure consistent operation on a daily basis. We provide accurate, cost effective chemical analysis to minimize the risks associated with reserve evaluation and mine planning. The following SGS chemical analyses will provide the foundation for rank determination and toxicity summation for later use in satisfying environmental standards:

- Proximate analysis (total moisture, ash, sulfur, calorific value, volatiles, fixed carbon).
- Ultimate analysis (total moisture, ash, carbon, hydrogen, nitrogen, sulfur, oxygen by difference).
- Elemental analysis.
- Heating value.
- Toxicity testing (arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver).
- TCLP extraction (used to determine the amount of leachable metal).

The ash component of the proximate and ultimate analysis refers to the non-combustible residue left after carbon, oxygen, sulfur and water have been volatilized. While the volatile matter pertains to the components of coal, except for moisture, which are liberated at high temperature in the absence of air.

### COAL PETROGRAPHY

Coal petrography is used to determine a coal's rank (degree of coalification) and type (amount and type of macerals). Macerals in coal are analogous to minerals and are determined by examining polished specimens of minus 20 mesh prepared coal. Petrography is mainly used as a tool to evaluate bituminous coals in terms of their ability to produce blast furnace coke. Rank is determined by measuring the percent light reflectance of the maceral vitrinite. Type is determined using a point count procedure to obtain the volume percent of the various coal macerals, or fossilized plant remains. Coal Petrography can also be used to determine whether contaminants are present in the coal and to detect oxidized coal in the sample.

### RHEOLOGICAL PROPERTIES

Coking coals possess the ability, when heated in the absence of air, to soften, swell, and then resolidify to form a coherent, porous, hard coke structure. The Gieseler Plastometer and Arnu Dilatometer tests are used to evaluate the rheological, or plastic, properties of a coal. The Arnu Dilatometer Test is used to determine the swelling properties of coal when heated under standard conditions in a dilatometer, while the Gieseler Plastometer Test is useful in determining the temperature at which: initial softening, maximum fluidity, and solidification occurs for specific coals. This data is valuable in determining the suitability of your samples for use as coking coals. Country specific tests are also available if required.

### COAL WASHABILITY STUDIES

Washability characteristics of coal are generated from float/sink analysis of core samples, mined samples, or from preparation plant feed samples. In addition to the float/sink analysis, SGS can perform froth recovery testing on finer size material. If a coal contains a high percentage of middlings material, SGS can perform the crushing studies required to determine if additional yield can be obtained by crushing and liberating this coal from the host rock.

SGS coal washability studies, including float/sink analysis, can be done on samples ranging in size from bulk washability samples (over 1 ton) to bench-scale size samples (2-10kg). These analysis can be done over a range of densities (S.G.1.30 to 2.20) and on coarse and fine coals.

Data from a washability test will determine:

- Potential for recovery and quality of coal reserves
- Preparation plant efficiency.
- Preparation plant design.
- Optimum operating parameters for preparation plant circuits.
- Characterizing types and amounts of impurities.
- Determining optimum size range of a specific coal for cleaning.



## GEOTECHNICAL SERVICES

### STABILITY STUDIES

SGS uses the latest methods and sophisticated equipment to examine the stability of the subsoil. For marshy or uneven land, and for spaces with restricted access, we make use of adapted probing installations and caterpillar vehicles to carry out mechanical and electrical cone penetration tests (CPT). By installing piezometers and taking undisturbed samples, we get insight into the local geology and hydrology.



The results of such geotechnical research are translated into usable physical quantities and effective foundation advice. The information is gathered through a geographic information collection system. Our expertise includes:

- Destructive drilling and coring (ROTAP).
- Geographic information systems (GIS).
- Mechanical and electrical cone penetration tests.
- Undisturbed sampling (MOSTAP).
- Parameter acquisition using mechanical or electrical manometers.
- Installation of piezometers.
- Slope stability tests.
- Geotechnical on-site supervision.
- Earthworks supervision, consulting, solution designs.
- Evaluation of the feasibility of materials and ground treatment methods to be applied.

## CONCLUSION

SGS provides complete services dedicated to the exploration and delineation of new or existing coal resources. We will:

- Design and support your drill program.
- Provide accredited laboratory services for your analytical needs.
- Provide resource models based on geostatistical analysis.
- Provide conditional mining simulations to help optimize your operations.
- Assist you with coal bed methane determinations.
- Evaluate and provide solutions for your geotechnical requirements.

At SGS, we strive to maintain a global benchmark for quality and integrity. We will ensure that each stage of your reserve evaluation process is handled professionally and efficiently in a manner consistent with SGS standards.

### CONTACT INFORMATION

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