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# Project Summary

# Use of Coal Cleaning for Compliance with $SO_2$ Emission Regulations

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**The results of an overall evaluation of the potential role for coal cleaning as a means of controlling $SO_2$ emissions from coal-fired stationary sources are presented in this report. The objectives were to examine the capabilities of coal cleaning in the light of various existing and proposed $SO_2$ emissions regulations to determine the applications in which the technology would be most useful, to identify the barriers which exist to prevent wider application of coal cleaning, and to describe actions which should be taken to overcome these barriers.**

**Much information about coal is compiled as resource data, including data on the coal reserve base and coal cleanability. It also includes present and projected coal production and use by utilities and industry, as well as the nature of coal contracts and the size and age distribution of coal-fired facilities.**

**The environmental impacts of coal cleaning are compared with other sulfur removal strategies such as flue gas desulfurization (FGD) and the use of low-sulfur coal; similarly, cost comparisons are made between various alternatives for $SO_2$ control. The results of the cost analyses show, when all costs and benefits to utilities of using physical coal cleaning (PCC) are properly evaluated, an economic superiority for physical coal cleaning, even if supplemental application of another method, FGD, must be used to achieve full compliance with applicable New Source Performance Standards (NSPS) or State Implementation Plan (SIP) emission limits. Comparisons also are made between the quantities of coal which could be made available through the use of various coal cleaning processes to meet different emission standards and the quantities of coal currently required by utility and industrial facilities operating under each standard. The results show clearly the usefulness of coal cleaning in producing coal to satisfy SIPs or the 1971 NSPS.**

**Barriers to the implementation of coal cleaning are identified in several areas: technical, institutional, environmental, economic and social, legislative and regulatory, and transportation. The common theme is that of uncertainty. Investments in coal cleaning facilities may be deferred because of such uncertainties as:**

- **Questions related to technical details; e.g., lack of performance data from a commercial plant showing that clean coal can be produced with the reduced sulfur content predicted by experimental washability data.**
- **Changing environmental regulations.**
- **Ultimate profitability of the investment.**

**Actions recommended to overcome these barriers include nine technical**

**research and development programs, and various actions to implement one of two policies: either to provide growth in coal cleaning by ensuring that coal cleaning is competitive in the marketplace and that coal users believe that it is worth the investment, or to require that *all* high sulfur coal be cleaned before it is burned.**

***This Project Summary was developed by EPA's Industrial Environmental Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).***

## Introduction

What is the best way to control the emission of $SO_2$ resulting from coal combustion? The answer to this complex question depends on such factors as the characteristics of the coal being burned, the size and type of the combustion facility, whether the facility is existing or being planned, the location of the facility, and the emission regulations the facility is required to meet.

Physical coal cleaning has been used for many years to remove ash from coal before combustion or coke manufacture. Conventional coal cleaning processes also remove part of the sulfur from the coal, and modified coal cleaning processes for enhancing sulfur removal are being implemented. Thus, coal cleaning is one way to reduce $SO_2$ emissions. The usefulness of coal cleaning in this role depends on the factors just listed, and this study was undertaken to evaluate the potential for coal cleaning, in the light of these factors, and to determine the applications in which the technology would be most useful. A further objective of this study has been to identify barriers which hinder the adoption of coal cleaning for $SO_2$ control and to recommend actions to overcome these barriers.

This report includes the results of the broad range of analyses required to meet the objectives. For many of these analyses summaries of the findings are given in the body of the report with details of the methodology and the results given in appendices.

## Conclusions and Recommendations

The major findings of this study are derived from an assessment of the cleanability of U.S. coals, from an analysis of the increase in the quantities of compliance coals achievable through coal cleaning, from a comparative evaluation of the costs of various $SO_2$ control methods, and from an analysis of barriers to the expanded use of coal cleaning. Additional background information had been developed and compiled, including: considerations of the variability of sulfur in coal; data on coal production, coal use, coal reserves, coal contracts, and constraints to increased coal production; an overview of coal cleaning technologies; and a comparison of the environmental effects of various $SO_2$ control methods. Brief summaries of the major findings are presented as background for the conclusions and recommendations.

## *Summary of Major Findings*

### Coal Cleanability

The potential for coal cleaning as an $SO_2$ emission control technique depends on the coal cleaning processes employed and on the characteristics of the coal being cleaned. To estimate the cleanability of the entire U.S. coal reserve base, many coal cleaning processes must be considered with respect to specific coal properties. To accomplish this, a computer model was developed which combines three sets of coal data and allows a variety of analyses to be performed on the resultant data base. It is called the Reserve Processing Assessment Model (RPAM).

The data base is composed of an overlay of the reserve base of U.S. coal, washability data for coal from sample mines, and about 50,000 detailed sample coal analyses. All three sets of data were obtained from the U.S. Bureau of Mines or Department of Energy in the form of computer tapes. The resulting overlay contains 36,000 coal resource records which have the following information for each:

- Region, state, county, and bed.
- Weight in tons of both strip and underground coal.
- Mean percent by weight of ash, organic sulfur, and pyritic sulfur.
- Mean heat content expressed in Btu/lb.*
- Float-sink distribution of the mined coal for different size fractions and media densities.

From this consolidated data base, the effects of a coal cleaning process on the reserve resources can be calculated. The coal cleaning process specified can be real or hypothetical, physical or chemical processes.

Programs were written to permit various analyses to be made on the combined data base, permitting:

- Calculation of the quantities of coal which could be upgraded to be in compliance with various fixed-limit $SO_2$ emission standards through coal cleaning by various processes. These were calculated on a regional basis, and include consideration of sulfur-content variability.
- Calculation of the quantities of coal which could be produced by different coal cleaning processes to meet standards which require removal of a stated percentage of the sulfur in the raw coal. These were calculated by region and for various emission-averaging times to reflect sulfur variability.
- Calculation of quantities of coal which could be burned in compliance with various percentage-removal standards using combined coal cleaning and flue gas desulfurization (FGD). These were calculated as a function of the FGD removal efficiency required. The results show, for example, that for 13 percent of the coal in the Northern Appalachian Region, a simple cleaning process consisting of crushing to 1.5 in. top size and separation at 1.6 specific gravity would allow the FGD system to operate at only 80 percent sulfur removal efficiency and still meet a 90 percent removal standard. Similarly, 45 percent of the coal of that region could be used with FGD operating at 85 percent removal efficiency to meet the same standard.
- Calculation of the $SO_2$ reduction which would be achieved if all of the coal produced annually were cleaned before combustion. The cleaning process assumed was 3/8 in. top size separated at 1.3 specific gravity followed by separation of the refuse at 1.6 specific gravity with combination of the two float fractions. These were calculated on a state-by-state basis. The results show that a 32.4 percent reduction in national $SO_2$ emissions could be achieved, at a Btu loss in

(*) Metric equivalents are given elsewhere in this Summary.

## Coal Availability

Existing coal-fired facilities must meet $SO_2$ emission standards prescribed by the states in the State Implementation Plans (SIPs). The SIPs for $SO_2$ vary widely from state to state and often within a state. Coal-fired electric utility boilers built since 1971 must meet the New Source Performance Standards (NSPS) of 1.2 lb $SO_2/10^6$ Btu. An evaluation of the usefulness of coal cleaning in providing compliance coal must consider not only the cleaning characteristics of coal produced in different regions but also the amounts of coal required by facilities under each of the various SIP regulations. A procedure was developed for making such an evaluation. A computer file was developed to store data on existing utility and industrial energy demand in which each facility was classified by state, actual SIP requirement, capacity, and fuel. The location, capacity, and fuel data for utility boilers were obtained from EPA's Energy Data Systems (EDS) file, and the corresponding information for industrial facilities was obtained largely from the Federal Energy Administration (FEA) survey of "Major Fuel Burning Installations" (MFBI). The SIP regulation applicable to each facility was assigned using a separately constructed matrix relating ZIP code and SIP regulations.

A "coal use" model was developed which relates the energy requirement taken from the facilities file to the quantities of raw coal in the reserve and to the quantities of coal that could be made available by application of various coal cleaning processes to meet the prescribed $SO_2$ emission standards. The coal quantities were obtained from the RPAM model. The analysis was by region, with facilities in a region using coal produced in the same region, and for the entire U.S. The model produced, for each SIP range, the ratio of the total amount of compliance coal in the reserve, either raw or cleaned by one of eight processes, to the current annual demand. This ratio is, in effect, the years of availability of compliance coal for each SIP at the current annual rate of consumption.

As an example of the results obtained, four bar charts are shown in Figure 1 for facilities in the northeastern U.S. using coal from the Northern Appalachian Region. In each chart the ratio of total coal to annual demand (or years of availability) is plotted against annual demand. The width of each bar represents the aggregate demand of all facilities in the region which operate under SIPs in the range shown at the top of the bar, while the height of the bar represents the number of years that compliance coal would be available if used at the current rates. The area of each bar represents the total quantity, in $10^{15}$ Btu, of coal in the reserves of the Northern Appalachian Range which can satisfy the SIPs in the indicated range. The horizontal dotted line shows the years of coal availability, at the current rates, if used without regard to sulfur content, and the area under the dotted line represents the total Btu's of coal in the Northern Appalachian reserve.

The four bar charts show the results for raw coal and for coal produced by three cleaning processes:

(A) Physical coal cleaning using 1-1/2 in. coal separated at 1.6 s.g. (specific gravity).

(B) Physical coal cleaning using 3/8-inch coal separated at 1.6 s.g. if this produced coal to meet the standard; otherwise, separation at 1.3 s.g. was used. An operating penalty of 1 percent energy use in the cleaning process was assumed.

(C) Meyer's process for raw coal with greater than 0.2 percent pyritic sulfur, the level of pyritic sulfur is reduced to 0.2 percent. No sulfur reduction takes place if the raw coal pyritic sulfur level is less than 0.2 percent. A 5 percent energy loss was assumed plus an operating penalty of 2 percent energy loss and a weight loss of 10 percent.

The charts show clearly the usefulness of these coal cleaning processes in producing coal to satisfy SIPs or 1971 NSPS. The chart for raw coal shows that no coal in the region could be burned in compliance with a SIP of 0.32 (New Jersey, industrial, metropolitan areas), and only limited quantities of raw coal are sufficiently low in sulfur content that SIPs of 0.5 to 0.8 could be met. On the other hand, the charts for coal cleaned by Processes A, B, and C show progressively increasing quantities (increases in the shaded areas) of coal in compliance with low SIPs which can be produced by these cleaning processes. Results of this type were produced for eight real or hypothetical coal cleaning processes, for six regions, and for the entire U.S. These results show how valuable coal cleaning is as a means of satisfying SIP regulations and 1971 NSPS.

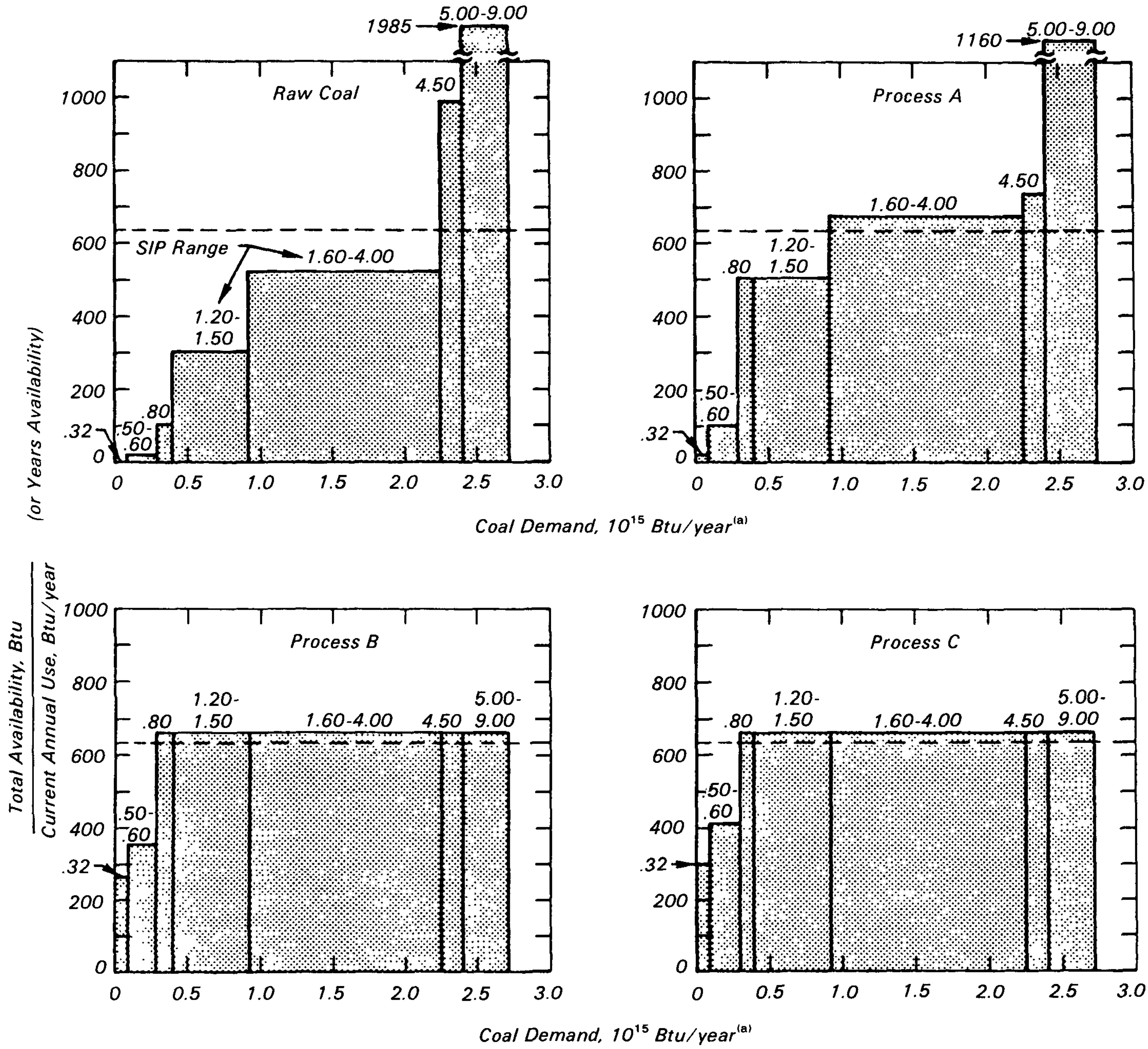
## Cost Comparisons

A comparative analysis was conducted of the current technologically feasible $SO_2$ emission control methods: naturally occurring low-sulfur coal, FGD, PCC, and FGD + PCC. The procedure utilized has been (1) to compare and analyze the results of previous studies; (2) to utilize these results and comparisons to develop further more nearly accurate, reliable estimates of direct costs and benefits; and (3) to evaluate the influence of the performance of complete energy conversion systems on the cost and attractiveness of the competing control methods.

In addition to the costs associated with each technology which is traditionally included in a cost analysis, emphasis was placed in this work on identifying and quantifying the benefits of coal cleaning. In the past, these benefits have been largely ignored in comparative cost analyses. The benefits attributed to burning clean coal are: (1) transportation costs are reduced because less coal is shipped due to the increased heating value; (2) ash disposal costs for the utility are decreased; (3) coal pulverizing costs are reduced; (4) benefits paid to the mine operations Pension and Benefit Trust Fund are reduced because fewer tons of coal are shipped from the mine to equal the same heating value; and (5) power plant maintenance costs are reduced by using coal with lower ash and sulfur content. Other indirect benefits to the power plant associated with burning clean coal result from increased boiler efficiencies, longer plant life, and increased boiler availability.

For an emission control system combining physical coal cleaning and flue gas desulfurization, it is necessary to determine the effects of physically cleaned coal on the FGD system. The benefits to the FGD system result from less flue gas to be treated and, consequently units of smaller size and capacity can be used. Therefore, there will be reduced costs for energy, labor, chemicals, maintenance, supplies, overhead, working capital, sludge disposal, and land requirements for both the scrubber system and sludge disposal system.

For this analysis a single-unit power plant with a nominal capacity of 500




[a]Northeast U S utility and industrial coal demand met by coal produced in the Northern Appalachian region.

***Figure 1.*** *Increase in the quantities of SIP-compliance coal achievable by coal cleaning (see text for definition of processes).*

MW was selected. For each alternative $SO_2$ control method, the system performance, availability, and costs were evaluated. A summary of the costs is given in Table 1.

The results show that, when all costs and benefits to utilities of using physical coal cleaning are properly evaluated, physical coal cleaning has a definite economic superiority, even if supplemental application of another method, FGD, must be used to achieve full compliance with applicable NSPS or SIP emission limits.

The Total Costs column of Table 1 is interesting. First, the systems which include coal cleaning provide the least cost methods of producing electricity. Comparison of the two systems not providing sufficient control to meet 1971 NSPS, Cases 1 and 3, shows that physical coal cleaning of the fuel provides for an overall lower cost of generation than does the use of raw coal (about 2.4¢/kWh versus about 2.5¢/kWh). This results despite the cleaning costs and the loss of some *able 1. *Summary of Costs for Power Generation Using Various Control Modes*

| Number | Case Description | Emission Regulations Met | Operating Hours per Year [b] | Power Plant Costs, ¢/kWh | | | | FGD Costs, ¢/kWh | | Coal Cleaning Costs and Savings, ¢/kWh | | | | Total Costs, ¢/kWh |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Fixed | Fuel | Production | Incremental Maintenance | Fixed | O&M | Fixed | O&M | PCC Savings | PCC/FGD Savings | |
| 1[a] | Raw high-sulfur eastern coal, no FGD (baseline) | None | 7008 | 1 446 | 0.840 | 0.148 | 0.093 | — | — | — | — | — | — | 2.527 |
| 2 | Raw low-sulfur western coal, no FGD | NSPS[c] | 6132 | 1.652 | 1.410 | 0.248 | — | — | — | — | — | — | — | 3.310 |
| 3[a] | Cleaned high-sulfur eastern coal, no FGD | Various SIPs | 7884 | 1.285 | 0.898 | 0.158 | 0.015 | — | — | 0.041 | 0.089 | -0.041 | — | 2.445 |
| 4 | Raw high-sulfur eastern coal, with FGD (4 modules + 1 spare) (Boiler = 0.8, FGD = 0.65/module) | NSPS[d] | 5493 | 1 845 | 0.840 | 0.148 | 0.093 | 0.389 | 0.230 | — | — | — | — | 3.545 |
| 5 | Cleaned high-sulfur eastern coal, with FGD (3 modules + 1 spare) (Boiler - 0.9, FGD = 0 75/module) | NSPS[d] | 7061 | 1.435 | 0.898 | 0.158 | 0.015 | 0.270 | 0.230 | 0.046 | 0.089 | -0.041 | -0.031 | 3.069 |
| 6 | Cleaned high-sulfur eastern coal, with FGD (3 modules + 2 spares) (Boiler = 0.9, FGD = 0.75/module) | NSPS[d] | 7569 | 1.339 | 0.898 | 0.158 | 0.015 | 0.282 | 0.230 | 0.043 | 0.089 | -0 041 | -0.031 | 2.982 |

*(a) Not in compliance with NSPS promulgated December 23, 1971 (36FR24876).*
*(b) Based on postulated availabilities.*
*(c) Only 1971 NSPS calling for maximum emissions of 1.2 lb/$SO_2$/$10^6$ Btu.*
*(d) Either 1971 or 1979 NSPS, but greater scrubber capability would be needed to meet the 1979 NSPS. Differences in costs of scrubbers to achieve higher $SO_2$ removals have been ignored. A more rigorous treatment has been provided by Kilgroe (1979).*

Btu's, because of the greater, more efficient utilization of the generation facility and a consequent lower fixed charge per kWh generated.

Second, for the systems which achieve full compliance with 1971 NSPS, the two cases which incorporate physical coal cleaning with FGD are by far more economical (about 3.0¢/kWh for Cases 5 and 6 and about 3.5¢/kWh for Case 4 for FGD alone).

Finally, the example shown for the use of low-sulfur western coal (Case 2) indicates no cost benefit in comparison with any other case except Case 4; i.e., FGD not in combination with physical coal cleaning. The cost here is about 3.3¢/kWh for Case 2 versus about 3.5¢/kWh for Case 4. This result tends to confirm the conclusion made by some utilities that the use of low-sulfur western coal to achieve compliance with the 1971 NSPS would cost less than the use of FGD.

In summary, the use of physical coal cleaning with FGD is significantly more attractive economically in the examples presented than either FGD alone or western low-sulfur coal. It is evident, also, that in any case where physical coal cleaning alone will permit compliance with 1971 NSPS or with SIPs, its use will provide the lowest cost solution. However, in any specific case, the comparisons must be evaluated independently to account for site-specific variables such as coal composition, transportation requirements, and plant utilization.

## Barriers to Expanded Coal Cleaning

A number of factors which might inhibit expansion of the use of coal cleaning were examined. The common theme encountered is uncertainty. Investments in coal cleaning facilities may be deferred because of uncertainty regarding technical details, emission limits or other environmental regulations, or the ultimate profitability of the investment. The general types of barriers and examples of each are:

(a) Technical
- Data needed to relate washability results to commercial plant performance are lacking.
- Improved quality control techniques are needed.
- Better techniques for separation of fine pyrite need to be developed and proven.
- More extensive data on benefits accruing to a boiler burning cleaned coal need to be obtained.

(b) Environmental
- Solid waste disposal requires control of leaching, fugitive dust emissions, and fires.
- Trace elements are concentrated in the refuse, a benefit with respect to the clean coal product, but they require careful waste disposal.
- Land-use options in the immediate area of the cleaning plant are restricted.

(c) Transportation
- Increased coal use will place stress on the transportation system.
- Coal cleaning will help in mitigating transport problems because of the higher Btu content per unit weight of cleaned coal.
- However, accelerated use of coal cleaning could add to the problem in certain areas in which cleanable coals predominate. For example, traffic from the Appalachian region to the middle Atlantic states would be expected to increase disproportionately as coal cleaning expands.

(d) Institutional
- PCC benefits may not be fully appreciated by potential investors.
- Commercial practicality of coal cleaning as a sulfur removal strategy may not be viewed as adequately demonstrated.
- Uncertainty exists regarding the Public Utility Commission's

attitude toward allowing fuel cost pass-through if a utility were to invest in coal cleaning facilities.

(e) Economic and Social
- Coal cleaning does not now qualify for tax purposes as a pollution control investment.
- Investment in coal cleaning may be deferred because of the possibility that, to increase production of indigenous high-sulfur coals, SIPs may be made less stringent. This would reduce the markets for cleaned coal.
- Capital may be difficult to raise because of the lack of information on commercial coal cleaning operations.

(f) Regulatory and Legislative
- Uncertainties exist regarding enforcement of SIPs, averaging periods, and variances.
- Uncertainties exist surrounding the permanence of any $SO_2$ emission standard.
- Uncertainties exist regarding air and water pollution standards for coal cleaning plants.
- Uncertainties exist concerning legislative incentives for the industrial use of coal.

## Conclusions

Coal cleaning is an effective, efficient, and economical $SO_2$ emission control technique. Accelerated development and expanded deployment of the technology must be instituted.

- Physical coal cleaning is the least-cost method of reducing sulfur emissions from the combustion of coal.
- Coal cleaning, with the proper selection of sources and users, can produce coal which can be burned in compliance, over a period of almost 200 years, with SIPs and with 1971 NSPS without additional control.
- The quantity of compliance coal can be increased substantially by coal cleaning. For example, in the eastern midwest region the amount of compliance coals capable of meeting SIP requirements in the range of 3 to 6 lb $SO_2/10^6$ Btu can be doubled by the use of physical cleaning techniques.
- Coal cleaning followed by flue gas desulfurization can be an attractive strategy for meeting the percentage removal requirements of the 1979 NSPS. Because credit is allowed for sulfur removal prior to combustion, cleaning would permit the scrubber to operate at a lower, more readily achievable, sulfur-removal efficiency and still achieve the required percentage sulfur removal.
- Preliminary data indicate that coal cleaning reduces the variability of sulfur in the product coal. If this is substantiated, cleaned coal would be preferred over raw coal. Reduced variability would allow scaling down of FGD capacities designed to take sulfur variability into account in meeting a percentage reduction.
- Cleaned coals have lower concentrations of many of the trace elements because of selective concentration in the refuse component.
- Substantial attendant benefits of coal cleaning include reduced transportation costs, reduced boiler maintenance costs, reduced ash disposal costs, and enhanced boiler availability. When all benefits are quantified for a given facility, the net cost of coal cleaning will be less than zero in many cases.
- Many of the barriers to increased use of coal cleaning are due to uncertainties regarding technical questions, the level and type of environmental regulations (now and in the future), and the profitability of investment in coal cleaning.

## Recommendations

This study leads to two basic conclusions: first, that widespread use of physical coal cleaning would benefit the entire nation; and second, that action by the Federal government is the only way to remove the barriers blocking expanded use of this method of sulfur control. Recommendations for technical research and development and for coal cleaning policy are based on these conclusions.

### Recommended Research and Development

Although coal cleaning has been employed for years for ash removal and for Btu enhancement, its use specifically to remove sulfur is new. Adequate ash removal technology exists, but coal cleaning for sulfur removal remains an art which must be advanced by applying and improving the present technology establish proven plant designs for sulf removal. The non-uniform nature coal underlies the major technic problems to be overcome. As co characteristics differ, their separatio properties differ, and so does th optimum approach to cleaning. In th technical area, EPA and/or DOE shou initiate the following research ar development programs.

(1) *Coal Washability Data.* Ongoir experimental determinatior directed at obtaining addition data on coal washability must b greatly accelerated and expande The washability data availab now are extremely limited i comparison to the unteste reserves. Additional data ar required because results fro one seam cannot be applied t another. Correlational technique should be further explored in a effort to minimize the exper mental data needed for eac seam.

(2) *Equipment Performance Correla tions.* Correlations of performanc for individual items of equipmer are needed to permit optimur design and control of cleanin plants. Such correlations can b obtained only by analysis c experimental performance dat recorded under a variety of cor ditions with many different coals Much of the experimental dat still need to be obtained.

(3) *Plant Simulation Model.* A com prehensive coal cleaning plan simulation model would permi the optimization of plant design and plant operations. This mode when computerized, must b capable of processing input concerning a broad range of coa characteristics, the range o cleaning techniques available the performance of individua types of equipment when presente with different coals (as exempli fied by their washability), an costs of various plant designs.

(4) *Advanced Separation Techniques.* Development of advanced sep aration designed specifically fo sulfur removal must be acceler ated—including research on fine and ultrafine particle separatior and on chemical cleaning tech niques for organic sulfur removal The goal of these developments

must be maximum sulfur removal at a specified cost or minimum cost at a specified level of sulfur removal.

(5) *Process Control System and Sensor Development.* Systems for the control of cleaning plant product quality must be developed. Sensors and control systems are both necessary. Sensors detecting changes in feed coal characteristics and product coal quality should provide inputs to the control system, perhaps based on the computer simulation model, so that equipment control set points would be changed. These changes in set points would be designed to moderate product quality variations.

(6) *Test Facilities.* Commercial coal cleaning test facilities should be built to develop advanced separation techniques and flow circuits. Analysis of the equipment and circuit performance at these plants will provide much needed engineering and cost data.

(7) *Variability of Sulfur in Coal.* Studies should be conducted to determine the sulfur variability in product coal as compared with the feed coal. Using these collected data, statistical studies must be performed so that intelligent selection can be made of sulfur levels of coal to be burned in relation to the emission levels permitted. Two candidate statistical approaches, traditional and geostatistics, giving contrasting results, are currently available for study.

(8) *Boiler Performance Data.* Existing data must be collected and additional experimental data must be generated on the effects of cleaned coal combustion on boiler performance. Only by analyzing such data may the potential benefits accruing from the burning of cleaned coal on boiler availability, maintenance, capacity, efficiency, etc., be evaluated.

(9) *Environmental Control.* Demonstrations of acceptable practices for solid waste disposal and for the control of pollutants in water effluents are needed. Few data are available on trace element migration and control and on infiltration of pollutants into groundwater. Acceptable practices should be developed and demonstrated in conjunction with plant demonstrations.

## Recommended Policy Approaches

To promote widespread use of coal cleaning, the Federal government could adopt one of the following approaches:

Policy A: Provide growth in the use of coal cleaning by ensuring that the technology is competitive in the U.S. marketplace and by assuring coal users that it is a sound investment.

Policy B: Require that *all* coal be cleaned before it is burned anywhere in the U.S.

*Policy A.* Assuming a successful outcome of the technical initiative just outlined, the private sector will make investment decisions on the basis of "bottom-line" economics. In general, institutional, legislative, and regulatory barriers are barriers because they have an impact on the economics. Therefore, a policy to ensure competitiveness is needed to promote rapid deployment of the technology.

Initiatives designed to implement Policy A could include:

(1) *Promote Regulation Stability.* Federal and state EPA's could remove the uncertainties regarding both $SO_2$ emission regulations and environmental regulations pertaining to coal cleaning plants. The private sector could then make investment decisions based on known costs of compliance without fear that future changes would cause the investment to become unprofitable.

(2) *Provide EPCA Loan Guarantees.* The Federal government could provide loan guarantees under Section 102 of the Energy Policy and Conservation Act (EPCA) for building centralized coal cleaning facilities to be used for processing the output of many small coal producers.

(3) *Appropriate Plant Construction Funds and Permit Management-Fee Plant Operation.* Congress could appropriate funds to construct coal cleaning plants to be operated by industry on a management-fee basis in a manner similar to that used by the Reconstruction Finance Corporation in the building of synthetic rubber plants during World War II. Provision could be made for the private sector to buy the plants once profitable commercial operation is demonstrated.

(4) *Reduce Tax or Subsidize.* Congress could legislate provisions for a lower income tax rate or for direct subsidies based on the percent of sulfur removed prior to the sale of the coal.

(5) *Permit Pollution Control Investments for Tax Purposes.* The Internal Revenue Service—through Congressional intervention if necessary—could reverse their position so that coal cleaning plants would qualify as pollution control investments for tax purposes. Arguments for revision can be based on EPA's move to credit precombustion sulfur removal toward an $SO_2$ percentage removal standard.

(6) *Allow Unit Train Rates for Rail Shipment.* ICC regulations could be changed to allow rail shipment of cleaned coal at the same rates as uncleaned coal. Permit the shipment of less-than-unit train lots of cleaned coal at unit train rates.

(7) *Establish Public Information Program.* EPA should create a task force to establish a top-notch information program to educate utilities and potential industrial users about the benefits of burning cleaned coal.

*Policy B.* As an alternative to Policy A, Policy B would require all coal to be cleaned prior to combustion. Congressional action would be necessary to mandate nationwide coal cleaning, of course. Coal cleaning as now practiced could be used in the implementation of this policy. However, the full benefits of coal cleaning in reducing both $SO_2$ emissions and electric power generation costs will be realized only after the recommended research and development programs are successfully completed and the results used to optimize the design and operation of coal cleaning plants.

Either policy has merit:

(1) *Low Cost.* Physical coal cleaning is the least-cost method for reducing $SO_2$ emissions.

(2) *Quick Results (No Retrofitting).* Cleaned coal could be used immediately in all existing facilities. There are essentially no "retrofit"



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problems. Thus, decreased $SO_2$ emissions can be achieved as soon as cleaned coal becomes available. In contrast, the NSPS for coal fired boilers will not materially affect total $SO_2$ emissions until a significant fraction of existing boilers are retired and replaced.

(3) *Significantly Reduced $SO_2$ Emissions.* State-of-the-art (ash removal) cleaning methods could reduce uncontrolled emissions of $SO_2$ from coal-burning facilities by an estimated 32 percent if all coal were cleaned. Even greater reductions would be anticipated as economically feasible advanced processes capable of removing organic sulfur are developed. Scrubbers, operating at 85 percent sulfur-removal efficiency, would have to be installed on 38 percent of the entire coal-burning capacity to achieve an equivalent reduction in $SO_2$ emissions.

(4) *Extended Boiler Life, Etc.* The use of cleaned coal is expected to extend boiler life, improve efficiency, and increase the capacity factor—all significant conservation, operation, and cost benefits.

## Reference


Kilgroe, James D., "Combined Coal Cleaning and FGD," Industrial Environmental Research Laboratory, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, Presented at: Symposium on Flue Gas Desulfurization, Las Vegas, NV, March 1979.


## *Metric Equivalents*

EPA policy includes use of metr units in all its documents. Although th Summary uses nonmetric units f convenience, readers more famili with the metric system are asked to us the equivalents below.

| Nonmetric | Metric |
|---|---|
| 1 Btu | 1055.06 J |
| 1 in. | 2.54 cm |
| 1 lb | 0.45 kg |


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*The complete report, entitled "Use of Coal Cleaning for Compliance with $SO_2$ Emission Regulations," (Order No. PB 81-247 520; Cost: $30.50, subject to change) will be available only from:*

*National Technical Information Service*
*5285 Port Royal Road*
*Springfield, VA 22161*
*Telephone: 703-487-4650*


*The EPA Project Officer can be contacted at:*

*Industrial Environmental Research Laboratory*
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