PROCEEDINGS

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Ninety-Eighth Year

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Richard R. Shockley

PRESIDENT 1989-90

THE COAL MINER

TRUE – he plays no grandstand role in life
But his importance is vital, great and just:
For without his toil in earth's caverns deep,
Civilization would soon crumble into the dust.
AD 1964 From his poem – Vachel Davis

(Dedicated on State Capitol Lawn, Springfield , Illinois, October 16, 1964)

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PROCEEDINGS
OF THE ILLINOIS MINING INSTITUTE

Ninety-Eighth Annual Meeting
Mt. Vernon, Illinois
Thursday and Friday, September 27-28, 1990

The opening session of the 98th Annual Meeting of the Illinois Mining Institute was convened at 2:00 P.M., Thursday, September 27, 1990, in the ballroom of the Ramada Hotel. Richard R. Shockley, President of the Institute, presided.

Richard Shockley: I call to order this 98th Annual Meeting of the Illinois Mining Institute. My name is Richard Shockley. I go by the name of Dick. I'm with the Illinois Department of Mines and Minerals working very closely with those good guys with the white hats. Their motto is: "I'm here to help you." You've heard that many times. But this afternoon and tomorrow, I hope that all of us are wearing white hats because our purpose for being here is to share with each other the experiences and things we have learned over the past year; things that are going to help us to improve the mining conditions, situations, and the mining industry of Illinois, hopefully this coming year. Not only are we here for the technical aspect, but for the good times—the fellowship part of this program.

Of course, tonight we have our social hour out here in the back from 5:00 to 7:00. We look forward to your being there. Then at 7:00, our dinner-dance. If you have not purchased tickets for the dinner-dance tonight, make sure that you get out to the registration desk and pick up tickets. They have a dynamic band here. The first time we've contracted, but they say they are dynamic. So if you don't believe it, come out and try them; see what you think.

Tomorrow at noon, we have a good program lined up. Our a speaker, Ed Krug, formerly with the Illinois Water Survey in Champaign, has actively been involved in the acid rain research under the U.S. EPA National Precipitation Assessment Program which was supposed to provide guidance for the federal government to develop acid rain strategies. All of us in the mining industry know that their strategies were handed down in their decisions before the results of this study were finished. Many of us have heard parts of the research program's results, but we will hear first-hand tomorrow from someone who was directly involved with this, and you may be surprised at some of the answers and comments he makes about this report.

I'm also pleased to remind you that this is the 100th anniversary of the UMW of America. Jerry Jones of the District 12 asked that we take note of this today.

Along with our agenda for tomorrow, we are going to have an early session at 8:30 in the morning. That's not a very early hour for you coal miners. SIU has put together a slide presentation entitled "Illinois Coal: Stubborn Treasure." Some of you may have seen this at the Holmes Safety meetings or mine rescue meetings. I think you will find it very interesting. It is a program they put together to make people aware of the importance of the coal industry to the State of Illinois and why it is vital for us to maintain an ongoing coal industry in Illinois. Our business session starts at 9:00 o'clock. We need more of you here. Two years from this meeting will be our 100th anniversary also. We are planning on having a little different format for the program in 1992. This requires some input from you people. So attend our business session in the morning at 9:00 o'clock. Come down at 8:30, have a cup of coffee, watch the slide show, and we will move right into our business session.

If you have not bought tickets for our luncheon tomorrow, please do so right away. The hotel must know tonight how many we will be serving. A good program is lined up for this afternoon and tomorrow morning.

We are fortunate to have Mr. Dan Hunter as our program chairman. To make sure I do not take away from his time and the four papers we have to be presented here today, I would like to turn this session over to Dan Hunter, our program chairman.

Dan Hunter opens the Thursday afternoon Technial session.

TECHNICAL SESSION

Dan Hunter: Thank you, Dick. Our technical session today consists of four papers. Each speaker will be talking for 20 to 25 minutes and then we would like to open it up for questions to the audience. You have two choices: either speak up loudly or come up to the microphone so that we can hear the questions, and then the speaker may want to rephrase the question because sometimes other people may not be able to hear it. Then he will answer the question.

We have a variety of topics today. Our first speaker has his B.S. degree from the Hindu University in India and his master of mechanical engineering and an MBA from the University of Missouri, Rolla . He works with Pro-Mac systems of the B.F. Goodrich Company, and the title of his speech explains a little bit about his background and also tells you what he is going to be talking about. The speech title is "Prevention of Water Pollution Problems in Mining Operations: Bactericide Technology." So, I would like at this time to welcome Vijay Rastogi.

Vijay Rastogi: Thank you, Dan. Thank you also to the Institute and Heinz Damberger for inviting me to make this presentation.

Speakers of Thursday afternoon Technical Session. Seated left, Robert A. Bauer; right, John Brown. Standing left, Visjay Rastogi; right, William Schrand.

PREVENTION OF WATER POLLUTION PROBLEMS IN MINING: THE BACTERICIDE TECHNOLOGY

VIJAY RASTOGI

Business Manager, ProMac® Systems
The BFGoodrich Company
Akron, Ohio

ABSTRACT

In pyritic environments, the bacteria *Thiobacillus ferrooxidans* catalyze acid formation by increasing the oxidation rate of pyrite by a factor of one million. This acid solubilizes metals and pollutes adjacent streams and lands. Bactericide sprays during mining and waste disposal operations attack the source of the problem by preventing acid formation and metals solubilization. Used in conjunction with current water treatment systems, bactericides can dramatically reduce operating costs. Controlled release bactericides contribute to successful reclamation by providing assurance against revegetation failure and post-reclamation water quality problems that can necessitate perpetual water treatment. While inhibiting *T. ferrooxidans*, these organic compounds aid in the establishment of beneficial heterotrophic bacteria which support vegetation. These conditions continue to persist after the bactericide is depleted from the controlled release system. Case Studies I and II show that bactericides inhibit acid generation during hard rock and coal mining operations, and they are cost effective. Case Studies III and IV illustrate the improvement in water quality and vegetation after reclamation when controlled release bactericides were used. Economic analyses show cost benefits are achieved when controlled-release bactericides are part of the reclamation plan.

INTRODUCTION

Bacterial catalysis of sulfide oxidation in coal, coal waste, waste rock, mine tailings and sulfide ores has been well documented (Beck et al., 1968 and Schnaitman et al., 1969). Anionic surfactants, organic acids, and food preservatives have been extensively used (Onysko et al., 1984 and Tuttle et al., 1977) to control the activity of the iron and sulfur oxidizing bacteria *T. ferrooxidans*. Kleinmann and others (1981) showed that anionic surfactants are the most economical inhibitors of *T. ferrooxidans* activity. They are extremely effective bactericides at low concentrations and low pH values and are themselves biodegradable (Dychdala, 1968). The four case studies of commercial applications show that bactericides can be effectively and economically integrated into mining operations, waste disposal procedures, and site reclamation.

SITE EVALUATION

All sites are evaluated to determine if bactericide treatment is needed and if the proposed treatment is an economical option. Diagnostic information includes topography, hydrology, geology, mineralogy and microbiology data. Sulfur forms and acid-base account data determine acid-producing potential (Sobek et al., 1978) and provide a basis to determine cost of conventional treatments for comparison. Lime requirement measurements (Sobek et al., 1978) are needed to determine the amount of neutralizers required to handle existing acid conditions at reclamation sites. No large quantities of lime are required to neutralize potential acidity because the bactericides prevent further acid formation.

Microbiological enumeration tests of the site material are determined using a 9K media (Horowitz et al., 1988). Incubation and column leach tests (Shellhorn and Rastogi, 1984) are used to assess the bactericide's effectiveness in controlling acid production in the particular site material and to set the dosage requirements. Table 1 and figure 1 show site qualification data generated during the site evaluation of a silver waste rock dump. Table 2 and figure 2 illustrate pre-qualification data from a coal refuse disposal site.

ACTIVE OPERATIONS

The use of bactericides during mining and waste disposal operations can minimize acidity, sulfates and metals in runoff water. This improvement in water quality leads to reduction in the costs of neutralization chemicals, sludge removal and disposal, equipment maintenance, energy, and personnel (Benedetti et al., 1990). If the decision to use bactericides as an integral part of water quality control is made during the design and permitting phases of mining, the total capacity of a water treatment system can be reduced, resulting in considerable savings in up-front capital expenditures.

The most common use of bactericides in active operations is a periodic surface spray of the coal refuse pile, coal stockpile, waste rock dump, etc., using a hydroseeder. Another method used at coal preparation plants is an automated spray bar system to apply the bactericide directly to the coal or coal waste as it leaves the processing plant via the conveyor belt system. The first method is the most flexible and requires a hydroseeder with a crew of two that costs \$600 to \$900 per day. The second methods carries an up-front cost of \$4,000 to \$7,000 for equipment and installation. The hydroseeder method was used in both situations because of its flexibility and low cost.

Table 1. Pre-qualification data from a silver mine.

Paste pH	Sulfur Forms (%)				$CaCO_3$ Equivalent (Tons/ 1000 Tons of Material)	
	Total	Sulfate	Sulfide	Organic	Acid Potential	Neutralization Potential
5.0	0.486	0.119	0.365	0.002	11.4	0.91

Lime requirement = 5 tons/hectare
Bacterial populations = 30,000-300,000/mL of extract

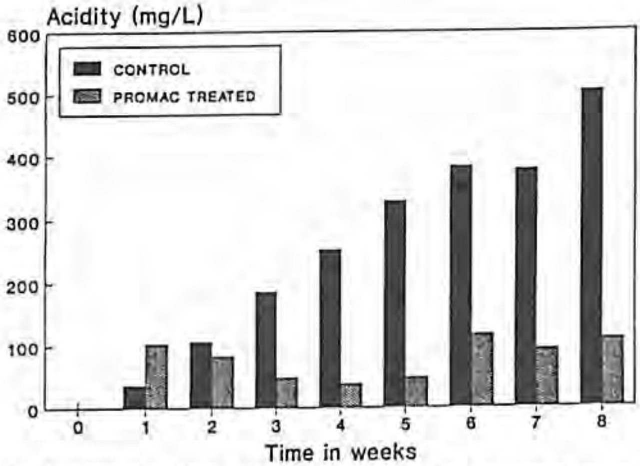

Figure 1. Acidity data from silver mine waste rock column leaching.

Table 2. Pre-qualification date from a coal refuse disposal site.

Paste pH	Sulfur Forms (%)				$CaCO_3$ Equivalent (Tons/ 1000 Tons of Material)	
	Total	Sulfate	Sulfide	Organic	Acid Potential	Neutralization Potential
7.4	7.000	0.390	6.200	0.410	193.75	12.56

Lime requirement = 1 ton/hectare
Bacterial populations = Tested after inoculation

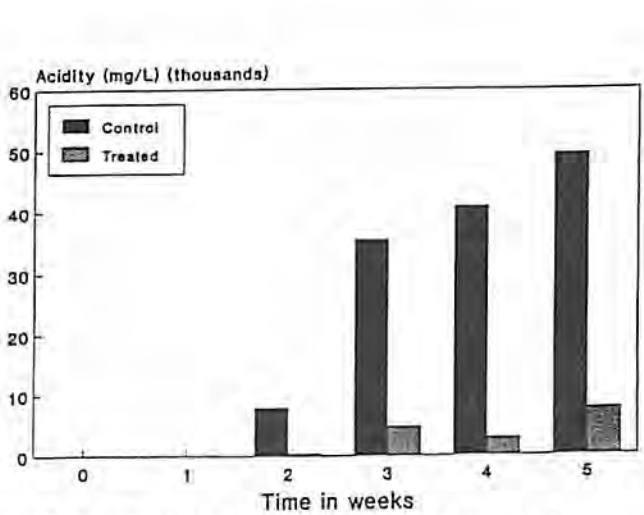

Figure 2. Acidity data from coal refuse incubation study.

Case I: A Silver Mine Operation

Current U.S.A. open-pit silver mining generates large quantities of waste rock that must be properly handled and disposed. All waste rock is placed into a previously mined pit as backfill. The pit is usually backfilled to the top, graded, and revegetated. Pre-qualification testing showed that the waste rock contained metal sulfides (mostly pyrite) capable of a long acid generation period. The waste rock had a sulfide-sulfur content that ranged from 0.1 percent to 1.7 percent and tested positive for *T. ferrooxidans* populations. Water quality data for the outflow at an older refuse disposal area in late 1988 was pH - 3.6 to 4.8, acidity—not measured, and sulfates—1780 to 2170 mg/L.

The initial bactericide application took place on October 18, 1988, using a 37,800 liter water truck with wing spray bars. Subsequent applications were identical to the initial application. Because of the climate, all exposed waste rock was sprayed after the snow melted in the spring and before the snow accumulated in the fall. Between these two dates, the disposed waste rock was treated at the completion of each 18.3 to 30.5 meter lift.

Two "nests" of lysimeters were established in an area of untreated waste rock and in an area of ProMac treated waste rock. Water samples were obtained when a sufficient quantity of soil moisture had been collected in each lysimeter. There has been improvement in water quality parameters in the bactericide treated waste rock after the first treatment.

Analysis of water samples obtained from lysimeters in the untreated area showed the pH - 4.2, acidity - 2541 mg/L, and sulfates–1001 mg/L. This water quality in the plant root zone would have a deleterious effect on site vegetation and the returning groundwater table. Water quality data from the treated area showed pH - 5.6, acidity - 182 mg/L, and sulfates–297 mg/L. This type of water quality would not kill vegetation and would not be as polluting to the groundwater as the water from the untreated area.

Costs and economics. The cost of five bactericide applications over a 15-month period to the active waste rock disposal area (10.2 ha and 1,484,000 tons of waste rock) is: (1) Bactericide: $19,950; (2) Water truck: $500; (3) Operator: $240; and (4) Water: $100; giving a total cost of $20,790.

The data in table 3 illustrate the daily and yearly cost savings in chemical costs based on this water quality improvement and an estimated flow of 6.3 L/s for the three most common neutralizing chemicals. The cost savings are much greater when associated savings are added. Associated savings include manpower to monitor and maintain the treatment system; electric power necessary to drive the pumps and chemical-feed machinery; and maintenance costs of sedimentation and treatment ponds including sludge removal and disposal. As bactericide treatment continues, the cost savings can be expected to increase.

Table 3. Cost savings at silver mine operation.

	Cost/day		Extrapolated chemical cost savings/year
Reagent	With bactericide	Without bactericide	With bactericide
Caustic Soda	$40	$554	$167,660
Soda Ash	26	363	103,050
Hydrated Lime	10	136	26,050

Case II: A Coal Refuse and Ash Disposal Area

This site receives fly ash and bottom ash from an electric power generation station and coal refuse from the coal preparation plant that supplies coal to the generating station. The site is being built in two stages, with Stage I previously completed and Stage II now in use. As the disposal site grows in size, more pyritic materials are exposed to surface water infiltration and runoff.

The pre-qualification testing showed that both ash and refuse contained sufficient pyrite (ranging between 0.2 to 6.2 percent) to generate acid. Stage I of this site had been constructed at an earlier date and left untreated; therefore, acid sulfate salts had been generated and stored in the refuse. Over time, infiltrating surface water solubilizes the acid salts and leaches them from the refuse. Analysis of the leachate from the disposal area showed the water had a pH of 2.2, an acidity equal to 12,038 mg/L, and a total iron content of 3,500 mg/L. The leachate from the disposal area is collected at a central treatment point where it combines with drainage from the entire station before the water is treated and discharged offsite. The initial bactericide application was made in December, 1988, using a hydroseeder. Subsequent treatments were identical to the initial one and are applied at three-month intervals to all exposed refuse.

Water quality data are collected routinely by the utility from the central treatment point before the water is treated. The change in acidity and iron concentrated in the leachate from the disposal area shows that acidity has dropped to 2,700 mg/L and iron to 710 mg/L (figure 3).

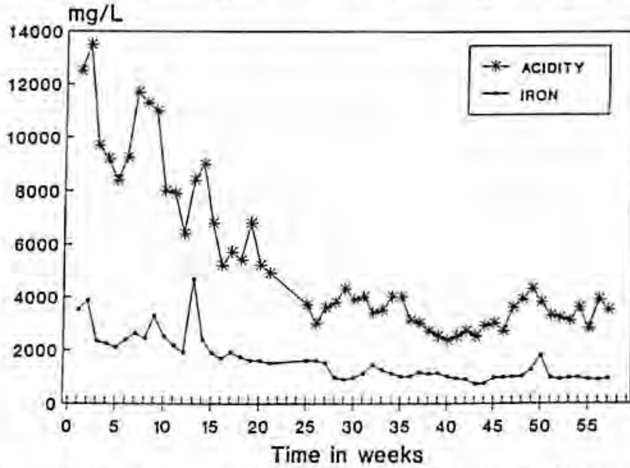

Figure 3. Water quality improvement after bactericide treatment.

Cost and Economics. The cost of a single application to the 8.1 ha refuse and ash disposal area totals $20,000 with bactericide ($18,400), hydroseeder ($1,000), operator ($480) and water ($120) included. The yearly total cost of bactericide treatments is $80,000 for improving the quality of the average daily flow (3.5 L/s) of drainage from the refuse and ash disposal site.

The daily and yearly cost savings (table 4) in neutralization chemical costs are based on the improvement in water quality. The client currently treats all wastewater in a hydrated lime treatment system before it is discharged offsite. The cost savings are much greater when reduction in personnel, electric power, sludge removal and disposal, and maintenance costs are taken into consideration.

Table 4. Cost savings at coal refuse and ash site.

	Cost/day		Extrapolated chemical cost savings/year
Reagent	With bactericide	Without bactericide	With bactericide
Caustic Soda	$641	$2,850	$730,150
Soda Ash	460	2,040	496,820
Hydrated Lime	70	310	7,890

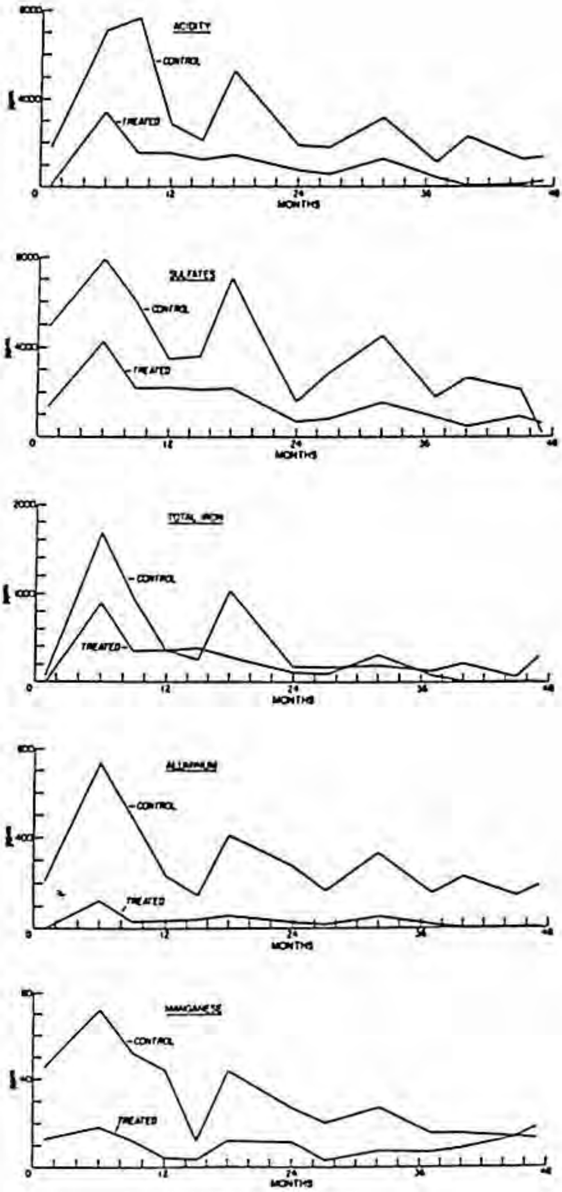

Figure 4. Refuse water quality data from the Route 43 site.

RECLAMATION

Bactericides provide assurance against post-reclamation problems of vegetation failure and against acid discharges. These problems can result in postponement of bond release, yearly site maintenance, and perpetual water treatment. Bactericides have worked effectively with less than 30 cm of soil cover and only enough lime to neutralize existing refuse acidity (Sobek et al., 1990).

The prequalification tests are used to determine a site-specific bactericide dosage consisting of an instantly available spray and controlled release pellets. The entire treatment is normally applied in a single step using a hydroseeder. After the site has been graded but before the soil cover is applied, the appropriate product mix is applied. The bactericides are, therefore, placed in direct contact with the acid-producing material that contains the large population of *T. ferrooxidans* .

Case studies III and IV are two reclamation projects which have been closely monitored for several years. Each of these sites has "control" areas that are identical to the bactericide-treated areas in all respects of site material, lime, soil cover, seeding, fertilizing, etc., except for the bactericide treatment itself.

Monitoring of these sites included periodic water collection from soil moisture samplers (pressure-vacuum lysimeters) that were installed at different locations in all treated and controlled areas. Site inspections, biomass measurements, recording of precipitation and periodic enumeration of bacterial populations in the refuse pile were other parameters monitored.

Case III: Route 43 Reclamation Project, East Springfield, Ohio

This 2.02 ha triangular site was divided into two parts with one part receiving the bactericide spray and controlled release pellets of Generation I configuration. These were rubber pellets with a release life of two years. The entire site was covered with 15 to 20 cm of soil followed by standard reclamation procedures with lime, seed, fertilizer, and mulch as recommended by the Ohio Department of Natural Resources. The site was reclaimed in 1984.

Prequalification tests showed the refuse to have a paste pH less than 3, a pyritic-sulfur of 0.43%, sulfate-sulfur of 0.11%, and organic-sulfur of 0.78%. Pre-reclamation seep water had a pH of 2.7 and acidity of 1,034 mg/L.

Water quality. Water quality data from lysimeters for fours years following reclamation (figure 4) show moisture quality in the refuse about 60 cm below the soil cover. The differences in the individual parameters (acidity, total iron, sulfates, manganese, and aluminum) between the treated and control (untreated) areas are indicative of bactericide effectiveness and its continued longevity beyond the life of the pellets. The treated area maintains consistently improved conditions and stability.

The data summarized in table 5 are the percent reduction in each parameter when the average of all water quality measurements from samples taken out of the four lysimeters in the treated portion of the site are compared with the average of all water quality measurements from samples taken out of the four lysimeters in the untreated portion of the site. The data (table 5) indicate that ProMac treatment has been very successful in reducing all parameters, except for manganese in 1987 and 1988. In the second year, except for total iron, the reductions are not as large as in the first year.

Table 5. Reduction in percent in specific parameters when comparing treated to un-treated areas at Route 43 site.

	Year			
Parameter	1985	1986	1987	1988
Acidity	72	58	97.2	89.0
Specific Conductivity	35	32	67.2	86.0
Total Iron	52	73	92.1	99.6
Manganese	94	91	44.0	15.6
Aluminum	93	89	99.5	98.9
Sulfates	68	58	81.4	57.0

Total iron shows a 21 percent increase in reduction in 1986 and a 40.1 percent increase in reduction in 1987 when compared to 1985.

Microbiology. Heterotrophic microorganisms aid revegetation; therefore, their populations were studied in the bactericide-treated area "topsoil" versus the untreated area "topsoil" on an annual basis. The results of the study indicate that the treated area clearly has more heterotrophic bacteria than the untreated control area, and that the heterotrophic population in the treated area is growing more rapidly. A count of *T. ferrooxidans* populations in the refuse indicate that the treated area has a smaller population and that this difference has been maintained. Figure 5 shows the *T. ferrooxidans* and heterotroph populations in 1989, five years after completion of reclamation.

The ratio of thiobacilli to heterotrophs is more important that the actual populations of *T. ferrooxidans* and heterotrophic bacterial which can vary from year to year, depending on environmental conditions. Horowitz and Atlas (1976) found that specific classes of microorganisms are better presented as a ratio of the total population. Specific classes of bacteria will increase in number as a result of a total increase in the bacterial population. Thus, if the total number of bacteria increases in a specific environment, it is expected that a general increase in every specific group of bacteria will be seen.

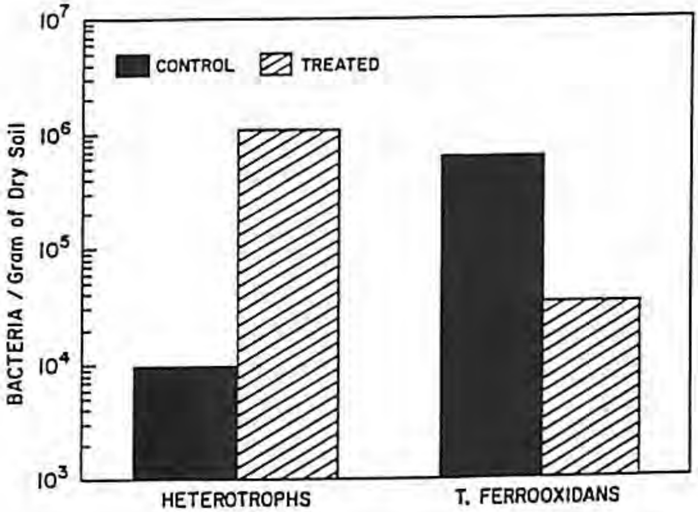

Figure 5. Bacterial populations at the Route 43 site in 1989.

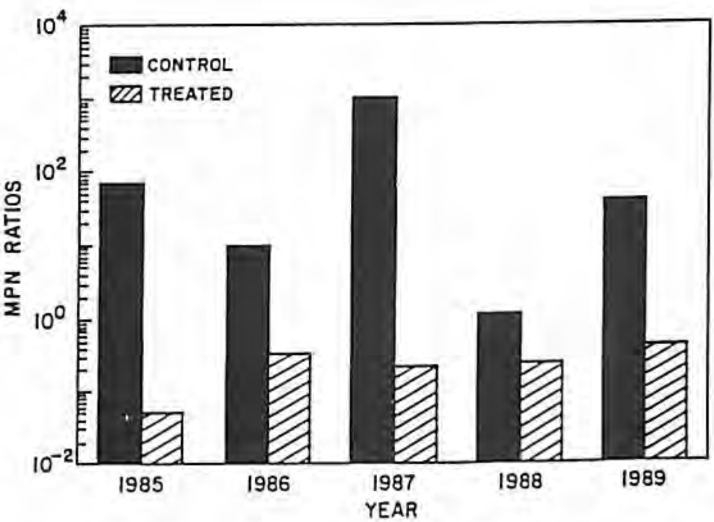

Figure 6. Ratio of *T. ferrooxidans* to heterotrophs at Route 43 site.

The ratios of thiobacilli to heterotrophs for a five-year period (figure 6) make the differences between the treated and control areas very clear. The data indicate a fairly stable and low ratio of thiobacilli to heterotrophs in the treated area. In the control area, the ratios are much higher. The ratio on the bactericide-treated area has always been less than one.

Vegetation. The treated area has a dense vegetative cover along with volunteer legume growth facilitated through nitrogen fixation by the high heterotrophs bacterial population. The control site has lost much vegetation to burnout and soil erosion. Biomass production was measured by running transect lines across the plots. The treated area had a total biomass of 2915 kg/ha in 1989 while the control area only had a total biomass of 315 kg/ha. In 1990, the treated area had a decrease in total biomass to 1,709 kg/ha while the control area increased to 565 kg/ha total biomass.

Case IV: Dawmont Refuse Reclamation Project, Clarksburg, WV

This 14.2 ha site was treated with Generation III plastic pellets with a release life in excess of seven years. The site received 30.5 cm of soil cover after application of the bactericide spray and controlled release pellets. A 0.4 ha area was left as a control. Standard reclamation practices were followed to lime, fertilize, seed, and mulch the site. This site was reclaimed in 1987.

Pre-qualification tests showed samples from this site to have a paste pH of 2.0, a pyritic-sulfur of 15.6 percent, and no neutralizers. The acid-base account showed that the deficiency of neutralizers was 497.87 tons per 1,000 tons of refuse. Seeps from the site had pH values ranging from 2.1 to 2.5, acidity from 2,876 mg/L to 20,160 mg/L with iron, manganese and aluminum concentrations as high as 3,600 mg/L, 290 mg/L, and 1,303 mg/L respectively.

Water quality. Water quality data from lysimeters for 29 months after the site was reclaimed (figure 7) show the treated area has made significant improvements in acidity, sulfates and metals. The control area appears to be subjected to climatic fluctuations from year to year. Overall, metals and acidity in the treated area's refuse moisture have been improved from 75 percent to 95 percent.

Microbiology. The ratio of thiobacilli to heterotrophs at the interface zone serves as a strong indicator for the overall microbial picture of the site. It balances situations such as high or low carbon availability or many other non-specific environmental factors that may affect the overall numbers. In most cases, it can be expected that the ratios of a specific bacterial group to the overall population will stay roughly constant. Total populations of *T. ferrooxidans* and heterotrophs in 1989 at the Dawmont site are found in figure 8.

The ratios of thiobacilli to heterotrophs (figure 9) in the control area increased ten-fold from 1987 to 1988, and very slightly in 1989.

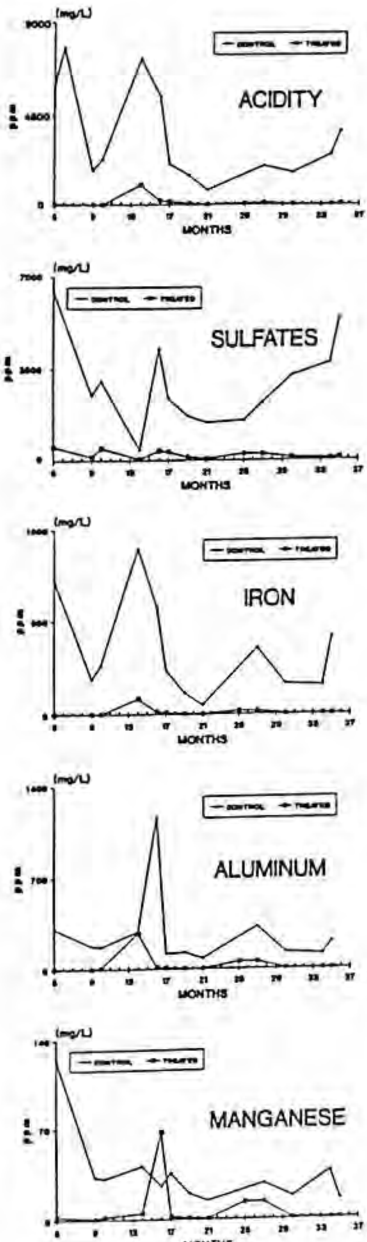

Figure 7. Refuse water quality data from the Dawmont site.

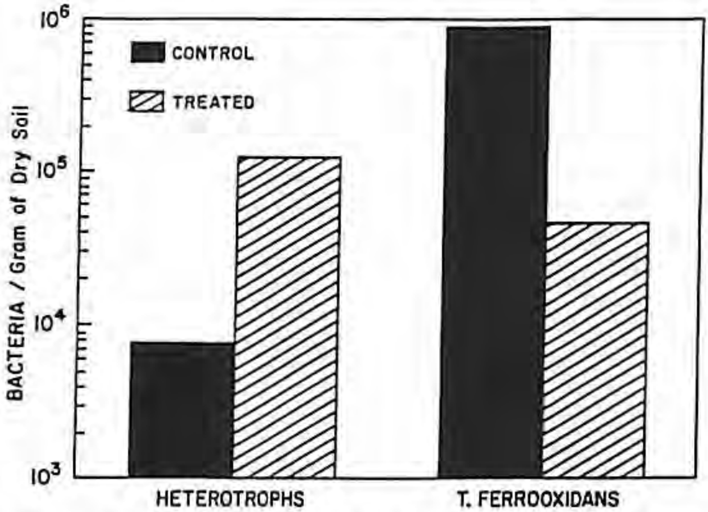

Figure 8. Bacterial populations at the Dawmont site in 1989.

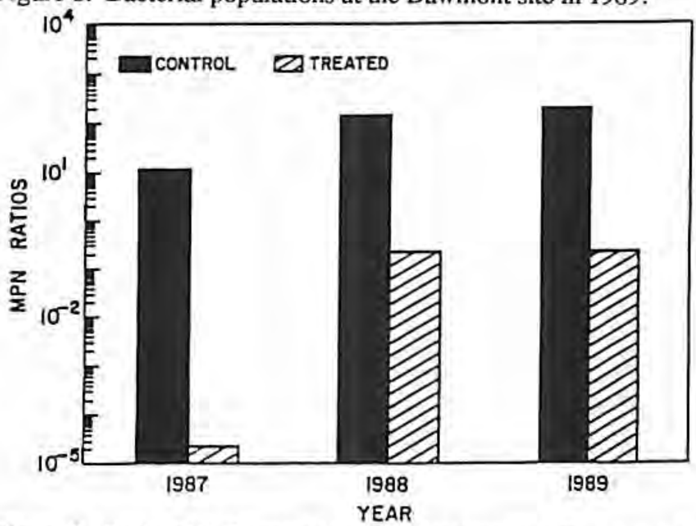

Figure 9. Ratio of *T. ferrooxidans* to heterotrophs at Dawmont site.

In the treated area, ratios were low in 1987, increased 10,000-fold in 1988 and remained the same in 1989. A much lower ratio was expected to be obtained for the treated area in these years. Climatic conditions could be responsible for these unexpected results.

Vegetation. Qualitatively, it is easy to distinguish between the vegetative cover over the entire treated area and the 0.4 ha control area. Biomass production in 1989 was 1,604 kg/ha from the treated area while the control area had only 1,033 kg/ha. Considering the continuing deterioration in the control area, the 1990 biomass data showing greater differences in biomass production was not unexpected. In 1990, the total biomass of the treated area was 4,447 kg/ha while the control area only produced 1,325 kg/ha total biomass.

COST AND ECONOMICS OF BACTERICIDES IN RECLAMATION

The cost of bactericide application is site-specific because the dosage is dependent on numerous factors that are site-specific. Therefore, treatment costs can vary from $3,705 per hectare for a 12.2 hectare spoil area to $5,928 per hectare for a 2.03 hectare site of highly pyritic coal refuse. In most cases, bactericide treatment cost less than 10 percent of the total reclamation price. Cost offsets are available from the reduction in the amount of soil cover and lime needed.

Liming can be drastically reduced because bactericides limit future acid production. Soil cover depth can be reduced to 30.5 cm, which in turn reduces clearing, grubbing, transportation and reclamation costs associated with borrow areas. Bactericides enhance vegetation growth and protect against acid burnout, thereby minimizing site maintenance costs (Rastogi and Sobek, 1986). The data (table 6) show the potential for cost savings with bactericide treatment.

Table 6. Cost per hectare of site reclamation.

Item	Standard Practice	With Bactericides
Site grading	$ 3,700-12,400	$ 3,700- 12,400
Lime	99- 3,000	99- 250
Soil cover	4,950-19,800	2,500- 7,400
Borrow area	1,750- 7,500	850- 2,000
Seeding	750- 1,000	750- 1,000
Site maintenance	1,700- 5,000	500- 1,700
Engineering	1,250- 2,500	1,250- 2,500
Bactericides		3,700- 5,950
Bactericide application		250- 500
Total	$14,199-51,200	$13,599-33,700
COST SAVINGS		4 % to 34%

CONCLUSION

The following conclusions can be drawn from these cases:

- Bactericide sprays are effective in controlling water pollution during mining and refuse disposal operations.

- Bactericides can be the most economical solution during the mining and refuse disposal operations by minimizing water treatment and associated costs.

- Controlled release bactericide systems are economical and effective in improving reclamation quality and probability of long-term reclamation success, including the improvement of water quality in any post-reclamation seeps.

- Bactericide treatments change the microbiology of the site and this condition continues to persist after all bactericides are depleted, thereby returning the site to a stable landform.

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Heinz Damberger: Are these peaks you are getting, sometimes months into a project, related to precipitation? Or, why do you get these sharp bumps?

Vijay Rastogi: Variations seem to be occurring about every twelve months. They occur generally after the winter months, which means that there has been time for acid salts to develop and then the snows melt and you get more water flowing to the site or the acid salts are flushed out.

Any other questions? Thank you very much.

Dan Hunter: Thank you, Mr. Rastogi. As we continue into our technical session, our next speaker currently works for AMAX Coal Company as the Manager of Drilling and Blasting. His background includes being an electrical union man with Peabody as well as coal uses supervisor and drilling and blasting with Peabody. He has a lot of experience in drilling and blasting, and I think you will find his paper very interesting. His talk is: "Drilling, Blasting and Storm Detection." So, I'd like to welcome John Brown, Manager of Drilling and Blasting for AMAX Coal.

John Brown: Thank you, Dan. I want to thank the Institute and Dan Hunter for allowing me to talk to you today. I hope that what I am about to say will be of some interest and maybe educational, or, at least get you thinking. I have two things to talk about today. One of them is entitled "Fire on Board Explosives Vehicle."

DRILLING, BLASTING AND STORM DETECTION: FIRE ON BOARD EXPLOSIVES VEHICLE

JOHN W. BROWN
Manager of Drilling and Blasting
AMAX Coal Co.
Evansville, Indiana

The title of my paper should get the attention of every blaster in this room. It is something that we have thought much about over the years. It is something that we hear about once in a while when it happens to someone else.

We have all heard and read of the tragedy in Kansas City, with the tremendous loss of life and property damage. After reviewing a video of the Kansas City disaster, I decided that I had to do something to insure that the same kind of accident did not happen at the mine where I was working and had the responsibility of drilling and blasting.

I drafted a plan that was approved by division management. With the help of the Mine Safety Manager, we met with outside units of firefighters, police and ambulance units that would respond to our mine in case of a fire and implement our plan. With the cooperation of the outside agencies, we felt that we had a good plan and everyone knew what to do in the event of a fire on board a truck carrying explosives.

When I left this employer and accepted my present position, I saw a need to develop this type of program for each of our mines. This is not always an easy thing to do. The program at one of our mines involves an interstate highway and two airports. This plan took a lot of time to finalize, and at times, we wondered if it was all worth it. Well, I believe it was worth the time, energy and trouble. As a lot of you know, we recently had a fire on one of our trucks. We followed our guidelines and achieved our goals, and we hope that it never happens again. But if it does, we will be better prepared to deal with it based on what we learned from this experience.

This paper will state facts, what action we took and our future plans should this happen again. This paper is in no way to be construed to be used in any manner other than to make each and every one of you involved in blasting think about ways in which you can improve your operations in the area of safety. Some of our ideas are based on fact, and some are based on theories only. Let me quickly run through the format that our mine policies follow to give you some ideas.

First, it tells of the different types of fires; the ones you should fight and how to fight them, and the ones you don't fight. The guidelines give a listing of whom to notify, who is in charge and where the evacuation line falls if any. It also lists which checkpoints the outside fire departments, police and emergency medical people are to respond to in order to meet with mine personnel to discuss how the incident is progressing and to make plans that will deal with the problem and bring it to a safe end. After a mine has its program finalized, the mine invites the neighboring emergency agencies in for a meeting at the mine, at which time aerial maps are given to them showing roads and areas to be blocked or evacuated. They are given a tour of the mine in order to become familiar with roadways, explosive storage areas, blasting areas and the types of explosives and blasting agents used. With this type of preplanning and communication, you have accomplished your desired goal.

We learned some very interesting things with our fire and are instituting some new ideas at our mines that we feel will be beneficial in furthering our efforts in safety.

We had a Ford 8000 truck with a tread Anfo-emulsion bed that was a total loss. There were 2,500 pounds of Anfo which burned for about seven hours, 4,000 pounds of emulsion, which went through some very intense heat, but did not burn or detonate. Some of this product is being analyzed by the manufacturer to try to learn exactly what this product went through. A note on this is a recommendation that you notify all the suppliers of your products in the event of a problem so that they can assist in the proper procedures to follow in disposing of an affected product.

There were four 20-ounce primers and 58 downhole delays that detonated within ten minutes of the start of the fire. Remember, the entire front of the magazine was open and lined with two inch hardwood. The shooters were loading a hole when the fire broke out. Some interesting facts were that the tape melted at 29 feet and the downhole tube was melted and stuck to the auger.

After investigating the fire, we feel that a hydraulic line ruptured, spraying on the hot exhaust or turbo.

Some of our recommendations for the mines to further the safety of the trucks are as follows:

- Use a hydraulic oil which has a high flash point. I have some data on this. If any of you would like it, see me later for a number and manufacturer.

- Use only high pressure hoses and fittings.

- Change hydraulic lines once a year.

- Install automatic fire suppression systems on all trucks.

- Use magazines located above the fender only to store caps.
- Magazines carrying primers must be mounted below fender level with 3/8 inch plate welded to the top, back and sides of the magazine, making them as directional as possible. This gives the bottom and front surfaces the weakest surfaces, hopefully directing the blast down and away from anfo or emulsion storage. We are currently planning some magazine testing to see if this idea will work.

Thank you. Does anyone have any questions?

Question: How susceptible is the computer system to interference from an electro-magnetic storm itself?

John Brown: The biggest thing we found with the computer system was at Delta Mine in southern Illinois. And the thing that bothers that system the most is a hand-held portable radio. When somebody comes through the office area and pulls their radio out and keys it, it wants to make it do silly things. So, we recommended that they put a hand set in there so that they don't pull out their portable radios and key them. Because when you are within 30 or 40 feet of the unit, the hand-held portable radio will make it do weird things. When you are in the middle of a storm and tracking it, you don't want anyone talking in there with a radio.

Dan Hunter: Thank you, John. Mining has some unique opportunities and we have seen where technology has changed in the last few years in the first two papers. But as we continue, our third speaker is head of the Engineering Geology Section at the Illinois State Geological Survey. He attained his B.S. in geology from the University of Illinois at Chicago his master's degree in from the University of Illinois at Urbana. At this time, I'd like you to welcome our third speaker, Bob Bauer, whose topic is going to be: "Illinois Mine Subsidence Research Program: What Have We Learned in Five Years."

Robert Bauer: Thank you very much. If you have been here every time for the past five years, you are probably saying, "Oh, no, not another Illinois Mine Subsidence Research Program talk." But, IMI is one of our forums where we can reach out to the industry and give a presentation and also get feedback from the coal industry.

ILLINOIS MINE SUBSIDENCE RESEARCH PROGRAM: WHAT HAVE WE LEARNED IN FIVE YEARS?

ROBERT A. BAUER and PAUL B. DUMONTELLE

Illinois Mine Subsidence Research Program
Illinois State Geological Survey
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INTRODUCTION

The history of the Illinois Mine Subsidence Research Program (IMSRP) was reviewed in previous presentations to the Illinois Mining Institute (DuMontelle and Bauer, 1985 and1986). The program was initiated in 1984 by the Illinois Coal Association and Illinois Farm Bureau who asked the Illinois State Geological Survey (ISGS) to manage the program. The program has an Advisory Board and a Technical Advisory Committee. Research participants include the U.S. Bureau of Mines (USBM) - Twin Cities Research Center, Northern Illinois University, Southern Illinois University at Carbondale (SIU-C), University of Illinois at Urbana-Champaign, and Northwestern University. Funding is provided by the U.S. Bureau of Mines and by the Illinois Coal Development Board, through the Illinois Department of Energy and Natural Resources.

The overall goals of the program are to 1) maximize coal mining productivity, 2) preserve productivity on undermined farmlands, 3) maximize recovery of coal resources, 4) protect groundwater resources, and 5) provide information/guidelines to both the coal and agricultural industries. The program was set up to address these issues associated with both high-extraction planned subsidence mining and partial-extraction room-and-pillar mining.

The program includes four basic study areas: 1) coal mine floor stability, 2) coal pillar stability, 3) overburden deformation during subsidence, and 4) impact on crop production.

FLOOR STABILITY

Mine floors are studied by Dr. Y. P. Chugh of Southern Illinois University at Carbondale especially relative to their in situ strength. During the past five years, core samples from selected mines were collected for laboratory analysis, tested and the laboratory test results correlated with large-scale in situ tests of floor bearing capacity. Dr. Chugh found a correlation between ultimate bearing capacity of the mine floor and moisture content as well as indirect tensile strength of floor samples (Pula et al., 1990).

A computer model was developed that predicts long-term surface movements over room-and-pillar panels due to failure of soft mine floor. This model, which runs on a main frame computer, was presented to the mining industry last year at the annual meeting of the Illinois Mining Institute (Pytel and Chugh, 1989). This model is being restructured to run on a 386-type personal computer using a Fortran compiler. This will enable most mining companies to use the program. Additional investigations documented the surface and subsurface movements associated with secondary recovery of pillars in a room-and-pillar mining operation (Hao and Chugh, 1990). Theodore Triplett of the U.S. Bureau of Mines - Twin Cities Research Center, has been investigating the theoretical and mathematical aspects of the mechanism of floor failures based on Dr. Chugh's data. Triplett has also constructed physical models to simulate behavior of floor material using various waxes; these produce failure characteristics similar to Dr. Chugh's field findings.

PILLAR STABLIITY

Dr. James Mahar and Michael Hasek of the University of Illinois at Urbana-Champaign have been documenting variations of coal strength and deformation characteristics in relation to sample size and shape. Several coal companies cooperated in obtaining large blocks of coal which were removed from mines in both the Herrin (No. 6) and Springfield (No. 5) Coal Members. These blocks are cut into hundreds of small samples, ranging from 2 to 6 inch cubes and prisms. Preliminary results indicate that strength values obtained in the laboratory do not change significantly between the 4 and 6 inch-size samples.

OVERBURDEN SUBSIDENCE CHARACTERISTICS

The response of the overburden of bedrock and glacial materials to deformations caused by subsidence above longwalls is being studied by several agencies. The authors are directing the study which monitors the fracture development in the bedrock, surface characteristics, and aquifer responses. Dr. Colin Booth of Northern Illinois University analyzes the aquifer responses. Preliminary information shows that the height of the caved zone above the longwall operation is limited, less than 2.6 times the mining height, and that the bedrock and glacial material above the caved zone move essentially as a large mass resulting in the development of very small vertical strain. Piezometers installed in large continuous bedrock aquifers near the top of bedrock demonstrate that water levels decline during subsidence, but recover within about three months. Studies are continuing to investigate the possibility that subsidence causes improvements in the aquifers by fracturing the aquifer. The assumption is that more water can be stored in the fractured media. No changes in water levels or chemistry were observed for wells located in the glacial material above the bedrock.

Several different monitoring methods were used to document bedrock deformations. A sondex/inclinometer arrangement was used at one site and at another site rod extensometers were used. Coaxial cables were installed in grouted boreholes at both sites. Dr. Charles Dowding of Northwestern University and Robert Bauer of the ISGS have been investigating the use of coaxial cables to document the location and shear and tensile movements in the bedrock (Dowding, Su, and O'Connor, 1988 and 1989).

The characteristics of surface subsidence profiles are all within the range of values previously documented throughout the state (Bauer and Hunt, 1982). Only a slightly higher increase in percent subsidence (ratio of maximum subsidence to mined-out height underground) is observed as the ratio of panel width to mining depth increases. Subsidence characteristics and aquifer responses were reported in Brutcher et al. (1990), Van Roosendaal et al. (1990), and Mehnert et al. (1990).

Theodore Triplett of the USBM has been using the subsidence data collected by this program to develop a predictive subsidence model for Illinois Basin conditions, based on the influence function technique (Triplett and Yurchak, 1990).

IMPACTS ON CROP PRODUCTION

Dr. Robert Darmody of the Agronomy Department, University of Illinois at Urbana-Champaign, has conducted studies on unmitigated impacts of high-extraction mining on crops yields, changes in soil structure, temperature and moisture caused by subsidence. This study investigated impacts on crops over both longwall and high-extraction retreat (HER) mining methods. The three-year average reduction in corn yield was 1.8% over HER mines and 4.7% over longwall mines (Darmody et al., 1988).

A separate followup study is investigating the success of mitigation techniques used on subsided cropland. This three year study on mitigated areas indicates that statistically there is no decrease in bean yields compared to unsubsided areas (Darmody, 1990). Corn yields have shown an average reduction of 16 bushels per acre on mitigated soils. Results are very site-specific and some sites have no significant yield differences. These studies are continuing.

ONGOING RESEARCH

Dr. Colin Booth is working on a computer model to predict the changes in aquifers associated with longwall mining. This model will be a valuable tool to predict short- and long-term water level changes resulting from mining.

Additionally, Dr. Chugh of SIU-C and Dr. Heinz Damberger of the ISGS are documenting mine design calculations and geotechnical data being used by the coal mine industry. These data are correlated with in-mine observations on the behavior of the floor, pillars and roof (Chugh et al., 1990)

The U.S. Bureau of Mines, along with members of the University of Tennessee, with additional support from the Illinois Mine Subsidence Insurance Fund and the National Science Foundation, have been constructing different foundation designs to evaluate construction techniques that withstand subsidence deformation (Kane, Bennett, and Drumm, 1990).

Projects are proposed within the next few years to document deformation of the floor-pillar interactions for chain pillars between longwall panels.

DATABASES

Several databases have been generated for the IMSRP. A database developed by Dr. Chugh includes the physical property characteristics of the floor, and mine characteristics. Another database developed by Ms. Billy Trent of the ISGS provides researchers access to a mine subsidence bibliography which now contains over 3,000 entries. This bibliography is periodically published (Trent, Bauer, and DuMontelle, 1988) and a computer search can be requested for specific keywords, or any word(s) that may be found in the citation. The ISGS also has databases on rock mechanics properties of bedrock units and coals, on mine attributes and on other features of coal mining in Illinois.

ACKNOWLEDGEMENTS

The research reported here would not have been possible without the cooperation of landowners who allowed access to their property and the mining companies who allowed access to their underground mines and gave generous assistance.

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M. E. Hopkins: Bob, I have a question about the areas where you had no crop damage. Did you actually have any creation of a depression in those cases or was there none?

Robert Bauer: Yes, that is an overall average for an entire panel operation. First of all, even before mining takes place, there may be contour-closed depressions already there and with subsidence taking place, it just accentuates that. If you go back over some of the worst settings of longwall panels, even in bottom lands, you will find that it is not the entire panel that has stifled growth. There are very localized small depressions. Anyone in the industry now doing mitigation work realizes that you do not mitigate the entire panel. There are areas where you have 90, 80, 70 percent yield reduction over small areas. Our values are based on the entire operation. They do not reflect the industry's mitigation programs in force today. Thank you very much.

Dan Hunter: You know we continue to see changes and ideas. Our next paper is another example. Our speaker is senior environmentalist with AMAX. He is responsible for permitting, forestry, and archeology, and, I trust, he tries to wear and does wear several other hats. He has his B.S. in forestry from Michigan State University and his paper is on "Wetlands: Case Examples." Let's welcome Bill Schrand.

William Schrand. Well it's an hour and a half of papers and 3:30 in the afternoon, I just wonder if I have something useful to say. Well, I think I do. I really definitely do, and I want to say I am really excited about the opportunity of talking to you about incorporating wetlands into mining and mine land reclamation activities.

USE OF WETLANDS IN COAL MINE RECLAMATION

WILLIAM D. SCHRAND

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AMAX Coal Industries
Indianapolis, Indiana

INTRODUCTION

In 1989, President George Bush announced a National Policy of "No Net Loss of Wetlands" on all projects supported by the federal government. In response, the Office of Surface Mining (OSM) has embarked on a campaign to encourage changes in the Surface Mining Conservation and Reclamation Act (SMCRA) rules that would clarify how the wetlands should be considered in final reclamation plans.

The rules have not yet been changed, but OSM and various state regulatory agencies have already approved construction of several types of wetlands based on existing rules. In several cases, the wetlands have resulted in release of all associated National Pollutant Discharge Elimination System (NPDES) and/or SMCRA permit liabilities.

It is the purpose of this paper to provide a brief description of those wetlands and to discuss how they were incorporated into a plan that complied with the governing regulations.

DISCUSSION

There are four major types of wetlands which have been constructed and have resulted in release of all NPDES and/or SMCRA permit liabilities. Together they would represent a complete range of wetlands that exist in nature.

Depressional Wetlands

In undisturbed lands, depressional wetlands are generally found on level landscapes surrounded by another land use such as pasture, forest or row crop. Current SMCRA rules recognize this relationship by allowing for construction of depressional areas, "...if they are needed to retain moisture, minimize erosion, create and enhance wildlife habitat, or assist revegetation, and will not interfere with the approved post-mining land use." Most state programs have adopted this same language.

More important, the Indiana Division of Reclamation has applied this situation in the field, but only in forest and pasture areas. The point of "interference with surrounding land uses" seems to be established at wetlands that are less than one-third acre in size, not have some water that is three feet-deep, are random in occurrence and represent less than five percent of the landscape. Wetlands which have met all of these criteria have been released from bond as an acceptable component of the surrounding land use. Where wetlands have not met these criteria, the state has asked for additional development work or post-mining land use changes to be submitted for formal approval of additional or relocated acres of wildlife post-mining land use.

Most frequently, depressional wetlands will develop naturally as differential settlement of grade spoil leaves small depressional areas on the surface. In many cases, the resulting wetland configuration conforms with acceptable standards. Only if the site is too large will a post-mining land use change be required.

Additional development work, however, may require increasing water in part of the wetland to a depth of three feet. On the other hand, it may involve supplemental planting of wetland plant species. In either case, the cost of supplemental work should be much more economical than either the cost of hauling dirt to fill in entire wetlands or the cost of regrading the surrounding topography to establish an acceptable drainage pattern.

After combining the obvious environmental benefits with the economic savings, it is hard to understand why depressional areas have not received much encouragement from either industry or the regulatory agencies.

Area Wetlands

Area wetlands naturally occur in low-lying areas such as swamps where surface drainage has been restricted by natural land features. Since they are protected by law, it is difficult to get permits to disturb them, particularly for coal mining or other activities that have the potential of permanently destroying their integrity.

There are numerous incidents where small wetlands have been permitted for mining activities, but there are very few incidents where area wetlands over 20 acres in size have been successfully permitted and mined by an organization such as Vigo Coal Company. According to Jim Tolin, their environmental specialist, the only way a permit could be acquired was through close cooperation with various federal and state agencies such as the U.S. Bureau of Fish and Wildlife and the Indiana Division of Reclamation.

In the pre-mining condition, the Buckskin bottoms were a conglomeration of small pothole-type ponds separated by clumps, tongues and rows of trees, swamp brush and aquatic herbaceous vegetation.

After the water depths associated with each of these vegetation types were documented, a reclamation plan was developed to replace the same range of water depths after mining. The primary components were open water greater than 15 feet deep, water two to five feet deep and wildlife areas less than two feet deep. Planned land uses also included forest, pasture, row crop and residential. The 15 feet deep areas were ideally situated for establishment in the final cut. The two to five feet deep areas were much more difficult to establish. The elevation of the graded surface had to be surveyed to guarantee that it would be flooded by the design water level, and islands had to be included in the lake profile. The zero to two feet deep area also required close ground control; however, islands were not intentionally constructed in these areas.

The keys to successful applications and maintenance of the wetland plan are engineered grading and a well-designed containment structure such as a levee or dam with an overflow that can be adjusted to raise or lower the water level. A revegetation plan for all of the wetland areas has not been needed. The shore line (zero to two feet deep) has been invaded by willows, river birch, cattails and numerous other aquatic plants while the deeper water (two to five feet deep) is almost completely covered by volunteer water lilies. Apparently, the seed source for all of the wetland vegetation has been stored in the replaced soil materials or has been carried into the mine site by flood waters from Buckskin Creek.

Today, the reconstructed wetland is under heavy use by Canadian geese and numerous other water fowl and warrant the Outstanding Reclamation Award for 1989 given by the Indiana Division of Reclamation.

Slurry Wetlands

Slurry wetlands are a major adaptation of wetland vegetation to the reclamation of slurry ponds found near coal washing plants. Slurry, the waste product from washed coal, is a random mixture of a coal ash, pyrite, shale and many other earthen materials that are described in several papers already published by various authors such as Jack Nawrot of Southern Illinois University. Until recently, it was thought this material had to be covered with four feet of soil before plant life could be established. Today, it is known that slurry can be used as a medium to support wetland vegetation (Nawrot). This relationship has been further demonstrated in a successful, experimental practice at AMAX Coal Company's Ayrshire Mine.

A detailed description of the project is contained in the paper, "Wetland Reclamation of the AMAX Ayrshire Slurry Impoundment," by Jack Nawrot, D. B. Warburton and Vance Wiram. Essential elements in the development of the wetland included a detailed chemical and physical analysis of the slurry to identify limiting agronomic factors. As in most slurry ponds, a general deposition pattern was identified, which allowed for the surface to be treated in three different ways.

The upland zone was characterized by acid-producing pyritic material so concentrated that the site had to be covered with four feet of soil material before vegetation could be established.

The intermediate zone was characterized by soil chemistry that could be treated with standard agronomic soil amendments. After temporarily lowering the water level, lime and fertilizer were applied at prescribed rates and frequencies. Subsequently, plant materials, selected specifically for their tolerance to wetland conditions, were established. The water level was then returned to its permanent pool.

The water zone is nothing more than part of the slurry pond which was never filled with slurry. Although the slurry fraction that did settle in this area is generally well-suited for direct revegetation, the water depths made the area best suited for a permanent impoundment.

The key to successful application of the treatments and long-term maintenance of the wetlands is a well-designed containment structure such as a dam or a levee with an overflow that can be adjusted to raise or lower the water level.

AMAX Coal Company has found this project to be environmentally desirable and operationally cost effective. The savings in soil replacement costs alone more than offset the costs of analysis and application of soil amendments. Today, the slurry is completely vegetated, blended with the surrounding native vegetation and used by numerous wildlife species including several varieties of water fowl. AMAX's Slurry Wetland Project continues to demonstrate why it was selected for the Indiana Division of Reclamation's Outstanding Reclamation Award in 1987.

Wetland Sinks

In natural conditions, wetlands have been shown to filter natural contaminants from surface water discharges, but it is not until recently that authors such as Greg Brodie and Cindy Britt of the Tennessee Valley Authority and Dave Turner of the Tennessee EPA have demonstrated practical ways of using these natural phenomena to remove contaminants from noncompliance mine water. These findings can be extremely important to a mining operation plagued by pit runoff laden with iron, manganese, acidity, etc., as well as operations plagued with acid mine water seeps after all other surface reclamation activities have been completed.

A unique characteristic of applying this wetland technology to coal land reclamation is determining how much wetland is needed to restore noncompliance mine waters to compliance standards.

The design of wetland sinks requires a detailed chemical analysis and flow analysis of the waters that are to be treated. Based primarily on the concentration and total volume of various water elements that are not in compliance, an estimate can be made of the size and configuration of the wetland needed. These estimates are only a guide to final designs. Current knowledge is not sufficient to predict a more accurate interaction of the wide variety of chemical processes that take place in a wetland environment. However, a typical wetland sink normally has a combination of four processes combined in different sequences to achieve the desired objective: 1) alkalinity is added to change the pH either in an aerobic riffle area or an anaerobic alkaline trench; 2) with proper alkalinity added, the effluent to be treated is passed through shallow water beds of cattails, rushes, reeds, etc., which physically encourages dissolved solids to precipitate out; 3) riffle areas encourage oxidation processes, particularly in waters with low iron contents; and 4) extended still water detention times are provided in deep water finishing ponds to encourage precipitation of dissolved solids such as manganese.

The results that have been achieved by this process have been phenomenal. In several cases, low-pH discharges, heavily laden with iron and manganese have been treated with a wetland system and subsequently released from further NPDES monitoring.

In other cases, the construction of wetlands to receive runoff from active mining operations has eliminated costly applications of calcium, sodium, carbonate, including pit pumpage, and ammonia-based materials. Release from permit requirements, savings in chemical treatment costs, and low cost of wetland construction combine to make wetland sinks one of the most promising technologies in coal land reclamation.

CONCLUSION

Depressional wetlands have been recognized as a desirable and economical component of surrounding land uses. Although they occur as a result of differential settlement, they may require modification to increase their depth or to establish wetland vegetation.

Area wetlands over 20 acres in size have been successfully re-established as part of a surface coal mining operation. Following recommendations from the U.S. Bureau of Fish and Wildlife, the reclamation plan featured construction of predetermined acreage of three different water depths.

The wetland sink is one of the most promising technologies in coal land reclamation. Biological methods which remove unacceptable concentrations of dissolved solids are far cheaper than the chemical treatments currently being used by the coal mining industry.

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Dan Hunter. I want to thank each of our four speakers; they have done a tremendous job. Let's all give them a hand, again. You have seen many examples of how we can improve mining today, and I think the techniques we are using are giving a more positive picture of our industry to the public. I know we still have a chore ahead of us because mining has created many barriers, but we have succeeded in the past, and mining will be around for a long time. Thanks again for attending. I think Dick would like to say a few words. Thank you for your attention.

Richard Shockley. Thank you, Dan. As all good administrators know, there are always things that come up that prevent you from doing what you want to do. Dan agreed to be our program chairman and generally would be recognized tomorrow at the Luncheon for the great job he has done, but since he is unable to be with us, I thought we should extend a hand to him for his great job of planning and for providing this program.

One thing I forgot to mention earlier. We are interested in recognizing our members and former members who are no longer with us. If you know of anyone who has deceased this past year, please notify Heinz or Phyllis, or someone at the registration desk, so we can remember them tomorrow at the noon luncheon.

The social hour is next on the agenda, so make sure you are all there. Thank you.

FRIDAY MORNING SESSION

The Friday morning Business and Technical Session convened in the ballroom of the Ramada Hotel, Mt. Vernon, Illinois, at 9:00 A.M., September 28, 1990. President Richard R. Shockley presided.

BUSINESS MEETING

Richard Shockley: We are glad you are here. Let's get right into our business session and ask Heinz Damberger to give our Secretary-Treasurer's report.

SECRETARY-TREASURER'S REPORT

Heinz Damberger: The financial report has been audited by the Auditing Committee and approved. This year's financial report is a little difficult to compare to last year's because we have changed our reporting date with the Internal Revenue Service, and we are reporting for eleven months, not twelve. We are cutting out September which means a lot of income is cut out and there were a few expenses. So that comes out on the negative side; and we didn't mail scholarship checks to colleges until August 31; that is $8,000: we are going to have $16,000 coming out next year and none this year; that makes the comparison between years difficult. Overall, we are not gaining or losing at this point. As a matter of fact, we show a surplus of a little over of $2,000 for some of the reasons I have just mentioned.

Looking down the road—we always make a projection for the Board meeting—we are showing a balanced budget. The cost of publishing our Proceedings has gone down significantly this year because of the investment that we made in computer equipment. We are now typesetting our Proceedings ourselves, which is saving us about $3,000. Our income items are down a bit. Advertising pages in our book are down, and we have fewer booths this year than last. On the other hand, we increased our dues and registration fee and that is showing up this year, at least partially. When we move over to Collinsville, we should be able to attract more exhibitors and that will help us. Our fellowship hour will be held in the exhibit hall, which will help the exhibitors.

I will be glad to answer any questions. Dick has already mentioned that registration is down. After checking late yesterday, we have about 125 fewer people than last year. [Final registration was 699, compared to 824 in1989]. Hopefully, after things have settled down next year, we will be back to our normal size.

FINANCIAL STATEMENT SUMMARY

Cash Balance Beginning 10/1/89	$23,649.00	Cash Balance Ending 8/31/90	$24,697.94
INCOME		EXPENSES	
Advertising	18,378.00	General Operating Expense	16,518.16
Annual Dues	10,848.00	Annual Meeting Expenses	18,059.42
Luncheon Receipts	1,560.00	Publication Expenses-Proceedings	10,492.14
Dinner/Dance Receipts	4,660.00		
Exhibit Fees	6,360.00	Scholarships*	
Short Course Fees	90.00	Subtotal Expense	45,069.72
Registration Fees	2,017.00		
Interest	1,529.48		
Miscellaneous	76.18		
Convention Cash	600.00		
Subtotal Income	46,118.66		
TOTALS	69,767.66		69,767.66

* Scholarships were mailed after September 1, 1990.

Assets as of August 31, 1990	
Liquid Assets	
Cash (checking and savings)	$24,697.94
Bonds	500.00
Fixed Assets	
ComputersEquipment	8,083.69
Software and Accessories	2,558.90
Office Equipment & Furniture	1,059.73
TOTAL ASSETS ON 8/31/90	$36,900.26
TOTAL ASSETS ON 10/1/89	34,811.87
1989-90 SURPLUS	$ 2,088.39

Richard Shockley: We appreciate your involvement, but we can do better. We need you to go back to your individual companies and encourage more people to be a part of IMI, especially the 100th anniversary year coming up in 1992.

We've had good committees this year. Committee chairmen will approach the chair as requested and give us your report. For the Nominating Committee, Paul Clites of Monterey Coal Co.

NOMINATING COMMITTEE

Paul Clites: Thank you, President Shockley. I appreciate your comments. It makes me feel good about coming up here. The Nominating Committee this year consisted of myself, Dave Webb from Freeman United and Kim Underwood of the Department of Energy and Natural Resources. In doing our duty this year, we looked at four vacancies on the Board, members whose three-year terms have expired. They include myself, Dave Webb, Carl Griffiths from Sahara and Mike Reilly from Zeigler. In addition to those four expiring terms, one member, Jerry Matthews of AMAX found it necessary to resign due to a relocation, so the remainder of that term also needed to be filled. In looking at the Board membership, we tried to get a good blend from mining companies, but also from government agencies, vendors and suppliers, and educational institutions. Accordingly, our nominations are: Dr. Y. P. Chugh, Southern Illinois University; Brad Peterson, Turris Coal Co.; Robert Shanks, Arch Mineral Corp.; and Charles Woolbright, Joy Technologies, Inc. And then as a replacement member for the remainder of Jerry Matthews' term, Mike Mitchell from AMAX. Turning to the officers of the Illinois Mining Institute, we are asking Heinz Damberger to continue the very critical and important position of Secretary-Treasurer. We have nominated Danny Wooton of White County Coal, MAPCO, to step up from First Vice President to President next year. We are asking Mike Reilly of Zeigler Coal to step up from Second Vice President to First Vice President and we are nominating Bob Danko of Peabody to step in the ladder of succession of the Institute next year, as Second Vice President. Each of these nominees has been contacted and agreed to serve in the position.

Richard Shockley: This slate was introduced in our Executive Board meeting yesterday morning. We feel it is a good slate; it gives us a good cross-section of people from industry and manufacturers and so forth and we recommend to the body here that they be accepted. But, in order to do this properly, we will ask for nominations from the floor. If anyone would like to nominate someone for any of these offices, I will hear it at this time. [No nominations were made from the floor.] Then, I'll entertain a motion that we elect this slate as presented by our Nominating Committee. [Motion to accept the slate was made and seconded. The slate was voted on by voice vote and was passed by members present.]

HONORARY MEMBERSHIP COMMITTEE

Richard Shockley: Harold Odle is not with us; he is out front running one of the booths this morning. This committee is recommending for Honorary Membership in the Illinois Mining Institute, Jack Bennett, formerly with Peabody Coal, who is now retired. Jack Bennett and his wife will be here at the Luncheon today to accept this award, and if I hear no opposition, will assume that Jack Bennett is expected to be the recipient of this award this year.

Now, would someone from the Advertising Committee come up and give us a report.

ADVERTISING COMMITTEE

Dan Bredel: Thank you President Shockley. On behalf of the Advertising Committee and my co-chairman, Walt Brandlein, I submit the following report. We are ahead of last year at this time for full-page ads; 65 for 1990 compared to 54 for last year's Proceedings, while half-page ads are slightly down: 37 for 1990 compared to 40 at this time last year. Exhibitors for 1990 took 38 booth spaces at $265 each totalling over $10,000 income. This number was down from 1989 by 4. Next year's meeting in Collinsville will allow for increased exhibitors, including a much larger area for displays of mining equipment.

Ad revenues for the 1989 Proceedings stayed at the same level as the 1988 book, slightly under $21,000.

As a final comment, I would like to thank all of the Advertising Committee members for their efforts during the past year, with special thanks to Phyllis Godwin and most importantly, thanks to those of you who generously support our efforts, the advertisers and the booth exhibitors.

Richard Shockley: Thank you Dan. That was a good report. The committee has worked well this year, and I think we should be pleased with the results that he shared with us this morning.

We will hear at this time from the Scholarship Committee.

SCHOLARSHIP COMMITTEE

Frank Snyder: Thank you Mr. President. On behalf of the Illinois Mining Institute Scholarship Committee, I am pleased to report on the activities of the Committee. The membership of the committee consisted Dr. Paul Chugh, Chairman of the Department of Mining Engineering, Southern Illinois University; George Woods, Dean, Illinois Eastern Community Colleges; and myself. The Board met yesterday and, in spite of some difficult financial times for our industry, approved the following expenditures for scholarships for 1991: Southern Illinois University, $3,500; University of Missouri-Rolla, $3,000; Wabash Valley College, $1,000; and Rend Lake College, $500. A total of $8,000 for our fine students. At the IMI luncheon today, we will present scholarship certificates to each recipient and will hear a report of activities from each institution. That concludes my report. Thank you.

Richard Shockley. Thank you, Frank. We are hoping that our enrollment will pick up in these schools of engineering in the next few years. We are in that cycle where the coal business is bad and nobody enrolls in the mining curriculum. Then all of a sudden we don't have enough engineers, and we can't find anyone to fill our vacancies. I know Dr. Chugh and the other schools are working to get students involved in mining at this time so that when your needs are there, he'll have people to give you to fulfill those needs.

If you know of any deceased members this past year to be remembered at our Luncheon meeting, please contact Heinz, or Phyllis at the registration desk.

If you have not picked up your ticket for the Luncheon today, be sure to do so right away. We need to give the hotel notice by10:00 a.m. of how many will be in attendance. We have a great speaker who will talk about the Acid Rain issue; something that is of interest to all of us. And I think this gentleman has first-hand information on what's going on that should be very enlightening to all of us.

Doc Harrell will now talk to us about 1992 meeting and what is being planned.

AD HOC CENTENNIAL COMMITTEE

Doc Harrell: As you all know, we are going to have our Centennial meeting in 1992 in Collinsville. And that is not too far to be laying our plans. I happen to be the chairman of the committee and, with the help of the Executive Board and Officers, plans are proceeding. I am up here today to solicit the help of all the members of the IMI. I think we have a lot of things in mind to have on display for everyone to participate in. We are looking for old movies; these would be historical movies about mining. If any of you have any thoughts about that, any place that we might go to contact to get some of these, we would appreciate hearing about it. Also, we would like historical mining photos; something similar to what Southern Illinois

University presented to us earlier in a slide program. We would also like mining memorabilia. We have a lot of things in mind for that, such as safety lamp displays and mining script. But, if any of you have anything or know of someone who has anything we could use in the display in Collinsville in 1992, either call myself or Heinz or get a hold of one of the committee members. We want to make this meeting something for everyone to look forward to and something to remember. I think that the facilities that we have in Collinsville are just great. We are going to have lots of display area there. And I think we have quite a lot to look forward to. Thank you.

Richard Shockley: Thank you Doc. Doc has put together a great committee. We were talking about having a time capsule put together to be opened in 50 years. A lot of us aren't going to be around when that 50 years gets here, so some of you younger people need to be involved here so you can open that capsule 50 years from now. We are inviting President Bush and the new governor. So we are not thinking small; we are thinking large. We were also talking about Loretta Lynn coming in as the Coal Miner's Daughter. But when we were told what it would cost, we marked it off the list.

Any other items that need to come before this body? Our morning session will start at 9:45. We have one other item. Regarding the Scholarship report, we should have had the representatives from our colleges and universities present their activities, so we'll do that now.

Paul Chugh: Good morning everyone. On behalf of Southern Illinois University at Carbondale and the Department of Mining Engineering at SIU-C, we are very appreciative of IMI supporting mining education. Before I introduce the scholarship winners, I would like to say a few words about the state of the department at SIU-C.

In a nutshell, the department is in sound health and doing very well. We have eleven undergraduate students and 22 graduate students in the department. Of the eleven undergraduates, we have three females; two of them are black females.

The masters program is doing extremely well. We have five students in the program who are from Illinois, who are pursuing a masters degree on a part-time basis.

The university administration is very supportive of the mining program at SIU-C. The department has launched a very aggressive recruitment program this summer to enhance undergraduate enrollment and, secondly, to attract working engineers to pursue an M.S. in mining engineering with emphasis on mine management on a part-time basis. And very shortly, perhaps within the next two weeks, you'll be getting something in the mail from us regarding this new emphasis that the faculty has put together.

The department attracted over $400,000 the past year for research. The research emphasized three areas: subsidence, disposal of coal-cleaning and coal utilization waste, and coal cleaning technologies.

I would like to introduce faculty, student scholarship winners and the other students that we have here. We have Professor Caudle, Associate Professor in Mining Engineering here with us. He is also the faculty advisor for the Society of Geologists and Mining Engineers. Dr. Sevim and Dr. Bradley Paul are supposed to be here. I have Miss Mary Evans, one of the scholarship winners. She is a junior in the department, and this summer, she worked for Monterey Coal, and the reports we got about here were just glowing. So they would like to have her back there again next summer. Stanley Reeder, he is a junior in the Department of Mining Engineering and another IMI scholarship winner. Richard Robben is a senior in the department and will be graduated in December 1990. Brian Hoyt a freshman in the department.

Again, we sincerely appreciate the support of IMI in supporting mining education. If the department or I can in any way assist the mining industry, we would be pleased to do so. Thank you very much.

Frank Snyder: Thank you Dr. Chugh. Next, the University of Missouri at Rolla.

Norman Smith: My name is Norman Smith and I teach mining at UMR. I would first like to introduce our new department chairman, Dr. John Wilson. He has had an awful lot experience around the world. John, would you stand up and be recognized. We are very happy to have John and all the experience he brings with him. Next, I want to thank the IMI for the three $1,000 scholarships. Now, I would like to introduce the three students who received these awards. Daron Hunt is from Alton, Illinois; Charles Comeau, a graduating senior from Lebanon, Missouri; and Fred Tullmann from the St. Louis campus. He is a junior.

A little bit about the department and what is going on there. Right now we have 49 undergraduate students and of that are six minorities; three are women. We have six graduate students. The sad turn about things is that the last two semesters we have only graduated one undergraduate and one graduate student. In other words. we had zero graduating this December. This spring we had one undergraduate student and one graduate student. But, things are beginning to pick up. Right now we have fifty-five students altogether. Freshmen enrollment, which is a big thing to us, is 21. And we appreciate the efforts of industry in helping us do that. This past summer we had every mining student have a job who wanted one. We had 25 put to work in the full spectrum— underground coal, surface coal, quarrying and hard rock. The industry is really helping us quite well. Thank you very much.

Frank Snyder: Wabash Valley College. John Howard.

John Howard: Thank you. This year we were awarded $1,000 in scholarships which we distributed to four students at the community college level. We have a little identity crisis. Wabash Valley College is located in five different areas of Illinois including Southeastern Illinois College, John A. Logan College, Belleville Area College, Lewis & Clark Community College, and Lincoln Land Community College. So people don't know who we are and we don't either sometimes. But we have four recipients, two who attend John A. Logan College and two of which attend Southeastern Illinois College, all under a cooperative agreement with Wabash Valley College: From John A. Logan College, Richard Boyes and Curtis Grant and from Southeastern Illinois College, Robert Sauls and Jason Cartwright.

On behalf of all of our students and all of the recipients out there, thank you for your continuing support. I am optimistic about the future of coal and appreciate these students who are going with it now.

Frank Snyder: That concludes the remainder of our Scholarship report.

Richard Shockley: Thank you, Frank and thank you gentlemen for your reports. I think anytime we give scholarships, it is going to benefit the industry as well as the recipients.

Keep in mind that the session starts at 9:45. Tom Lippencott will be in charge. I appreciate your being here. Thank you.

Tom Lippencott opens the Friday morning Technical Session.

TECHNICAL SESSION

Tom Lippencott: Welcome to the second technical session of the 98th Annual Meeting of the Illinois Mining Institute. I would like to introduce our first speaker. His name is Paul Sovinski, Director of Organization Development, AMAX Coal Industries. His paper is entitled "Encouraging Employee Development into the 21st Century." Paul has been active in the area of personnel and organization development for the past 14 years. He has been an employee with AMAX since 1987. He was an undergraduate of Franklin College and received a master's degree from Indiana University. He is also a member of the American Society for Training and Development and has been active in the United Way and Big Brother organizations. At this time please welcome Paul Sovinski.

[Mr. Sovinski's paper was not available for publication]

Tom Lippencott: Thank you very much Paul. You've brought up a lot of points that we will all take back to our jobs with us and hopefully make our companies more aware of employees. Our next speaker is Tim Reeves. He is the Department Manager of Corporate Services at Southern Illinois Power Cooperative in Marion, Illinois. He is a graduate of Southern Illinois University and has been at Southern Illinois Power Cooperative for the past ten years. His paper is entitled "Low NOx/SOx (LNS) Burner at Southern Illinois Power Cooperative."

Friday morning speakers Paul Sovinski (left) and Tim Reeves (right).

CYCLONE RETROFIT DEMONSTRATION PROGRAM WITH TRANSALTA'S LOW NO_x/SO_x BURNER*

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ABSTRACT**

The U.S. Department of Energy, under the Innovative Clean Coal Technology Program, in concert with TransAlta Technologies, Inc., a non-regulated subsidiary of TransAlta Resources Investment Corporation and TransAlta Utilities, in Calgary, Canada, will demonstrate the retrofit and operation of the Low NO_x/SO_x (LNS) Burner on a 33 megawatt (MW) utility cyclone boiler at Southern Illinois Power Cooperative in Marion, Illinois.

The typical cyclone boiler fires a high-sulfur bituminous coal at high temperature, which results in high SO_2 and NO_x emissions. The U.S. Congress is expected to pass new environmental regulations to control SO_2 and NO_x from all coal-fired boilers. It is not economical to fit conventional emission control equipment to older cyclone units. What is needed, if these units are to be kept in service, is a low-cost retrofit option.

The LNS Burner has the potential to control both SO_x and NO_x emissions from cyclone boilers at a lower cost than any known technology. The experience gained from this demonstration program is expected to prove LNS Burner operation, thereby providing coal fired boilers a design option for extended life with the ability to meet acid rain environmental legislation.

**This abstract replaces a paper delivered during the 98th Annual Meeting by Tim Reeves, Department Manager, Corporate Services of Southern Illinos Power Cooperative, Marion, IL, entitled Low NO_x/SO_2 (LNS) Burner at Southern Illinois Cooperative. *Paper published in *Proceedings of ASME/VGB International Joint Power Generation Conference, October, 1990, Boston, MA.* Abstract printed by permission of Dr. Gerard G. Elia, Project Manager, U. S. DOE, Pittsburgh Energy Technical Center, Mail Stop 920-L, P. O. Box 10940, Pittsburgh, PA 15236 and William L. Fraser, President, TransAlta Technologies, Inc., Calgary, Canada.

The LNS Burner involves high temperature fuel-rich combustion for the control of both SO_2 and NO_x. High-sulfur bituminous coal, mixed with limestone, is burned in a refractory-lined, air- and water-cooled chamber. Using one-half of the total combustion air, the burner creates a hot fuel-rich gas. During this combustion, the fuel sulfur is captured by the calcium from the limestone and is retained as a solid in the melted coal ash. Nitrogen that is chemically bound in the coal is converted to harmless molecular nitrogen. All of these operations are carried out in the burner. No solids or other fuels need be injected into the furnace, and no flue gas scrubbing is necessary.

Generally, modifying the cyclone plant to fit the LNS Burner will require only:

- Modifying the cyclone furnace section with the LNS Burner.
- Reworking the coal preparation and conveying system with a coal pulverizer in place of the coal crusher.
- Providing a silo and metering system to add limestone and other additives to the coal.

The demonstration program is estimated to cost $16.3 million with a 1992 target date for completion. DOE will manage the project from the Pittsburgh Energy Technology Center (PETC) in Pittsburgh. Industrial participants include:

- TransAlta Technologies, Inc. (TransAlta Resource Investment Corporation)
- Illinois Coal Development Board, through the State of Illinois Department of Energy and Natural Resources
- The National Rural Electric Cooperative Association (NRECA), through its Cooperative Research Committee. NRECA will be represented by Associated Electric Cooperative, Inc., of Springfield, Missouri
- The Electric Power Research Institute, Palo Alto, California
- Baltimore Gas & Electric, Baltimore, Maryland
- Central Illinois Public Service Company, Springfield, Illinois

[*Question regarding disposal of ash*]

Tim Reeves: Well, Right now we are selling all of our ash. It will change it. We are waiting to see when it comes out of there. We will test it and see just exactly how it is changed and what happened to it. We certainly hope it is not a waste that we have to dispose of. Basically, what we do now, because there are a lot of BTUs left when it comes out of our small units, we burn it again through a larger unit. And then as it comes out of the larger unit, we sell it.

Question: The limestone you use in the scrubber, is it scrubber lime, agricultural lime, or will any limestone do?

Tim Reeves: We use limestone out of southern Illinois, in particular, limestone from a quarry south of Jonesboro. We use that limestone because it is pure. We have no problem crushing it because of impurities. Several of the limestones in southern Illinois have impurities such as flint, and other things that make it very difficult to crush. I believe they use that limestone from that mine for agricultural limestone also. It is such a pure limestone, though, they won't use it on roads; it just won't hold up.

Tom Lippencott: Thank you Tim. Our next speaker is Mark Roll who is the Market Manager for Coal Gasification for Destec Energy, a division of Dow Chemical. Mark is a graduate of the University of Kansas and joined Dow in 1977 at their Texas division where he held various R&D assignments. In 1984, he moved into Marketing with Dow Plastics; Mark joined Destec earlier this year as Market Manager for Gasification. His paper is entitled "A Review of the Dow Coal Gasification Process, Including the Recent Tests with the Illinois Herrin (No. 6) Coal."

Mark Roll: Thank you Mr. Chairman. I am very pleased to be here today to report the first findings of the Herrin (No. 6) coal tests that we ran recently at a plant down in Louisiana, which I am going to describe.

Friday morning speaker Mark W. Roll

THE DOW SYNGAS PROJECT: ECONOMIC AND ENVIRONMENTAL IMPACT OF THE INTEGRATED COAL GASIFICATION /COMBINED CYCLE

MARK W. ROLL

Market Manager
Destec Energy, Inc., Division of Dow Chemical
Houston, Texas

INTRODUCTION

With the passage in 1990 of stringent new clean air legislation in the United Sates, the country's electric utilities face the challenge of continuing to meet increasing demand for electricity while sharply reducing emissions to comply with the new standards. No single strategy will meet every need. For example, switching to natural gas has been suggested as one of the best all-around solutions. No doubt, it is for some utilities in some regions of the country. But natural gas is much less abundant than coal, and increasing demand is likely to drive its price up. Moreover, the nation's gas pipeline system, which is not equally accessible to all regions, is already operating virtually at maximum capacity, and it is not clear how increased volumes of natural gas would be transported, or at what cost.

On the other hand, America's coal reserves are immense, and about 45 percent of existing generating capacity is in plants with coal-fired boilers. Coal will thus continue to be the fuel of choice for many utilities for the foreseeable future. To take advantage of America's coal wealth and still meet the requirements of the Clean Air Act will mean modifying, repowering or replacing dozens of aging power plants. Several technologies have been developed whose potential for filling this need is being assessed. They include atmospheric and pressurized circulating fluid-bed combustion, flue-gas desulfurization (scrubbers), and integrated coal gasification/ combined cycle (CGCC) processes. Of these three, Destec Energy, Inc., of Houston, Texas, a wholly-owned subsidiary of The Dow Chemical Company, believes that CGCC is the superior coal-based technology and has the greatest potential for broad commercial application in the utility industry.

HISTORICAL PERSPECTIVE

Before examining the relative merits of the "clean coal" technologies available today that can be commercially applied in the 1990s and beyond, it is helpful to recall the historical events that led to the development by Dow Chemical of proprietary CGCC technology now owned and marketed by Destec. For more than a century, Dow has been a major participant in the manufacture of energy-intensive products and the generation of power used in the manufacturing process. In fact, Destec's other principal business, natural gas-fired cogeneration, is an outgrowth of this tradition. Thanks to the global presence of Dow's chemical facilities, the company has gained worldwide experience in the cogeneration of power and has a total of approximately 4,000 megawatts (MW) of natural gas-fired generating capacity. Dow's global perspective, coupled with the need to plan long-term, risk-minimized fuel strategies for its chemical complexes, led Dow to develop its coal gasification technology.

The first step in Dow's energy strategy of preparing for a long-term fuel conversion from natural gas to solid fuels began in earnest in the 1970s. Dow's large Louisiana and Texas division, located on the Gulf Coast, operates near a large lignite reserve that runs through central Texas into western Louisiana. During the 1950s and 1960s, a few lignite power facilities were constructed in this region. During the 1970s, additional plants were built and many more were planned. Dow selected lignite as the company's solid fuel option, and during the latter half of the 1970s, Dow obtained the rights to one billion tons of consolidated lignite reserves. These reserves represent more than 75 years of fuel supply for Dow's Texas and Louisiana power facilities. In addition to reserving lignite for future use, this low-grade coal may be sold in the merchant market. The first external use of Dow's lignite was in Houston Lighting & Power Company's limestone generating plant, which came on-stream in 1986.

With a firm lignite reserve position and efficient gas turbines operating at its facilities, Dow took the next step of its solid fuel energy strategy and embarked upon the company's largest research and development project in its history. Dow's subsequent step was to develop the gasification process to produce syngas from lignite for use in gas turbines. Dow began research on this process in 1973, shortly after it first purchased lignite reserves. At the outset, Dow established a number of goals that it believed a practical coal-based power generating technology would need to meet in the future; it needed to be environmentally clean, reliable, energy efficient, capable of using a range of coals, competitive in power costs and capable of being introduced with short lead times to meet market needs. No existing technology met Dow's criteria, so the company began work on its own process.

An air-blown pilot plant using 12 tons of coal per day started up in 1978. The pilot plant was later converted to a 36-ton-per-day, oxygen-blown plant. In 1982, Dow began construction of a 1,600-ton-per-day, oxygen-blown prototype plant incorporating Dow's unique two-stage process. This plant operated from 1983 to 1985, to collect enough data to establish the design bases for a commercial scale plant. In May, 1987, construction was completed on a 2,400-ton-per-day, integrated coal gasification/combined cycle plant in Plaquemine, Louisiana, the first commercial scale demonstration plant of the CGCC technology developed by Dow. Related research and development costs ($100 million) and construction costs ($73 million) for this plant were paid entirely by Dow. In its role as a demonstration plant, the project qualified for a fuel price guarantee from the federal government's Synthetic Fuels Corporation in 1984. The guarantee pays Dow the difference between the guaranteed price and the current market price of natural gas until 1997.

CGCC: THE PREFERRED TECHNOLOGY

Dow and its power marketing subsidiary, Destec, are convinced that they are on the right track with their solid fuels program. U. S. Department of Energy officials are now touting clean coal technologies as a way of bolstering America's position in world trade and protecting the environment. With the new Clean Air Act [signed into law by President Bush on November 15, 1990], U.S. utilities are looking for ways to comply with the new regulations and to benefit from the emission credit features of the legislation. The coal gasification technology developed by Dow and marketed by Destec is ideally positioned to take advantage of these opportunities.

The Dow/Destec "clean coal" technology, which integrates the gasification process unit with a combined cycle turbine, has several advantages. First, it is environmentally superior to other coal gasification processes; second, it provides a high level of efficiency; third, the fuel is based on an abundant domestic resource; and fourth, a plant utilizing this technology can be built in phases, which promotes responsiveness to changes in the energy market. Recently, a report to the United States Congress by the National Research Council entitled, "Confronting Climate Change: Strategy for Energy R&D," gave a high degree of preference to CGCC technology.

"Of the new coal-based technologies, the [CGCC] system has the highest efficiency and the lowest emission of environmental pollutants. Reduction in CO_2 is directly related to thermal efficiency gains; thus, the CGCC has the potential for being the preferred coal-based technology considering all environmental emissions, including CO_2."

The Destec process removes the sulfur from coal prior to combustion, which significantly reduces acid rain. The new amendments to the Clean Air Act call for drastic reductions in acid rain-forming emissions of sulfur dioxide, to 2.5 pounds per million Btu (lb/MMBtu) by 1995 and 1.2 lb/MMBtu by 2000, respectively. Destec's coal gasification plant's SO_2 emissions are only a fraction of the new standards, at 0.08 lb/MMBtu (figure 1). NOx and CO_2 emissions are also low compared to alternate coal-based technologies. Additionally, there are no disposal problems because the high-grade sulfur and slag which are by-products of the process have commercial applications; hence, there is no "waste" produced by the process.

Destec's process has been honored with numerous awards, including the Walter Flowers Achievement Award, presented by The Council on Alternate Fuels (1990); the Energy Conservation Award, presented by *Power* magazine (1989); the Energy Technology Innovation Award, presented by the Industrial Energy Technology Conference (1990); and the Innovation in Power Generation Technology Award, received in 1989 at the Electric Power Research Institute's international conference on "Technology for Generating Electricity in the 21st Century" (this conference is a major event held once every four years).

Commercially Proven Technology

The syngas plant in Plaquemine, Louisiana, which generates 161 MW of electric power, is operated by Louisiana Gasification Technology, Inc. (LGTI), a subsidiary of Destec. Energy produced by the plant helps supply the electric power and steam needs of the 1,400-acre chemical manufacturing complex of Dow's Louisiana Division. The commercial scale of this plant has provided invaluable operating experience, as well as data on operating costs and performance that make construction of similar plants attractive to electric utilities. [Through December, 1990, the LGTI plant had processed 1,275,429 tons of coal (the energy equivalent of more than three million barrels of oil) and reached a 90-day availability record of 79 percent.]

Although the amount of coal processed at the plant is impressive, it does not include a recent test of bituminous coal which took place in July, 1990. The test coal was fed into the second stage of the gasifier while the primary reactor remained on Rochelle western subbituminous coal. The test coal, classified as Illinois No. 6 (Herrin), was provided by Arch Minerals Corporation from their Captain Mine in southern Illinois.

The test was observed by staff of the Electric Power Research Institute (EPRI). Michael Epstein and Ed Clark, Project Managers of EPRI, commented, "Our member utilities are keenly interested in the clean use of high sulfur bituminous coals, abundant in the U.S. This successful initial test with Illinois No. 6 coal in the second stage of the gasifier at Plaquemine has provided Destec Energy with process and operating information important to the design of future gasification power plants that will be fueled by domestic bituminous coals."

This test was performed to support Destec's coal gasification marketing strategy to utilize lower cost, abundant high sulfur fuel for future power generation while meeting the most stringent Clean Air Act Amendments and other environmental requirements. This second stage only test was necessary, since LGTI's existing environmental permit precludes operation of the plant on a coal feed of greater than 1.2 percent sulfur. The high sulfur bituminous coal posed no operational problems as the gasifier and downstream equipment performed well for the duration of the test. Other

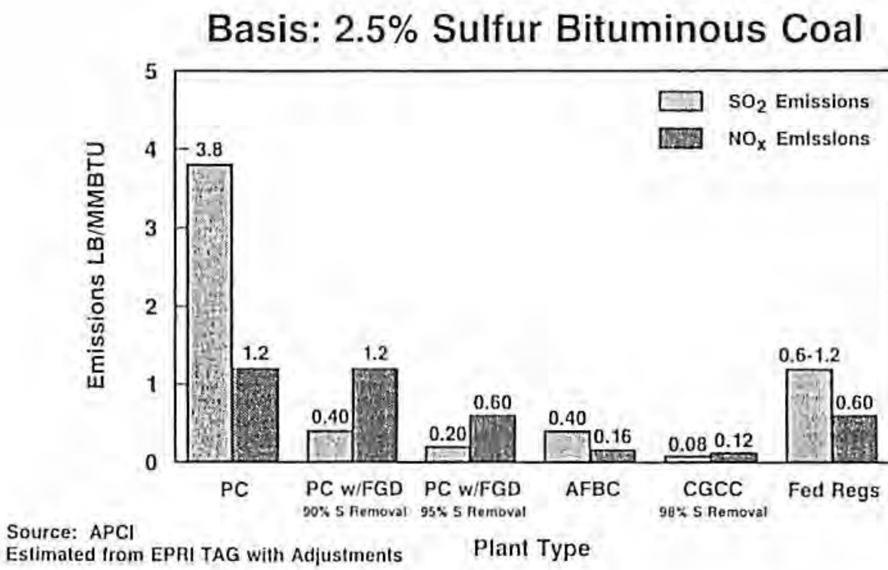

Figure 1. Emissions from coal-based power plants.

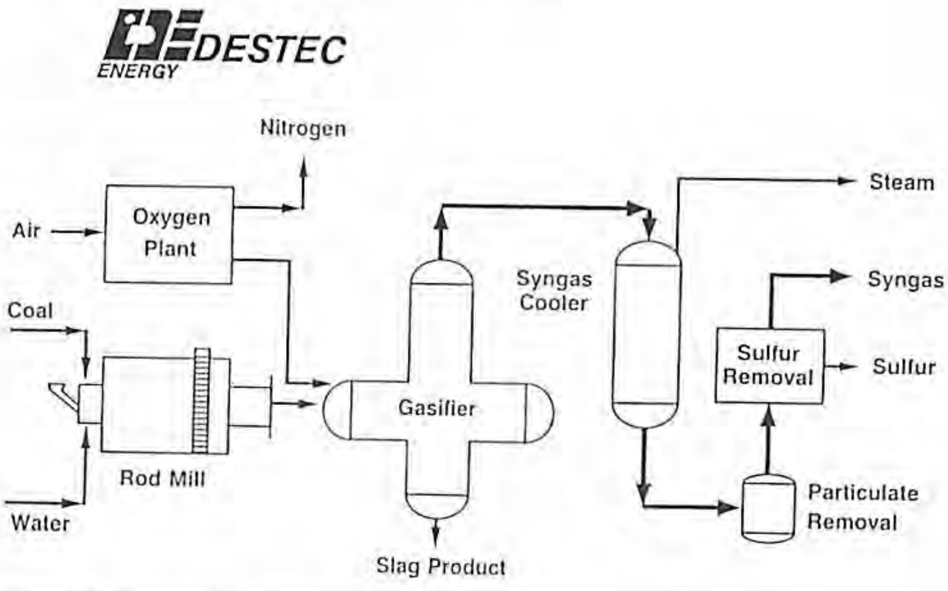

Figure 2. Dow coal gasification process.

highlights in 1990 included a monthly production record of 84 percent capacity in the month of August. Operation through August also was part of a record 47 consecutive days of delivering syngas to the combustion turbines.

The Destec Coal Gasification Process (figure 2) includes a unique two-stage gasifier yielding higher conversion to syngas. The continuous system is reliable in feeding raw materials and removing slag, a coarse, sand-like material used as an aggregate in roadway resurfacing. Systems include char and water recycling to minimize effluents from the plant. Coal is ground and slurried with water, forming a high concentration solids mixture. Most of this slurry is fed into the first stage gasifier and combined with oxygen provided by the dedicated Air Products' 1,500-ton-per-day air separation plant. Raw materials are quickly converted to syngas at 2,600°F at 400 pounds per square inch gauge (PSIG). Products of the partial oxidation reaction that takes place within the first stage consist primarily of carbon monoxide, hydrogen, carbon dioxide and trace amounts of methane and nitrogen. The sulfur present in the coal is converted primarily to hydrogen sulfide and carbonyl sulfide. Slag flows from a tap hole at the bottom of the gasifier into a water quench, which freezes and shatters the molten slag. Mechanical crushers further reduce particle size so the slag/water slurry can be transported to dewatering bins.

Syngas rises into the second stage gasifier where the remaining slurry is fed. Addition of slurry reacts endothermically with syngas, enhancing the heating value of the gas by pyrolyzing and gasifying more coal. The slurry feed in the second stage also lowers the gas temperature to about 1,900°F. The raw syngas then rises out of the top of the gasifier to a high temperature heat recovery unit (HTHRU). The HTHRU, consisting of a boiler, a superheater and a boiling economizer, cools the syngas to less than 500°F. Recovered heat makes steam. The syngas then proceeds to a soot scrubber, removing particulates which are recycled back to the gasifier. The scrubbed syngas is further cooled through a series of heat exchangers prior to hydrogen sulfide removal. As the gas cools, sour water containing ammonia, carbon dioxide and other dissolved gases is collected and treated in a sour water treatment unit for discharge from the process, or for recycle to the slurry preparation plant to make more coal slurry.

Hydrogen sulfide is then removed from the syngas. First, the syngas is contacted with a solution of methyl diethanolamine (MDEA) in an absorption column. The acid gas is stripped from the solvent and sent to a sulfur recovery plant. Sulfur recovery utilizes a process licensed from Union Oil of California and catalytically oxidizes the acid gas to elemental sulfur with a purity of 99.7 percent. All of the recovered sulfur is sold locally in the area, to manufacturers of sulfuric acid for use in, for example, agricultural fertilizers. The sweet syngas is reheated before being sent to the power plant. These sulfur recovery steps make the process the most environmentally clean coal technology in the world.

It should be noted that nitrous oxide (NOx) emissions from the combustion turbines, with constant steam injection rates, are lower when fueling syngas than natural gas. As with fuel gas, NOx emissions decrease as steam injection rates increase while using syngas.

CGCC is Cost Competitive

The Destec CGCC process is exceptionally efficient, converting more than 99.9 percent of the carbon in coal to syngas. The thermal efficiency of a coal gasification plant is better than alternative technologies under development, such as atmospheric and pressurized fluid-bed combustion and advanced pulverized coal. Further development of the Destec coal gasification process (with addition of molten carbonate fuel cells) is expected to raise plant efficiency by more than 20 percent during the next five to ten years.

Compared to pulverized coal with flue-gas desulfurization, a mature competing technology, Destec's CGCC process is notably superior in thermal efficiency (39 percent versus 34 percent) and roughly equivalent in capital costs. Long-term costs of electricity are also lower, as the information in table 1 illustrates.

Table 1. Competitive cost and performance, 400-500 MW IGCC and pulverized coal plants.

	Heat Rate, BTU/KWh	Capital $/KW	30 Year Levelized Cost, Mills/KWh
Coal-fired Steam	10,390	1280	50.2
IGCC (Dow)	9,280	1350	43.7

Basis: Illinois High Sulfur Coal
Dow estimate for capital is site specific.
Range is $1200 to $1400/KW
Reference: M. Gluckman, EPRI, May, 1988

The Destec process offers other, less direct economic advantages as well. For example, plants using the process will be dramatically cleaner than the new standards require. Any plant operating so far below acceptable emissions levels will earn substantial emissions credits. The utility can then either use these credits (worth an estimated $500 to $1,500 per ton) to offset emissions at other, higher emissions plants it may own, thereby saving (or delaying) the capital costs of installing scrubbers at those plants, or sell the credits to other utilities, thereby raising revenues to fund its operations.

The savings are multiplied by the practice of economic dispatching, wherein a utility brings on-line its most efficient generating stations first, as electrical demand increases during the daily load cycle. Delaying the dispatching of older, inefficient (and more costly to operate) stations increases the economic benefit to the whole system.

Overall, the benefits from emissions of offsetting, sales of emissions credits and economic dispatching could amount to savings of hundreds of millions of dollars in operating costs.

The economic benefits to a utility of repowering units with Destec's CGCC process also extend to the region where the utility operates. By reducing the utility's contribution to regional emissions, the region would have room for emissions "growth" and would thus be able to attract additional investment and industry. Existing industry, also required to meet new clean air standards, would avoid being pressed simultaneously to reduce their own emissions and pay higher electricity rates. In many areas where locally mined coal is burned to generate power, the CGCC process can provide a "new lease on life" for the regional coal industry by allowing high sulfur coal to be burned cleanly and economically.

Once the CGCC process is chosen, other cost savings can be realized because gasification plants can be built in a relatively short period of time. The LGTI plant, for example, was built in 21 months. Each gasification module is sized to produce syngas to power 150 to 200 MW combustion turbines. Therefore, if more capacity than 200 MW is needed at a gasification facility, the plan can be built in phases as demand requires reducing the overall interest cost during the construction period versus building to capacity at the onset.

CONCLUSION

For coal-based utilities, CGCC is today's best available technology for meeting the needs of expanding demand for electricity and cleaner air, and it is well-suited for repowering old plants and incorporating into the design of new ones. The process can use all types of coal effectively, regardless of sulfur content. CGCC's exceptionally clean operation yields both economic and environmental benefits, and as the solid waste crisis intensifies, CGCC's waste disposal advantages will become increasingly important.

Question: How do you market the sulfur and what is the use for it locally?

Mark Roll: The sulfur is sold locally in Louisiana for the manufacture of sulphuric acid.

Question: Have you looked at the markets for slag byproducts in areas outside the Gulf coast, because there is no competition in the Gulf coast for traditional aggregates like there would be in the rest of the country.

Mark Roll: We haven't done any actual studies, but for sulfur. What we have done is to work with state highway departments and provide splint test data on how these asphalts, aggregates from slag may perform. And they really perform quite well. These slags that are used to make asphalt have very abrasive characteristics which are actually very good for roads. So, I think it is updated, developed, and as we expand the technology into other states, those markets will emerge. I think the other point is that even if these slag products do not have value as a byproduct, they do not have to be landfilled; they can be inventory on land, they do not have leachate problems. These are non-toxic materials, so you have no special waste disposal handling methods or costs to deal with the ash that comes out of the coal burned in this gasifier.

Question: What size do you grind the coal to and what would be the ideal ash content for the coal?

Mark Roll: I don't think there is any particular ideal ash content, and as far as the size of the coal that is ground up, it's in the hundred mesh size area. A finely divided particle in a water slurry.

Thank you.

Tom Lippencott: Our next speaker is Dale Nolan. He is a land reclamation specialist with the Illinois Department of Mines and Minerals. Dale is a graduate of Southern Illinois University. He has been employed by the Illinois Department of Mines of Minerals since 1983, when he started as a field inspector. He has helped coordinate the GIS effort with the engineering and is also serving as personnel computer coordinator at the Marion office. His topic is "State Primacy-The Illinois Perspective." Please welcome Dale Nolan.

Dale Nolan concludes Friday morning presentations.

PRIMACY — THE ILLINOIS PERSPECTIVE

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ILLINOIS REGULATORY HISTORY

The Illinois Department of Mines and Minerals, the regulatory authority in Illinois for the mining and the oil and gas industries, is one of the original code agencies created by an act of the Illinois General Assembly in 1917[1]

The country's first commercial surface coal mine was opened near Danville, Illinois, in 1866.[2] The first regulatory bill for surface mined land reclamation in Illinois was introduced in the state legislature in 1929; however, it was defeated. In 1941, the Illinois legislature passed the first law dealing with land reclamation. This was an investigative act that culminated in the passage of the first land reclamation law for surface coal mining in Illinois in 1943. This law, however, was declared unconstitutional by a court decision in 1947.

Until passage of the Illinois Open Cut Land Reclamation Act, effective January 1, 1962, Illinois had no regulatory authority over the surface mining industry. This law applied to all minerals extracted by surface mining methods. This act was amended in 1963 and again in 1968. The 1968 amendment changed the name of the Act to the Surface Mined Land Reclamation Act.

The first two Illinois acts regulating surface mining required that the areas be permitted yearly and that the operators provide a surety bond prior to permit issuance. Grading requirements were also implemented that required the spoil ridges to be struck-off or reduced, first to a minimum width of 10 feet for pasture use and later to a minimum width of 18 feet. The 1968 Act also required that lands within 660 feet of a public road be graded to a slope of 30 percent or less.

Additionally, this Act required revegetation of affected lands and set forth minimum standards for vegetative success of both ground cover and tree stocking and required permanent impoundments be adequate to support fish populations. Regulation of slurry and gob disposal were also part of these early regulations.

In 1971, Illinois passed the Surface Mined Land Conservation and Reclamation Act. This law transferred the Land Reclamation Division from the Illinois Department of Conservation to the Illinois Department of Mines and Minerals.

The Surface Mined Land Conservation and Reclamation Act was the beginning of the Illinois regulatory administration procedure under which county boards or commissioners were given a designated role in permit application reclamation plan review. This was also the beginning of having permit application reclamation plans filed with the County Clerk of each county in which the permit area was located and initiated opportunities for public hearings on reclamation plans prior to permit issuance. Prior to this law, the practice was to submit proposed reclamation plans within two months following the reporting of affected acreage for that fiscal year. The reclamation plans were for the same acres declared affected for that fiscal year (July 1 - June 30).

As originally passed, the Surface Mined Land Conservation and Reclamation Act of 1971 carried some of the toughest restrictions for the coal mining industry in the country. In addition to the administrative requirements to file reclamation plans with the respective county, the minimum per acre surety bond amount was increased. All grading was required to be completed within one year after it was affected. All rowcrop agricultural lands were required to be graded to within four percent of original grade and cast overburden was required to be covered with a minimum of four feet of rooting medium of a specific texture. All other lands had to be graded to 15 percent slope or less except for reforested outside slopes of boxcut spoils, final cut slopes, and incline side slopes which had a slope requirement of 30 percent or less.

The Surface Mined Land Conservation and Reclamation Act was amended in 1975 and again in 1977. The significant changes brought about by these amendments included the filing of the entire permit application with the county, increased minimum bond amounts, grading of final cut highwalls to a slope of 50 percent or less, and the removal, segregation and replacement of all available topsoil for rowcrop reclamation areas (minimum of 8 inches). Replacement of the topsoil on rowcrop agricultural lands had to be over suitable agricultural rooting medium and the total soil depth over the grade spoil had to be a minimum of 48 inches. The 1975 amendment required the reclamation of affected lands to be based on the capability of the pre-mining soils and not simply the pre-mining land uses. The Act incorporated by reference the United States Department of Agriculture Soil Conservation Service land use capability classes.

With the enactment of the Federal Surface Mining Control and Reclamation Act (SMCRA), the State of Illinois enacted a new section, Section 17, to the Surface Mined Land Conservation and Reclamation Act which became effective on August 11, 1978. This action incorporated the federal interim regulations in the Illinois rules and empowered Illinois to participate in the federally-sponsored program for all surface and underground coal mines in the state. With the passage of the Section 17 regulations, Illinois began administering different land reclamation and permit procedures for coal and non-coal mining, and for the first time, underground coal mines and secondary recovery operations became subject to bonded permit and reclamation requirements. The non-coal mining industry in Illinois is still subject to the Surface Mined Land Conservation and Reclamation Act as amended.

The Section 17 regulations also established the Interagency Review Committee which consists of the Illinois Departments of Agriculture, Conservation, Energy and Natural Resources, Commerce and Community Affairs, Transportation, and the Illinois Environmental Protection Agency. Each of these agencies receives copies of permit applications and is given an opportunity to review and comment on components applicable to their respective areas of expertise. The United States Department of Agriculture Soil Conservation Service also receives copies of permit applications for review and comment.

On September 22, 1979, Illinois enacted the Surface Coal Mining Land Conservation and Reclamation Act (Public Law 81-1015) to allow development and implementation of Illinois' permanent program under SMCRA. The Illinois Act was to take effect with the approval of the Illinois permanent program by the Secretary of the Interior. On June 1, 1982, after four submittals of revisions, additional information, and modifications to the Illinois permanent program, the Secretary of the Interior conditionally approved the Illinois permanent regulatory program under Title V of SMCRA. The requirements of the performance standards of the regulations became effective for all surface and underground coal mining operations, including carbon recovery operations, on February 1, 1983, (eight months after the approval of the Illinois permanent regulatory program).

As a result of the Federal Regulatory Reform effort initiated in 1983, Illinois was required to amend its regulations in order to be as effective as the revised federal regulations. On March 28, 1986, Illinois submitted extensive regulation amendments to address the regulatory reform and to incorporate changes needed in Illinois as a result of four years of primacy. The program amendments were approved by the Office of Surface Mining (OSM) on October 25, 1988.

THE ROLE OF SMCRA

Prior to the passage of SMCRA, Congress considered legislation that would have banned all surface coal mining. Fortunately, for all of us, this never occurred and the development of SMCRA "... (moved away) from an outright ban to a policy stance which allowed strip mining, but only under rigorous controls and where states could have primary responsibility for enforcing the law." [3]

Sections 101 and 102 of SMCRA clearly set forth the four basic purposes of the Act in not so few words as: 1) mine the coal, 2) protect the public and the environment, 3) reclaim the land affected by mining, and 4) allow the states to regulate their own surface coal mining and reclamation operations subject to the Act. Section 101(f) states that "because of the diversity in terrain, climate, biologic, chemical, and other physical conditions in areas subject to mining operations, the primary governmental responsibility for developing, authorizing, issuing, and enforcing regulations for surface mining and reclamation operations subject to this Act should rest with the states."

Section 201 of SMCRA established, in the Department of the Interior, the Office of Surface Mining Reclamation and Enforcement (OSM) and under Subsection (c), set forth the duties of OSM. Section 210(c)(12) states that OSM is to "cooperate with other Federal Agencies and State regulatory authorities to minimize duplication of inspections, enforcement, and administration of this Act." It is evident that Congress intended the regulation of surface coal mining and reclamation operations to be the responsibility of the individual states that developed regulatory programs that effectively administered the requirements of the Act and that OSM was to have an oversight role in the development and implementation of the state regulations after the state was granted primacy by the Secretary of the Interior. Clearly, the principle of federalism and the belief that local governments were the best authorities over decisions of local matters were of primary importance to Congress in fashioning the regulatory program.

Section 503 of SMCRA lays out the ground rules a state must follow in order to be granted primacy and be given "exclusive jurisdiction" over surface mining within its borders. The Act does not, however, lay out the ground rules of oversight by OSM of the states' implementation of their approved programs.

WHAT IS PRIMACY

Primacy, according to Webster's New World Dictionary of the American Language, is defined as "the state of being first in time, order, rank, etc.; supremacy...." In order for any state to be granted primacy, the state must abide by the ground rules established by SMCRA in Section 503 and must develop a program of administration and implementation that will accomplish the goals of SMCRA. In order to retain its position of "supremacy," a state must enforce its program and effectively implement the Surface Mining Act or face program revocation in accordance with section 521 of SMCRA and Part 733 of the agency regulations. If a state has been granted primacy and is effectively accomplishing the goals of SMCRA, that is, protecting the public and the environment while the coal is being mined and assuring that the land is reclaimed to at least the pre-mining capability, then OSM, in its oversight capacity, is not to be a "monkey on the back" of the states, nor does SMCRA empower OSM to "micro-manage" or "second guess" the states in their program implementation.

THE OSM APPROACH

At the time of the implementation of the Interim Regulatory Program on May 3, 1978, Illinois had one of the more stringent regulatory programs in the nation. Illinois had provisions for public participation and public hearings, required segregation, protection and replacement of topsoil and required reclamation based on land capability rather than land use. In addition, Illinois required an applicant to provide a surety bond and to pay permitting fees prior to the issuance of a permit. Many of the aspects of the federal act were modeled after the existing state programs of Pennsylvania and Montana, and it would appear that many of the early Illinois initiatives played a large part in the development of SMCRA and the federal regulations.

Despite the fact that Illinois had comprehensive regulations in place at the time of the passage of SMCRA, federal regulators and professional environmental groups approached the Illinois program as if the regulation of surface coal mining and reclamation were something new in Illinois. The development of the Illinois laws and regulations from 1962 to 1977 had fostered a cooperative but firm relationship with the Illinois coal industry and the industry had for the most part been cooperative with the state in obtaining a higher level of reclamation success and environmental protection.

The federal approach to implementation and oversight has been more traditionally confrontational. The industry oftentimes found itself in the middle of state and federal controversies concerning the interpretation and implementation of the regulations. By the early 1980s, the federal attitude had begun to mature. The Office of Surface Mining had begun to employ persons with experience in surface coal mining and reclamation and was giving more credence to state and industry input. The industry's attitude also improved as they became more familiar with what was expected of them and as the regulations and the implementation of the regulations stabilized—at least to some degree.

With approval of the Illinois Permanent Regulatory Program in 1982 and implementation of the permanent program performance standards on February 1, 1983, the Illinois Department of Mines and Minerals became the regulatory authority responsible for implementation of the act. The Office of Surface Mining, in its oversight capacity, was to monitor the program and assure the state did not fall below the minimum standards established by SMCRA in the regulation of surface coal mining and reclamation operations within the state. The level of oversight that OSM initially exhibited in the State of Illinois was considered by the Department to be at times excessive and was waged with a "gotcha" mentality.

The Illinois field office received nearly every document the Department received or generated. Every detail was scrutinized by OSM and huge amounts of data were collected and generated. These data were used to generate lengthy annual evaluation reports with as many as two hundred pages. The annual reports, with their endless statistics, numerous tables, and performance comparisons, were viewed as exercises in "bean counting" with little correlation to the protection of the environment. This bean counting gave the impression of a weak, inefficient program in need of constant management in every aspect. The only really positive part of the evaluation report for FY'84 was in its summary findings which stated that "(the Department) and its Land Reclamation Division are to be commended for implementing a high quality regulatory program. The state has assembled a highly professional permit review team with all necessary disciplines and is conducting thorough reviews of each permit application." The report also stated that the findings document that had been developed by the state for permit issuance was "thorough" and "detailed" and had been forwarded to other OSM field offices and states to be used as a model. The rest of the 114-page document was a compilation of statistics and tables without a single mention of on-the-ground results of the program.

Likewise, the FY '85 annual evaluation gave Illinois a quick "atta-boy" for program implementation and then went on for 185 pages of bean counting. This report at least included one and one-half pages of discussion concerning reclamation and the positive effects of the program in accomplishing the goals of the Act. It was this type of reporting, in Illinois and in other primacy states, and the omnipresent oversight approach by OSM that made it difficult to understand why the Department of the Interior bothered to grant states primacy.

The Reform Effort

In 1983, as as result of the Reagan administration's effort to reduce the burden of federal regulation of the private sector and as part of the regulatory reform effort by the Office of Surface Mining, oversight took on a new direction. Emphasis was directed toward "increasing flexibility and minimizing record keeping and compliance burdens on the states and mine operators,'" and to "...foster better state-federal relationships." [3]

The reorganization of OSM was also directed at improving state primacy. According to Richard Miller of the Office of Surface Mining, "The earlier OSM structure was organized on a regional, district, and field office basis more appropriate to a situation where direct federal enforcement of SMCRA in the absence of an approved state regulatory program was the norm. OSM has been restructured under the Reagan administration for the announced purpose of conforming more closely to states' boundaries and placing more people at the local level as states assumed greater responsibility for implementing the Act".[3] These initiatives were certainly steps in the right direction.

In Illinois, monthly meetings between the Office of Surface Mining's Springfield Field Office and the Department's Land Reclamation Division were initiated at the outset of the program. Information gathered by OSM from permitting, enforcement, and inspection documents as part of the oversight process as well as items the state wishes to discuss are placed on the agenda and attempts made to resolve concerns before they become problems. This open communication between the agencies has fostered a cooperative atmosphere and has led to rapid correction of errors, clarification and implementation of policies, procedures, and interpretations, and has resulted in a more balanced enforcement of the Act.

Oftentimes, an issue flagged as an agenda item by OSM and put forth as a problem is not considered to be an actual problem by the state. This leads to discussion, explanation, compromise, and/or change within one or both of the agencies. The important aspect of this is that both agencies have come to the realization that it is not in anyone's interest to be confrontational. The Illinois experience thus far has fostered what, at least in our thinking, is one of the best, if not the best, reclamation programs in the country.

In FY '84, the State of Illinois had a near perfect record in meeting the inspection mandate, and in FY'85 one complete inspection was conducted five days late. Since FY'86, the State of Illinois has met 100 percent of its mandated inspection frequency.

In FY'84, the Office of Surface Mining issued one Notice of Violation (NOV) and two Cessation Orders (CO). These actions were taken at two carbon recovery sites. At one of the sites, the Department had already issued an NOV and a CO, but was unable to get the Attorney General's Office to obtain an injunction. At the other site, the Department felt that the circumstances did not warrant enforcement action, but OSM disagreed and issued a CO which they upheld. In FY'85, OSM issued an NOV for exposed toxics. The Department had previously issued an NOV for gully repairs and contended that abatement would take care of the problem. OSM disagreed and later issued a CO for failure to abate.

Since FY'85, the Office of Surface Mining has not issued a Notice of Violation or a Cessation Order in the State of Illinois.

The Illinois Department of Mines and Minerals is proud of its program and its accomplishments. After five years of meeting its inspection mandate at 100 percent and aggressively enforcing the regulatory program, the Department feels that it is effectively implementing the Act. Although there is a cooperative oversight atmosphere in Illinois, the Department feels that more credit should be given where credit is due and that states with good program track records should be rewarded with redirected oversight that reflects their accomplishments.

Illinois has been granted primacy and has shown that it is willing and able to regulate surface mining and accomplish the goals of SMCRA. We are not contractors for OSM as has been the opinion of some within the agency. We are the regulatory authority and deserve the "exclusive jurisdiction" over our program that was promised in SMCRA.

The "New" Oversight Concept

With the passage of the Surface Mining Control and Reclamation Act of 1977, the Office of Surface Mining was given the responsibility of implementing the Act and was given the duty to guide and assist the states in developing and administering their own programs. Approval by the Secretary of the Interior of a state program that was no less effective in implementing the Act gave the state primacy and the opportunity to regulate their own mining industry under the watchful eye of OSM.

Congress could not possibly anticipate every situation which could arise in an industry as diverse as surface coal mining. Likewise, it was an impossible task to write federal regulations to address every situation that could be encountered in the field. This is evident by the continuous process of regulation development, revision, and modification as the program matures.

Similarly, not every state that has been granted primacy is given the same level of oversight scrutiny by OSM, as evidenced by the use of the federal NOV as an enforcement tool for dispute resolution in some primacy states and not in others. It could not be expected that every state and federal administration would be any less divergent than the industry that was being regulated.[4]

It was not until after most states had been granted primacy in 1980 to 1982 that OSM began to develop the policies and procedures that would be used to evaluate state program implementation and for the annual report format. These policies and procedures were eventually incorporated into OSM's directives systems as Directive Reg.-8,. "Oversight of State Regulatory and State and Tribal Abandoned Mine Land Reclamation Programs," and were revised each year based on experience and comments from various interest groups.[5] It was this directive that the Field Offices used to produce the lengthy annual evaluation reports with their numerous tables and endless statistical comparisons of state program performance.

In an effort to revise the oversight process and shorten the annual evaluation report, OSM established a five-member task force which met the first time on March 24, 1988. The revised Reg.-8 was finalized on June 30, 1988, and became effective on July 1, 1988, for the 1989 evaluation year. The states requested full involvement in the oversight revision effort and the task force was expanded to include state officials.

Over the next several months the task force developed a conceptual approach to state program evaluation and suggested that a prototype program be used to evaluate the effectiveness of the new policy. The task force suggested the prototype program be initiated for FY'90 beginning in July of 1989, and at the same time, the existing directive on oversight (Reg.-8) be revised to incorporate several of the critical elements contained in the new approach.

The intent of the new concept was to assure a meaningful analysis of what an effective state program evaluative review should entail with the objective of formulating an oversight policy that would provide a timely, comprehensive, and meaningful overview of state programs and implementation of the Act by the respective state regulatory authorities.

In the Executive Summary of the Oversight Concept Paper, the task force states that "Under the new conceptual approach, federal evaluation of state programs would move away from a yearly auditing type function that relies heavily on numbers crunching and 'bean counting' and instead focuses on a cyclical analysis of various state program elements from both a data collection and analysis perspective as well as an evaluation of on-the-ground results. Special emphasis is placed on how the states are administering their programs so as to accomplish the purposes and objectives of the Surface Mining Act as set forth in Section 102 of SMCRA."[5]

"The concept . . . suggests the use of a new type of annual oversight report that focuses on the accomplishments of the states, as well as potential problem areas. A summary of statistical information would be included but the emphasis would be on the state's effectiveness in achieving the goals and purposes of the Act. Resolution of potential issues at an early stage would replace outdated annual overviews that merely list deficiencies and fail to reflect how they have been handled."[5]

The task force felt that state program evaluation and not program management was "the only subject appropriate for oversight under the Congressionally contemplated doctrine of primacy. "[5] Furthermore, since state program implementation was dynamic and progressive, federal oversight policy should also be progressive, and states with good performance should be rewarded with more meaningful oversight.

The approach to oversight as proposed by the task force included the following:

- Evaluation of program elements on a multi-year cycle with each element scheduled in a joint state-federal work plan. The work plan was envisioned as a tool by which each program element would be reviewed in no less than two to three years with some elements reviewed more frequently than others. The work plan was to be a dynamic document that could be renegotiated by the state and OSM as issues changed.

- Reviews were to be specific with trend analysis and early identification of issues and problems and with resolution by state-formulated action plans. Issues were not to be saved for one-time reporting, but were to be resolved as they were identified.

- The method of testing the effectiveness of state program implementation was to be addressed via data analysis and random oversight inspections.

- The primary focus of oversight was proposed to be an on-the-ground review accomplished by random oversight inspections. This approach was to provide information on whether the purposes of SMCRA were being achieved in the field. Data and inspection report reviews as well as the oversight inspections were to focus on whether reclamation and environmental performances were being achieved and not just whether violations exist or were missed by the state inspector.

- The states were to develop and maintain data management systems that were compatible with the respective OSM systems so that data could be used by both the state for management purposes and OSM for oversight purposes. The task force concept paper stated that "...there is an apparent dichotomy between emphasizing on-the-ground results and utilizing a data management system for the collection and analysis of data that has been criticized as 'bean-counting'. However, an appropriately structured and limited data system should fit well into an overall oversight policy that emphasizes on-the-ground results while allowing identification of potential program deficiencies through trend analysis of the data."

- The states would have internal controls in place in accordance with state law that would assume the maintenance of adequate standards for program management under the doctrine of primacy.

- The statutory annual report would include a state-by-state narrative summary that would highlight accomplishments, identify potential problems, issues, and trends and would include data and statistics that supported the narrative conclusions.

- The current OSM organization was to be reviewed and possibly adjusted to reflect the new oversight approach. With field offices geared to a detailed annual review, it was felt that staffing may need to be reorganized or even reduced due to the anticipated change from the micro-management, hard-copy approach to the new approach.

The task force suggested that implementation of the new approach be phased in starting in July of 1989 for the 1990 evaluation year as a prototype program that would initially involve six states (Illinois, Oklahoma, Virginia, Alabama, Pennsylvania and Wyoming), with the rest of the primacy states being phased into the program by evaluation year 1992. As part of the phase in, the Oversight Directive (Reg.-8) should also be revised to reflect concepts put forth in the new approach and to be as dynamic as the new oversight approach was envisioned to be. The concept paper was viewed by many states to be perhaps the most significant development in the state-federal relationship since the enactment of SMCRA. This paper was unfortunately misunderstood by many and sharply attacked by the environmental community as a "plot" to gut oversight rather than recognition of the paper's real purpose—to redirect oversight to make it more issue specific based on identified problems and needs.

Fortunately, although somewhat watered down, the prototype program was approved for four states for the 1990 evaluation year. Illinois, Alabama, Pennsylvania, and Wyoming participated in the test of the revised oversight concept.

Prototype Program Results

The state-OSM task force that developed the prototype program recognized that the program would need to be monitored and evaluated for its effectiveness if it were to be supported by upper management in the Department of Interior and in the Office of Surface Mining. The task force recommended internal review with regular reports issued on a state-by-state basis and also an independent evaluation during the second year the program was in place.

A new four-member internal task force was formed within OSM by the Deputy Director for Operations and Technical Services on March 7, 1990. This task force reviewed quarterly progress reports prepared by the Field Offices involved in the prototype process at its initial meeting on March 15, 1990, and reviewed the evaluation criteria that were developed by the previous working group. The revised evaluation criteria were used as guidelines by task force members as each visited one of the prototype states and its respective field office and personally reviewed implementation efforts and results and interviewed appropriate officials.[5]

The *OSM Task Force Report on the Prototype Oversight Process*, dated July, 1990, states that "For the most part, prototype oversight efforts involve experimentation with state internal controls, data collection and management systems and on-the-ground reviews."[5] The report details the findings, conclusions and recommendations of the task force's evaluation of the new oversight concepts in the three primary areas indicated.

In regards to data collection and management systems, the task force report concludes that "with limited exceptions, states are collecting basic quantitative data concerning all applicable program elements, although not necessarily in an automated or readily accessible form." Illinois and Pennsylvania have provided OSM with direct access to their automated databases, while Wyoming provides printouts and a data disc. Alabama, because of state policy prohibitions, provides printouts and not direct access.

The report also concludes that the states are willing to work with OSM in data capture and reporting and because of the new data transfer procedures, most states no longer supply OSM with hard copies of inspection and enforcement documents which are not needed for oversight.

In regards to state internal controls and management systems, the task force reports that as a rule, the states seem content to rely on OSM as their internal control for program operations in relation to program elements of Directive Reg.-8. All of the prototype states have internal controls and management systems to verify data entry and accuracy but feel that OSM is the primary internal control for the elements of Directive Reg.-8.

Illinois considers OSM's suggestions of internal control systems to improve self-detection and correction of program implementation issues as an attempt to "micro-manage" the program because it feels the nature and frequency of the issues do not warrant the resources required for internal control development and maintenance. Larger than the micro-management issue, however, is the issue of cost. More internal controls mean more staff. Without additional funds, this is not possible. The Department cannot and will not redirect existing field inspection staff in order to hire administrative bean counters. This has always been OSM's traditional role, and they have shown themselves to be quite good at it. Until such time as the funding becomes available, the Department will concentrate on the quality and accessibility of its databases for OSM's use. This is apparently the same attitude held by the other prototype states as well as non-prototype states.

According to the task force report, there is some difficulty in determining overall success of reclamation capable of comparison on a national basis. Directive Reg.-8 requires all field offices to develop and implement a means of evaluating the on-the-ground performance of all primacy states as part of the oversight duties. The Knoxville Field Office has been assigned the task of reviewing the various field office methods and developing a national evaluation procedure.

Field offices have developed supplemental inspection report forms for expanded narratives and some have developed pre-inspection state file review forms to collect data pertinent to the on-the-ground effects of mining and the overall success of reclamation. OSM is approaching this element of oversight from the data collection and analysis aspect based on permanent program bond releases. According to the report, OSM does not feel that there is enough data available to conduct a meaningful evaluation of the success of reclamation and the off-site impacts of mining at the present time.

The task force findings state in part that "...both the states and the field offices believe the changes resulting from the prototype effort have been worthwhile and should be continued. In addition, OSM-state relationships in general have improved in the prototype states."[5]

Report recommendations were to (1) continue the changes in oversight and to encourage other states to adopt the new process; (2) require states to track and report data pertinent to their performance for each program element listed in Directive Reg.-8 as a grant performance reporting requirement; (3) OSM should encourage states to develop management systems and controls to monitor and enhance state performance for each program element of Directive Reg.-8; and (4) OSM should continue its current experimental efforts to measure and report overall reclamation success and on-the-ground effects of mining.

The most disturbing aspects of these recommendations is the proposal to use the administration and performance grants as a club to force states into developing and maintaining databases to track and report their own performance for each program element of Directive Reg.-8 and the emphasis that is placed on the development of management systems and internal controls by the states to monitor and enhance performance for each element of Directive Reg.-8.

CONCLUSION

Illinois, as well as several other states, has been in the business of surface mining regulation for many years. Existing state programs were used as models in development of the Surface Mining Control and Reclamation Act of 1977 (SMCRA). Prior to the enactment of SMCRA, the State of Illinois required reclamation to approximate original contour, replacement of the land's capability, and had provisions for public participation. Illinois incorporated the federal interim regulations into its existing Act and established the Interagency Review Committee composed of other state agencies effective August 11, 1978. These agencies were afforded the opportunity to review and comment on permit applications in regard to their areas of expertise.

With the enactment of SMCRA, the Office of Surface Mining (OSM) and the environmental groups approached the Illinois program as if surface mining regulation were something new to the states. The mining industry was oftentimes caught in the middle of state and federal controversies concerning the interpretation and implementation of the law. It was not until the mid 1980s that a more cooperative relationship with the state and OSM was realized.

Illinois was granted primacy in 1982, and the permanent program performance standards became effective on February 1, 1983. As a result of the federal regulatory reform effort of 1983, the State of Illinois revised its regulations to be no less effective than the federal regulations. The revised Illinois regulations were approved by OSM on October 25, 1988.

Unfortunately, the Illinois regulations are little more than a mirror image of the federal regulations. Some work well while others are meaningless and/or a burden to both the operator and to the Department. The wide diversity in terrain, climate and other conditions requires regulations that fit the situation. Just because a state regulation isn't worded exactly like its counterpart federal regulation doesn't mean it is any less effective.

Oversight of state programs by OSM has traditionally been confrontational. The policies and procedures by which the states were to be evaluated were not developed until most states had been granted primacy. These policies and procedures which were incorporated into the OSM directive system as Directive Reg.—8, "Oversight of State Regulatory and State and Tribal Abandoned Mine Land Reclamation," should have been developed at the time of the enactment of SMCRA and with state input. This approach would have resulted in less "bean counting" and more meaningful evaluations.

SMCRA promised states primacy and the right to "exclusive jurisdiction" in regulating their own programs. OSM is having great difficulty in relinquishing control. Their approach of "micro-management" and "second guessing" the regulatory authority at every juncture is contrary to the intent of Congress and to cooperative federalism. Although the Illinois Department of Mines and Minerals and the Springfield Field Office have developed a cooperative approach to implementation of the Act and to oversight, there still exists a widely different perspective of true primacy. Illinois' many years of experience with surface mining regulation, its willingness to do the job, and the fact that the Department is composed of a highly qualified and professional staff should be rewarded with less micro-management and more finely-tuned and meaningful oversight.

The state-federal oversight initiative of 1988 and 1989 is considered by both the states and field offices involved to be worthwhile. The results of the program after only one year are encouraging and have shown that it is better for both parties to cooperate and function as partners than to be at odds with each other. Directive Reg.—8 and the evaluation work plan need to be dynamic. These documents need to reflect the diversity of the agencies that are being evaluated. Continued efforts in refining the process and implementing the new oversight concepts in additional states will further the concept of "cooperative federalism" and allow the states to become the primary regulators of their mining programs as was intended by Congress.

Finally, the OSM Task Force Report on the Prototype Review Process placed heavy emphasis on state development of management systems and internal controls for each element of Directive Reg.-8. The report even suggested using state program grants as a lever to force the states into tracking, maintaining and reporting the data for each of the Reg.-8 elements. If this is to be the case, then OSM should provide full funding for the resources necessary to accomplish this goal.

On August 29, 1990, OSM approved amendments to approximately sixty Illinois permanent program regulations (see Federal Register, Vol.. 55, No. 168, dated August 29, 1990). Of particular importance to Illinois is the approval to exempt wholly incised impoundments and impoundments which do not facilitate mining or reclamation from the requirements of quarterly examinations and yearly certified inspections. Illinois field inspectors are certified as impoundment inspectors by the U.S. Mine Safety and Health Administration, and it was determined that the quarterly complete inspections by the field inspector would be adequate to effectively implement the counterpart federal rule. This type of action, allowing the state to conduct business based on local conditions, is the essence of primacy. The use of the "State Window" in program implementation needs to be encouraged by the states and implemented to a greater extent by OSM.

On July 25, 1990, OSM approved a program amendment for the State of Wyoming that allows the citation of minor violations and the establishment of an abatement date in an inspection report (see F.R. Vol. 55, No. 143, dated July 25, 1990). The State of Illinois tried this approach to enforcement for minor infractions several years ago, but was informed by the Field Office that each of these would be tracked as uncited violations for the annual report. Hopefully, the State of Illinois will also be allowed to amend its program to incorporate such a system of enforcement. A field inspector can accomplish much when allowed to work with the operators in a reasonable manner as opposed to punishing them with NOVs.

Congress was the architect of a grand structure in SMCRA. Like any other structure, it is only a reality because of the laborers who built it. Federal policymakers need to be familiar with and sensitive to the industry, the people, and the state being regulated in order for the laborers to build that grand structure of SMCRA. True primacy will not be realized until the state-federal partnership envisioned by Congress becomes a reality in the field. The states and OSM have, at least theoretically, the same objective. Now, let's work together to get it accomplished.

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Heinz Damberger: Thank you, Dale. Tom Lippencott is unable to close the meeting. He had to leave to catch a plane, so he asked me to take care of that aspect. First, do we have any discussions about this paper?

Let's thank all the speakers that gave us a good program this morning.

LUNCHEON MEETING

The Annual Institute Luncheon Meeting convened at 12:15 P.M. in the Ballroom of the Ramada Hotel. Approximately 175 members and guests were in attendance. President Richard R. Shockley presided.

Richard Shockley: Welcome to our luncheon meeting. I would like to introduce the people at the head table. Please hold your applause until I have introduced everyone.

On my far left is someone you have already met, my former supervisor and boss for many years, E. H. (Buster) Roberts who gave the invocation. Next to him and with us again is Jack Simon, who headed our Illinois State Geological Survey for many years. Next to Jack is a gentleman some of you may not see everyday, but he is very active whether you know it or not. He is vice president of the Illinois Coal Association, Taylor Pensoneau. The next fellow is our guest speaker and I am going to introduce him later. To my left is Danny Wooton from White County Coal, who is our President-Elect. He will be serving you next year. To my far right is Dean Spindler of the Department of Mines and Minerals. He is a soil specialist, and he will be giving an award in a few minutes. To his left is Mike Reilly whose name has been in the paper this week more than mine, thank goodness. He is our President for 1992, our Centennial year. To my right is Jack Bennett who was an executive with Peabody Coal, now retired and working for his wife. We will be talking more to him a little in just a few minutes.

I wonder how many past presidents we have with us today. All of you past presidents please stand. How about honorary members? How many honorary members are here? We are glad to have you here.

How many of you presidents did what I did? I've been strutting around here with this ribbon on my chest making you think I've done a lot of work this year, but really those who have done the work are over here at this table to my right: Phyllis Godwin and the people who have been working with her at the registration desk, and some of the people from the Illinois State Geological Survey that do most of the work that the presidents get credit for. We need to give them a big hand of appreciation.

The Illinois Mining Institute has been very successful in the past several years as it is this year, in being able to give scholarships to some of our schools in this state and adjoining states. Frank Snyder, chairman of our Scholarship Committee, will share with you what the program is this year.

Frank Snyder: Thank you, Dick. We are going to recognize the scholarship recipients. Dr. Chugh (SIU) would you like to introduce your students.

Paul Chugh: [Dr. Chugh introduced and presented certificates to the following scholarship recipients from Southern Illinois University: Mary Evans, Brian Hoyt, Stan Reeder, and Richard Robben.] In addition to these students we have some undergraduate students that I would like to recognize: Erica Baird and Tricia Lockett. And we have a graduate student Mr. Jun Jun Yan. We also have some faculty members: Professor Caudle, he is advisor to our student group; Dr. Bradley Paul, he is assistant professor in our department; Dr. Sevim, who is looking at the aspects of coal waste utilization and disposal.

SIU-C scholarship recipients with Dr. Y. P. Chugh; left to right: Richard Robben, Brian Hoyt, Stanley Reeder and Mary Evans.

Frank Snyder: Dr. Norman Smith, University of Missouri, Rolla.

Norman Smith: Our scholarship winners are: Charles Comeau from Lebanon, Missouri, a senior. We have Daron Hunt from Alton, Illinois, a junior. And, we have Fred Tullmann from St. Louis, Missouri. He is a junior, also. Besides those three, we have nine more students from Missouri School of Mines I'd like to recognize. Michael Serrage, Missouri; Brad Grigsby from Eldorado, Illinois; Roger Hickam from Goreville, Illinois; Steve Kinsey from Marion, Illinois; Joe Bond from Greenville, Missouri; Mitch Scherzinger, St. Louis and one other person, David Snyder, who says he's from back east somewhere.

We have four staff here, and I'd like to introduce them: Dr. John Wilson and his wife Megan. John is our new department chairman. Dr. Paul Worsey, and Troy Harris, who runs our experimental mine. Thank you.

Dr. Norman Smith with scholarship winners from University of Missouri-Rolla; left to right: Fred Tullmann, Daron Hunt, Dr. Smith and Charles Comeau

Frank Snyder: Next, I'd like to hear from Wabash Valley College and the silver fox, Professor John Howard. John and I have been friends for a long time. I might mention to you that John prepares these certificates for the Illinois Mining Institute.

John Howard: We have four recipients who are here: Jason Cartwright, from Harrisburg, Illinois who attends Southeastern Illinois College; Curtis Grant from West Frankfort, who attends classes at John A. Logan College in Carterville; Robert Sauls from Norris City, Illinois attending Southeastern Illinois College; and Richard Voyles, who also attends John A. Logan College.

Professor John Howard with scholarship winners from Wabash Valley College, left to right: Jason Cartwright, Curtis Grant, Robert Sauls and Professor Howard.

Richard Shockley: Thank you, Frank. Well, it looks like we are raising up some young engineers for the coal business in the years to come.

Earlier, we requested all to give us names of any of our members or former members who deceased this past year. As of this time, we have not received any names for the listing. Have we missed anyone that we need to make mention of at this time.

HONORARY MEMBERSHIP AWARD

We have a very active group of committees this year, and the Honorary Member committee has been so active that they are going to make me introduce the recipient. We have an outstanding person to receive the Honorary award today. He comes from a long history of coal mining. He just shared with me that he used to be a superintendent and his father was a mine manager at the same mine. How would you like to be in a situation like that where your dad was working for you. We've all dreamed of those situations, but he had that experience. His grandfather earlier worked in the same mine where he and his father worked. This gentlemen is a person that all of us are acquainted with, and one who has been active with us here in Illinois. He is also one of those depression babies, like many of us were, too, starting out with things being sort of meager He attended Davis and Elkins College in Elkins, West Virginia. He is from West Virginia. He received a degree in physical education, went into the military shortly thereafter and served as a First Lieutenant in the Army Medical Corps. During that time, he got married and had two sons.

He worked in the coal mines in West Virginia, for North American in Ohio and then spent several years here in Illinois in the midwest with Peabody Coal. He started out as a draftsman in this mining business and gradually moved up into various positions that many of us look forward to in any career path. He retired January 11, 1989. He was Vice President of Peabody Coal Company and President of the Illinois Division. In that position, he was responsible for mining operations, engineering, reserve management, human resources, customer service, and finance in surface mines in Illinois, Missouri, and Oklahoma. Most of you already know who I'm talking about, but it gives me great pleasure to present this certificate and life membership to Mr. Jack Bennett.

Jack Bennett: To receive an honorary membership in an organization that is 98 years old and is known as one of the better mining institutes in this nation, is quite an honor. It is flattering to have my name placed with previous members that are honorary members. It is quite a list. I'm proud to accept this award, and I am also accepting this award with the people who have worked for me and with me. Any success that I might have had, these people, especially the people in the midwest, had a great deal to do with it. You're the best. Thank you very much.

Richard Shockley: Last year, we gave a land reclamation award to one of our companies in Illinois for outstanding land reclamation and we have another award this year. I will call on Dean Spindler, our soil specialist from the Department of Mines and Minerals, to make that presentation.

LAND RECLAMATION AWARD

Dean Spindler: In 1987, the Land Reclamation Division of the Department of Mines and Minerals established an award program for excellence in reclamation. Criteria used to judge this program include: innovative reclamation practices and reclamation beyond that called for in the regulations. The reason for this program is to enhance reclamation practices and to recognize those companies doing exceptional work. Each year the competition gets tougher, which makes our job judging even harder. In the end, both the society, the environment, as well as the coal industry benefit from all the good work done by all the operators.

This year's winner is AMAX Coal Industries, Inc., for reclamation work at its Sunspot Mine. AMAX is being recognized for innovative techiques in reclamation by transforming a large portion of its former support facilities and mine into an alfalfa feeding facility and hay market operation after the mine had closed. As we all know, a coal mine is a major financial asset to a region during its operation. When the mine closes, however, there is a significant impact on the local economy. The transformation of the mining operation to a large-scale agricultural operation has helped to offset that impact. A whole new industry was created at this site. Not only were the mine facilities used and the reclaimed ground used for this hay for high quality feed, but a new hay market was opened for neighboring farmers in the area.

On behalf of Director Shockley and Paul Ehret, our divisional supervisors, I wish to thank AMAX for its past efforts and hope that this new industry will be a continued success and model for other companies. We wish to thank all the competitors for their good work in reclamation as well. We would like to ask Delbert Tarr, the general manager of the Alfalfa operation at the Sunspot Mine to step forward and accept the 1990 award. I will also be presenting an honorable mention in the national competition from the Interstate Mining Compact which recently bestowed the award as well. Our department gives a nice certificate for their office as well as a nice plaque.

Dean Spindler of the Illinois Department of Mines and Minerals presents plaque and certificate for Land Reclamation Award to Delbert Tarr of AMAX Coal Company.

Richard Shockley: We are glad that AMAX has this recognition. Now we come to the main part of our program for the day. We have an outstanding speaker with us. Taylor Pensoneau, Vice President of the Illinois Coal Association and an old friend, will make the introduction.

Taylor Pensoneau: Thank you, Dick. It is inevitable, isn't it, that every time we have an Illinois coal gathering, sooner or later it has to get around to acid rain. As we all meet here this week, of course, the conference committee is continuing to work in Washington to resolve differences between the Senate and House versions of the federal clean air legislative package passed earlier in the year already by each house. Conferees report that they have reached what they call the mid-point in efforts to get a comprehensive measure that will receive final approval in each chamber. As for the acid rain control provisions, which, of course, are of primary interest to those of us in this room, discussions are in progress. However, irrespective of the outcome, there is little doubt, really, no doubt, that reductions are going to be required in sulfur-dioxide emissions, that are going to force our utility customers here in Illinois and other states to make some really big time decisions on whether to use clean coal technology so as to continue to use our Illinois coal or whether to just switch fuels, using low-sulfur western coal or possibly natural gas.

Now, I should say that the turmoil created by the Persian Gulf crisis has prompted speculation in some places that the clean air package may not get out of Congress at all this year. I'm not sure, but perhaps our very excellent speaker today may be among that number. However, I should say that before we all get too excited about this, most participants—most players in Washington, still feel otherwise. They say that Congress is going to recess for the fall election campaign by the end of next week or no later than the end of the following week. And by that time the Congress committee will have an agreed bill that has the blessing of both houses. Then, of course, if that happens, everybody assumes that President Bush will sign the bill.

That gets us to our speaker here today. He's a good one. Dr. Edward Krug, a very knowledgeable individual on the acid rain issue and also a very interesting gentlemen. Although Ed now lives in Winona, Minnesota, I got to know him well during the past five years when he had a very important role as an Associate Scientist with the Illinois State Water Survey. In that role, Ed, who is a soil scientist, did research on an assessments of the acidification of soils and water in the United States and Canada, Australia and New Zealand. The results of his efforts were incorporated into the work of the National Acid Precipitation Assessment Program (NAPAP), which recently submitted its conclusions of the acid rain issue to Congress. As many of you know, the Illinois State Water Survey is the central analytical laboratory in the whole nation-wide NAPAP program.

Prior to his role in Illinois, our 43 year-old speaker was employed from 1980 to 1985 by the state of Connecticut where he also worked on the acid rain issue. Specifically, he worked with the Connecticut Agricultural Experiment Station at New Haven. A native of South River, New Jersey, Ed has three degrees from that state's Rutgers University. They are a bachelor's degree in environmental science, a master's degree in soil chemistry, and Ph.D. in soil science. And let me add that Ed was the valedictorian of his graduating class at Rutgers. He has had a view on the acid rain issue that has been different and apart from the view of a number of other scientists and certainly from the national media and some other people. Ed has spoken out in a way that has often supported the way we have seen the issue out here in Illinois and for that he has taken some heat, some criticism, especially from environmentalists and others. He is a very outspoken individual and he is very well-versed on the issue. He has a view of it from long participation and perspective that will be a little different from that that you often hear or read about in this day and age. However, Ed is going to cover more territory than just the acid rain issue. He is going to try to put the issue into a broader perspective—to paint the bigger picture surrounding this issue and the bigger picture growing out of this matter. I think that we are lucky to have Dr. Ed Krug with us here today.

Friday Luncheon speaker Edward Krug.

ACID RAIN: AND JUST MAYBE THE SKY ISN'T FALLING

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Washington, D.C.

INTRODUCTION

Industry's Credibility Crisis

Surveys show Americans think environmental conditions are worsening and would sacrifice economic growth to protect it. A majority (67 percent) agree with the statement that "threats to the environment are as serious as the environmental groups say they are." Only six percent said they trust scientists seen as representing industry (*Washington Times*, August 15, 1990).

Scientific truth is not established by vote, but political reality is. Government has been responding to this public mandate through legislation that is strangling material extraction and production. Similarly, environmentalists are winning almost all litigation largely through precedent-setting cases such as Sierra Club v. Morton (1972), where environmental groups are legally recognized as representing the public interest. This seriously weakens recognition of the public interests served by industry.

In the ongoing struggle over public opinion, environmental legislation and litigation, environmentalists are portrayed as the idealistic defenders of the public interest and Mother Earth. Their opponents are viewed as Darth Vader in a three-piece suit--special interests opposed to the common good.

A key mistake made by industry is examining issues one by one rather than analyzing the underlying ideology of environmentalism. By responding to accusations and always being on the defensive, industry gives the appearance of always hiding something. This supports the environmentalist image of good against bad.

There are those who have decided that if you can't beat 'em join 'em. Over half of the financial support ever received by environmental organizations has come from the great private-sector foundations. As Ron Arnold, the environmental pioneer, observed this attempt "to co-opt the environmental movement with massive foundation grants ... only sold rope to the hangman" (Arnold, 1987, p. 10, 53). By not grasping the true nature of the conflict, industry's effort has been turned against itself.

THE ENVIRONMENTAL PARTY

Environmentalism has emerged to become the preeminent American political party. Twelve organizations comprise the base of support for the Environmental party. "All told, the Environmental party has an operating budget of $336.3 million (1988) and a donor base of 12,959,000. That's nearly $250 million more than the Republican and Democratic parties combined and a donor base of some 10 million persons more!" (Rep. Dannemeyer of CA, September 1, 1990). About 90 percent of funds go to support political activities.

The Environmental party attracts well-meaning citizens who are honestly concerned about pollution and conservation—wise use of the Earth's resources. Having established the moral high ground, a large and highly-motivated corps of volunteers and professionals, and overwhelming financial resources, the Environmental party has become the proverbial 800-lb gorilla. As if this is not enough, government and mass media are natural allies of the Environmental party.

To help understand government's role as an environmental ally, think of government as the business of regulation. Like all businesses, the business of regulation seeks growth. However, even governmental growth is not risk-free. It has the inherent liability of incurring the displeasure of the consumer (taxpayer) by increasing the cost (taxes) of the product. Environmental legislation, however, is like manna from heaven: a free ride in that it is an off-budget tax. The government is thus perceived as working literally for free for the common good. Industry has few friends in the media. A report of the Media Institute shows that "Television almost never portrays business as a socially useful ... activity." Americans love the underdog. Stories of the "common citizen" battling against the industrial giants are popular and, like government's environmental involvement, pays big dividends with little risk. The myth of the great lobbying power of the "Timber Barons", "Oil Monopolies", and "Mining Kings" support the image of a David v. Goliath conflict.

Objectives

Very few of our fellow travelers on Spaceship Earth realize the fundamental goals of the Environmental party. This is partly because well known environmental organizations, such as the Sierra Club and National Audubon Society, started out as bona fide organizations promoting wise use (conservation) of the land. However, as Ray Arnett (former National Wildlife Federation President - the largest of the 12 organizations) noted, the "National Wildlife Federation was known as the largest conservation education association in the world. Now they have moved into advocacy, lobbying" (Warren Brookes, *Detroit News*, March 11, 1990).

This cover is used to distract from the fact that environmental advocacy is merely a means to an end which lies in the domain of social engineering. As the best-known environmentalist of our time, Dennis Hayes, observed for the first Earthday, "We feel that Earthday has failed if it stops at pollution, if it doesn't serve as a catalyst in the values of society" (*Newsweek*, April 13, 1970).

What are these values? Ron Arnold states: "America's new-found sensitivity to nature came packaged in a strongly anti-industry, anti-people wrapper. It came with a gut feeling that people are no damn good, that everything we do damages nature and that WE [emphasis added] must be stopped before we totally destroy the earth" (Arnold, 1987, p. 10).

Environmental advocacy has long relied on emotive arguments. To this already impressive arsenal is being added an ever-increasing array of the super-firepower weapons of science advocacy. To quote Jonathan Schell, who theorized nuclear winter: "We have to offer up scary scenarios, make simplified, dramatic statements, and make little mention of any doubts that we might have" (*Discover*, October, 1989).

Environmental Science: Upon These Conclusions Our Facts are Based

Advocacy is the anathema of science. As students of law learn in forensic debate, advocacy is not objective. Skepticism, not advocacy, is the heart of the scientific method (Chamberlin, 1965). Accordingly, society bestows scientists with the privilege of being principally self-policing since it is our responsibilty to be skeptics who eschew attachment to theories, causes, and other forms of self-interest in the outcome of science. Because it is obvious that self-interest creates conflict-of-interest, rarely are human endeavors so exclusively self-policing as is science.

With the no-holds-barred advocacy of environmentalism, the end justifies the means. Advocacy disguised as science is the most powerful modern weapon of persuasion. People of all political beliefs regard science as being objective "Truth". Clearly, the growth of scientific advocacy - be it nuclear winter, acid rain, or global warming - is a cancer on science. Such activity is science in name only. When science stops, so stops the progress of modern civilization. And so goes the respect and privileges that society bestows on us scientists.

Acid Rain

The Norwegian national acid rain program of the 1970s was the forerunner of the national acid rain programs of the 1980s. The Norwegian parliament's enabling legislation (Nr. 172/1974) stated that the express purpose of the program is advocacy disguised as science: "to provide material for negotiations to limit the emission of SO_2 in Europe" (Rosenqvist, 1990).

The U.S. National Acid Precipitation Assessment Program (NAPAP) owes its existence to the belief established by unfounded but repeated assertions from authoritative sources that acid rain has created an aquatic "silent spring" - thousands of Northeast lakes were allegedly dead with thousands more soon to die. For example, in 1980, the U.S. EPA asserted that the average lake in the "sensitive" northeastern U.S. has been acidified 100-fold (2 pH units) over the last forty years as the result of acid rain. In 1981, the National Academy of Sciences asserted that the number of acidified lakes would double by 1990. However, when an analysis of the state of the environment was finally done, the environmentalists did not like the answer. In 1987, when NAPAP released the national lake survey, results showing only hundreds, not thousands of acidic lakes in the Northeast, and that the number of acid lakes is not changing, its director was pressured into resigning.

The Environmental party's furor over NAPAP's lake survey and mislabeling that assessment as "bad science" not only successfully distracted the public from realizing that acid rain is not responsible for any environmental catastrophe, this red herring also diverted us from the fiction of acid rain's so-called science.

Strange Science

If we were in second grade and the teacher was pouring water through peat moss and we insisted on answering that he was pouring water through lime-bearing gravel, we would get a zero. Moreover, we would then be led by the hand to the school psychologist for examination. However, in 1984 a National Academy of Sciences panel of world-class acid rain scientists was lauded for precisely that answer. They reported a "scientific consensus". Because acid lakes and streams receive their water principally as runoff through highly acidic peaty soils and associated acidic vegetation (such as Sphagnum mosses) - which have little in the way of mineral substances to remove acid - but slight additions of acid were asserted to result in tremendous increases in acidity (large decrease in pH) of runoff. Since lime-bearing gravel can only produce alkalinity and not acidity, acid rain was asserted to be responsible for the acid lakes and streams.

Such strange science fails the reality check. The existence of peat moss is impossible to reconcile with acid rain theory. But peat moss does exist and it is the diagnostic of "sensitive" watersheds. Unfortunately, acid rain is not a typical scientific discipline where the reality of peat moss would instantly disprove the theory. Furthermore, acid rain theory predicts that soils cannot impart acid to water. That soil scientists measure soil acidity by mixing soil in water and then measuring the acidity that soil imparts to water is yet another "silver bullet" in the heart of the acid rain theory.

Three categories of NAPAP research also invalidate acid rain theory. One, isotope-dated lake sediments indicate that acidic lakes "were relatively common in the Adirondack Mountains and New England before the Industrial Revolution."

Two, laboratory and watershed experiments support the sediment research by showing that "clean rain" on acid soils gives acid runoff that resembles soil pH. This should be no surprise to soil scientists as we use 2.5 to 5 volume ratios of water-to-soil to measure the pH of materials like peat moss. This is equivalent to a flood of biblical proportions—10-to-20 inches of instantaneous rainfall on four inches of peat moss. Acid rain has little or no measurable effect on the acidity (pH) of runoff (figure 1). Again, this should not be a surprise to soil scientists. Materials like peat moss are well buffered acids containing about 100,000 times the pH measure of their acidity (e.g., Brady, 1974, p. 384).

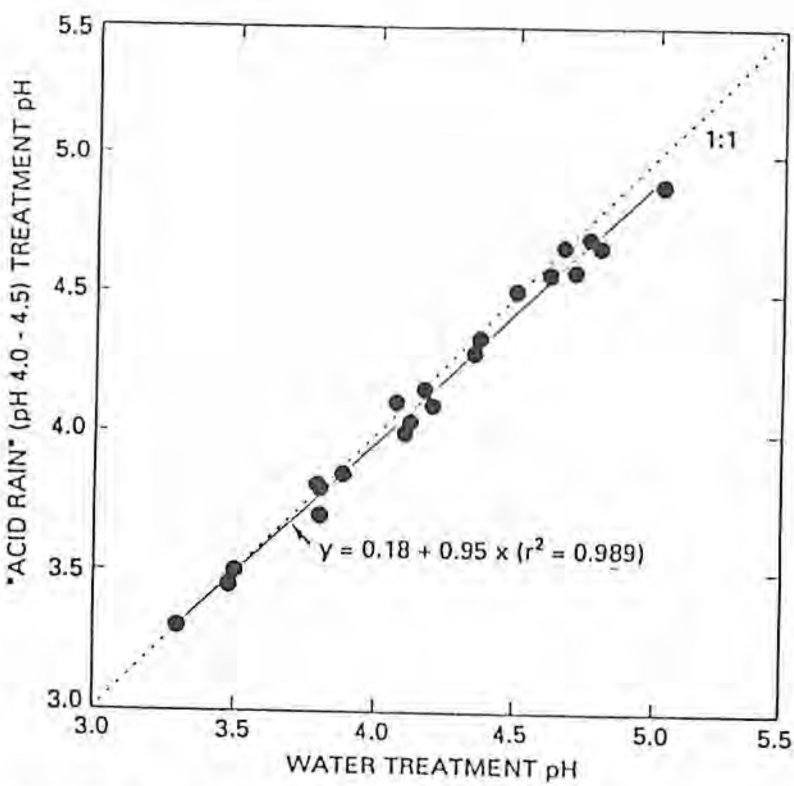

Figure 1. Relationship between the pH of water from "acid rain" and "clean rain" drained or separated from soil. Data from Cronan, 1978; 1980; Abrahamsen and Stuanes, 1980; Mulder, 1980; Wiklander, 1980; Jones et al., 1983; Chang and Alexander, 1984; Wieder and Lang, 1986; David et al., 1989.

Three, the magnitude of acid-dead lakes and streams in areas of the world having acid soils but not acid rain dwarfs that of areas supposedly "devastated" by acid rain. In the Amazon basin, a river the size of the Mississippi, the Rio Negro is naturally acid-dead. The naturalist and explorer Alexander von Humbolt wrote about these "rivers of hunger" nearly 200 years ago, definitely pre-dating industrial activity in the jungles of the Amazon.

About 3.5 percent of lakes in "sensitive" watersheds of the eastern U.S. are acid-dead. In Australia and New Zealand there are "sensitive" watersheds similar in character to those in the eastern U. S., southern Norway, and eastern Canada. Anywhere from 28 percent to 79 percent of the surface waters in these southern hemisphere locations are acid-dead. There is no acid rain here. The World Meteorological Organization and others monitor the atmosphere and precipitation here to see what clean atmosphere and precipitation actually looks like (Krug, 1989).

Any one of these facts is enough to be the proverbial "silver bullet" through the heart of the acid rain theory. That a whole bandolier of such silver bullets has been shot into the heart of the theory and the theory still lives, illustrates that acid rain theory derives its life from something other than science.

Ozone Depletion

In 1985, a British group at Halley Bay, Antarctica, announced they had found that stratospheric ozone declines to about 150 Dobson units in October, or about 50 percent of the expected value. This is known as the "ozone hole", widely reported to have started in the late 1970s because of the use of CFCs as refrigerants. However, the British ozone observatory at Halley Bay, Antarctica, was started by Gordon Dobson in 1956. Dobson observed this temporary disappearance of 50 percent of stratospheric ozone in 1956. It was not reported until it was observed again in 1957. Thus, the "ozone hole" pre-dates by 20 years when environmentalists tell us it first occurred, pre-dating the possibility of CFCs being the principal cause of the "ozone hole".

Oxford University professor Dobson was not some obscure scientist in the field of modern ozone measurement. He started modern ozone observations, and the measuring unit for ozone (the Dobson unit) is named after him.

Global Warming

A call to 1-800-TOO-WARM connects us with the likes of William Shattner (Star Trek), Lloyd Bridges (Sea Hunt) and John Ritter (Three's Company) who tell us about the horrors of global warming. This is just part of "the Sierra Club informational campaign ... designed to move that process along with the urgency normally felt as one's feet approach the flame" (*Sierra*, May/June, 1990, p. 19). Unfortunately, there are plenty of "scientists" who are making glorious careers out of also giving us the Sierra Club hot foot.

In the summer of 1988, a NASA scientist, James Hansen, turned the world on its head by stating the climate record of the 1980s shows that it is 99 percent certain that greenhouse warming is here. Dire consequences of temperature changes were predicted for forests and agricultural crops. That NASA's own data show no global warming was somehow overlooked by this NASA expert. Strangely, when NASA's data are brought up "greenhouse experts" point out that the NASA data cover too short a time period to establish trends in temperature even though these NASA data go back to the 1970s and are more comprehensive and are of higher quality than the data used by Hansen to start the greenhouse scare in the first place.

As with acid rain, picayune technical arguments about arcane technical issues distracts from the fact that we have reality checks on global warming theory - namely the crops and forests that we are being told are beginning to fry. Changing temperatures are having a negative impact on forests and crops. But the bad effects are those of increasing cold, not warmth.

USDA climate growing zone maps have required changes to show cooling not warming. For example, citrus crops were successfully grown up to Charleston, South Carolina around the turn of the century. The citrus belt has subsequently shrunk out of South Carolina, then Georgia, then northern Florida, and is now moving south out of central Florida. Mountain forests are also becoming increasingly more damaged by winter weather. However, increasing cold damage is being blamed on acid rain, not increasing cold.

"Greenhouse experts" do not advertise the fact that the World Meteorological Organization was established in the late 1970s because of concern that we are heading into a new ice age. In fact, given the periodicity of the last seven ice ages, we are due, or even overdue for the next one.

Assessment of the Problem

We continually hear global warming merits draconian sacrifices to avert global disaster. Nevertheless, world-class agronomists, geologists and environmental scientists of the United Nation's Intergovernmental Panel on Climate Change (IPCC) find that if global warming occurs to the degree and extent that the doomsday global warming models predict, it will be of great benefit to the world (table 1). What these IPCC data mean for the U.S. alone is an increase of $12 billion per year in food production, $30-50 billion per year in water resources, an increase in wood of 80 billion cubic feet, more than $500 billion in wood by 2050.

Table 1. The Effects of Doubled CO_2 by 2050*.

Country	Temp. Rise	Food Prod.	Water Res.	Forestry Volume	Shoreline Costs
USA	2.5	+ 15%	+ 9%	+ 10%	$ 25.0
USSR	3.0	+ 40%	- 1%	+ 20%	1.0
EEC	3.0	+ 20%	+ 6%	+ 10%	25.0
China	2.5	+ 20%	- 1%	0%	5.0
Australia	2.5	+ 25%	+ 15%	0%	2.0
Brazil	2.0	+ 15%	+ 17%	- 3%	3.0

* Temperature rise in °C. Shoreline costs in billions assuming a 50 cm. rise in sealevel. EEC is the European Economic Community. Source - Climate Impact Response Functions, September 11-14, 1989, Coolfont, W.V. United Nations Intergovernmental Panel on Climate Change (IPCC) and National Climate Program Office, NOAA.

Archeology and the biological fossil record support the IPCC conclusions by showing that the world was a much better place to live in when it was warmer. That is why archaeologists and natural scientists call the several thousand year warm era prior to the present "Little Ice Age" the "Climate Optimum". However, the IPCC estimates are underestimates of the benefits of global warming. During the Climate Optimum, continental interiors were wetter not drier, as predicted by the models. For example, many of the American Plains Indians were not Plains Indians prior to about 1300 A.D. They were forest Indians who planted corn and hunted elk and deer, not buffalo. When it got colder, it got drier, the forests shrank, the plains and desert expanded. Forest Indians became Plains Indians. And Plains Indians of the Far West left when plains became desert, driving out and killing their neighbors, the cliff city dwelling Indians.

Also, CO_2 is the ultimate plant fertilizer. Over 1,000 laboratory and field experiments show that, on average, a doubling of CO_2 increases plant productivity by about one-third. Commercial greenhouse growers, whether growers of tomatoes or tropical orchids, elevate concentrations of CO_2 in greenhouses to increase yield. Science indicates that increases in temperature, moisture, and CO_2 inherent to the global warming scenario will transform the Earth into a Garden of Eden and not a den of death as we are led to believe.

It is frightening to read that even in light of the IPCC's very conservative assessment of the benefits of global warming (if it will even occur), the IPCC is recommending draconian sacrifices to stop this make-believe catastrophe. It is even more frightening to read that the stated fundamental goal of the formal negotiations toward an international convention on global warming is no less than the development of a statist world government which will control every activity of life in excruciating detail (Nitze, 1990).

Conclusion

Those who manipulate science as a tool of persuasion do not respect the sanctity of science. Nor do they respect the sanctity of an individual's right to self-determination. Their belief is that given the truth, we the people do not have the ability to make the "correct" decisions. Only they have the ability to come to "correct" decisions. They view the present world order - which places power in the hands of the people - as an act in bad faith. They must feel ironic validation of their low opinion of us in using our own institutions to force the world through a form of boot camp in which they break us down and remake us in a new green image.

Enviromentalism and Social Responsibility

On the cover of the February 10, 1986, issue of *Newsweek* is a dramatic picture of the space shuttle Challenger exploding in midair with the caption, "WHAT WENT WRONG?" The answer: O-ring failure. The problem O-rings worked fine for 15 years until asbestos was taken out of them. Then with the new "safe" asbestos-free O-rings, 4 of 12 shuttle flights showed O-ring erosion. In the fateful thirteenth flight, O-ring failure was catastrophic, killing all seven astronauts aboard the Challenger.

Challenger blew up because of the environmental crusade to take all asbestos products off the market. The EPA considered all forms of asbestos to have the toxicity of the most toxic asbestos mineral, crocidolite, which was used in only 2 percent of commercial asbestos.

But Challenger is just the tip of the iceberg. Consider the over $100 billion to unnecessarily remove asbestos from buildings and the resulting unnecessary exposures to it. Consider what must be over a trillion dollars in property devaluation because of such perceived hazard and financial liability and what this is doing to our economic vitality, including the S & L's and other financial institutions who hold the mortgages and the EPA-manufactured risk. Now consider the death and disease in Third World countries who cannot use asbestos piping for sanitation because they accept our aid. Asbestos is one of the many materials that the Environmental party is attacking.

Risk

Starting with the first federal water pollution law in 1948, our government has given itself increasing authority to regulate everything from noise to wildlife. With the passage of RCRA (the Resources Conservation and Recovery Act of 1976) and "Superfund" (the Comprehensive Environmental Response, Compensation, and Liability Act of 1980), government now has the authority to regulate literally every substance in existence (Arnold, 1987, p. 15). Government also has the means to label anything a carcinogen.

By definition, a substance shown in any study to cause cancer at any concentration is defined as causing cancer at all concentrations. The definition of carcinogen does not recognize thresholds. Take a common substance, like quartz, and add massive enough amounts of it to damage lung tissue. Such damage causes the body to respond by inducing rapid cell division to make up for the dead cells. Rapid cell division is a condition which, in and of itself, increases the likelihood of cancer. Just one study out of hundreds showing cancer–or even benign tumors–gets that substance labeled a carcinogen. Negative results do not count. It was such testing that now allows the EPA to label quartz a carcinogen and rocks containing more than 0.1 percent quartz as toxic material. Such idiocy also means that metals such as iron, chromium, and selenium are toxic at any concentration - remember threshold values are defined as not to exist. However, these "carcinogens" if deficient result in anemia (iron), diabetes (chromium), and heart disease (selenium). Thus, the Environmental party has the means to subdue any resource extraction and production activity.

The risk that the Environmental party has is that the public is educated enough to know that common beach sand and iron are not normally cancer-causing agents. However, this risk of offending public sensibilities does not exist for most things because, in our post-industrial society, few of us are directly involved in resource extraction and production. Technical people are also pretty ignorant of the overall picture because increasing specialization is making our expertise thumb-wide and mile-deep. Add to these demographic factors the shaping of public perception by environmental "education," and the risk of offending public sensibilities becomes quite small. The media/government/green triad of self-interest can prevail over the rational objections of the impacted minority, even one as large as the agricultural community. The Alar scare is a case in point.

The media Alar scare was based on a Natural Resources Defense Council report which asserted that Alar sprayed on apples causes cancer in children. Alar is a plant growth hormone that when sprayed early in the growth of apples promotes the growth of thick stems. Thick stems means that the farmer does little or no late-season spraying of pesticides to fight infections of mites and leaf miners which weaken stems and make apples fall off prematurely. Alar also suppresses the production of a natural pesticide produced by apples - a natural pesticide 40 times more toxic than Alar. In fact, 99.99 percent of pesticides ingested are natural pesticides, the remaining 0.01 percent are man-made (Ames and Gold, 1990). Overall:

"The risk of pesticide residues to consumers is effectively zero. This is what some 14 scientific societies representing over 100,000 microbiologists, toxicologists and food scientists said at the time of the ridiculous Alar scare. But we were ignored" (Sanford Miller, Univ. of Texas Health Science Center, *The Detroit News*, February 26, 1990).

Social Responsibility: To Shut Us Down

When the Environmental party began in the late 1960s and early 1970s corporate social responsibility meant such things as: do you hire the poor and disadvantaged; provide adequate health insurance and retirement benefits, and provide opportunities for employee advancement through education and on-the-job training. Since then, the Environmental party has learned to use financial clout to directly motivate industry to be "socially responsible" through a series of investment funds, $450 billion (and growing) in government pension funds, and a "green" version of United Way which is supposed to hit at the end of the year. However, the odds for these funds indicate a new definition of "social responsibility", one which has little to do with people and much to do with sea turtles, dolphins, acid rain, global warming, the ozone hole, and "toxic" chemicals.

This brand of "social responsibility" focuses on minute or "manufactured" risks that are useful in shutting down some resource extraction or production activity while overlooking very real and serious problems. Such "solutions" often create even bigger risks. For example, fungicides are being banned from use on food. However, the molds and fungi that fungicides control produce some of the most potent poisons known.

There is great concern about minute amounts of man-made pesticide but none about natural pesticides, which can comprise up to five percent by weight (50 million parts per billion) of the food. Calls for breeding of more pest-resistant strains of fruit and vegetables invariably means breeding for greater pesticide content of food. Because natural pesticide is part of the food, it cannot be avoided. Most farmer-applied pesticides are avoided by washing and timing of application.

There are calls to spend $ billions on acid rain to prevent a hypothetical risk to about 300,000 acres of high altitude spruce-fir forest. But little is being done for the remaining 18 million acres of spruce-fir forest which are getting chewed up by imported insect pests - 90 percent of the mature fir trees in the southern Appalachians are dead or dying because of the woolly adelgid and the spruce budworm have eaten millions of acres of red spruce in Maine and many more millions of acres in Canada.

Then there are the 150 million acres of eastern hardwoods that have been assaulted by a variety of imported diseases and pests. Before the chestnut was eliminated from our forests by blight, an enterprising squirrel could have gone from Maine to Georgia on the branches of chestnut trees coming down only to cross rivers.

President Bush planted an elm in Indianapolis this year as a symbol of Earthday. This elm, like the others, will die of Dutch elm disease. Oak, which has replaced much of the elm and chestnut, is being devastated by the gypsy moth. And now beech bark disease -a "gift" from Canada - is making its way across the country after being introduced at Halifax, Nova Scotia.

If the Environmental party was truly interested in the forest, it would not be preoccupied with acid rain. Environmentalists in the Midwest bemoan the 4,000 acres of acid-dead water which they assume is the result of acid rain. But we hear little from them about the zebra mussel - a "gift" from Norway - which has no natural enemies and threatens to eat the planktonic base of the Great Lakes food chain to the severe detriment of the productivity of over 180 million acres of water.

I submit to you that there is a pattern here. The real agenda is energy, not forests and fish. Increasingly strict environmental regulation is choking our use of nuclear energy and coal even though we are the world's "Saudi Arabia of coal". Thus, between 1987 and 1989 alone, American utilities increased their oil consumption 34 percent. But this additional oil must be imported.

Increasingly strict environmental regulation is also choking our production of oil. We were once the world's leading oil producing nation. But no more. Current oil production has dropped to 1942 levels. The federal government owns over one-third of the country, approximately 762 million acres. From the earliest days, U.S. policy has been to dispose of public domain lands and put them into private hands. But these lands, in which lie 50 percent of our proven energy reserves, are being sealed off from use. Indeed, the federal government has now reversed its philosophy and history by acquiring about 160 million acres of private land. The government is steadily reducing our resource base.

We are being prohibited from exploring offshore for fear of killing seagulls. We cannot drill in the Alaska Wildlife preserve for fear of disturbing birthing caribou. The Environmental party tells us to conserve energy by doing such things as going to smaller cars. But analysis by the Insurance Institute for Highway Safety shows that for every one mpg improvement there is a four percent increase in the accident mortality rate. Air bags help out with direct front end collisions, the least likely type of car accident. Big cars with air bags are safer than small cars with air bags. Put this together with the political stance of "we'd rather fight than drill" and you get the idea that wildlife is more precious than human life.

The Environmental party tells us to go to alternative, clean, non-polluting forms of power generation. But try putting up a dam. And geothermal plants have stopped in the West and in Hawaii on the basis of esthetics and interfering with volcano worship. The ground under California windmills are littered with the dead birds that fly into the spinning blades.

Is the Environmental party really for solutions? If they were sincere, you would expect cheering from the rooftops at the announcement of an inexpensive, cheap, and virtually unlimited source of unpolluting power. But when such a possibility was announced with low-temperature fusion, the reaction was quite the opposite. Paul Ehrlich (*The Population Bomb*) stated, "the prospect of cheap, inexhaustible power from fusion is 'like giving a machine gun to an idiot child'". Jeremy Rifkin stated that "'It's the worst thing that could happen to our planet'" (*Los Angeles Times*, April, 19, 1989). The answer to the question is: even if we can achieve the impossible goal of perfectly risk-free, unpolluting activity, it is not to be good enough. Apparently they just want us to drop dead.

Ron Arnold's assessment of the Environmental party appears to be correct: "America's new-found sensitivity to nature came packaged in a strongly anti-industry, anti-people wrapper. It came with a gut feeling that people are no damn good, that everything we do damages nature and that we must be stopped before we totally destroy the earth" (Arnold, 1987, p. 10).

WHAT TO DO

Businesses must not attempt to take on the Environmental party directly. Regardless of the merit of your arguments, your motives are immediately suspect because you exist for a profit. Secondly, the American public does not yet have the ability to distinguish the environment from the environmentalist. The private sector has created a "Frankenstein monster". Its support has enabled the Environmental party to become a powerful self-supporting grass-roots citizen advocacy movement. The private sector must stop supporting its mortal enemy.

If we are to maintain a vital economy and a functioning government your support must be switched to the free-enterprise advocates to create a grass-roots citizen support movement. Your fate is in your own hands. You have friends but we need your help. The free-enterprise organization I support is: CFACT (Committee For A Constructive Tomorrow), P.O. Box 65722, Washington, D.C. 20035. Phone: (202) 319-0104.

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Richard Shockley: Thank you, Dr. Krug. Any questions? We need to hear more of this from time to time instead of the other side of the story. We keep putting ourselves down and think nothing can be done, but we should be listening to those who have made the proper studies and be sharing with the people outside this group some of the things that he shared with us today. We appreciate your coming.

It has come to the time when you are just about through with me. But I appreciate the people that have worked with me as president and you that have been members of committees in making this past year a successful year for IMI. Our attendance is not up to what we had hoped it would be today, but we know there are several reasons behind this and we are looking to next year for that number to be back.

I must recognize Heinz Damberger for the work that he does to make this IMI successful. He keeps presidents on the straight and narrow of things to do and not do. He gives us scripts that we can follow. Heinz, I appreciate everything that you have done to help us this year in making this a successful year.

And as old codgers need to turn it over to some young blood, it gives me great pleasure at this time to turn the gavel over to a young man that I've been acquainted with for several years now and one that I believe has great potential. I'm sure he will lead our institute in great fashion this coming year, Danny Wooton.

Danny Wooton: Don't sit down yet, Dick. As you all know due to the unfortunate passing of George May, Dick has actually helped us for two years now. That has only been done once in the history of the Illinois Mining Institute. I think you will all agree that Dick Shockley, with professionalism and wit and charm he has exhibited the last two years, that he has certainly set a standard for all presidents in the future to uphold. We certainly appreciate the service he has given us. I would like to present you with a gavel in recognition of that service.

The only announcement I have is that the 99th annual meeting will be held in Collinsville, Illinois on the 26th and 27th of September, 1991. Any further announcements or anything else, Heinz or Dick?

Be safe going home wherever your destination may be. With that, I adjourn the 98th meeting.

President Richard Shockley passes the gavel to incoming President Danny Wooton

Some Exhibitors at 98th Annual Meeting

98th ANNUAL MEETING
LIST OF EXHIBITORS

A.S.P. Enterprises, Inc., Fenton, MO
Ace Equipment Co., Pittsburgh, IL
Advanced Drainage Systems, Inc., Monticello, IL
Advanced Mining Systems, Inc., Steubenville, OH
American Mine Research, Inc., Rock Gap, VA
Baker-Bohnert Rubber Co., Inc., Louisville, KY
Bearings Service Co., Inc., Evansville, IN
Brookville Mining Equipment Corp., Brookville, PA
Construction Machinery Corp., Marion, IL
D-A Lubricant Co., Indianapolis, IN
DuQuoin Iron & Supply Co., DuQuoin, IL
Fairmont Supply Co., Mt. Vernon, IL
Gooding Rubber, Co., Benton, IL
IL-MO Welding Products, Mt. Vernon, IL
JH Service Co., Evansville, IN
Lake Shore, Inc., Louisville, KY
Marcal Rope & Rigging Co., Alton, IL
McJunkin Corp., Calvert City, KY
Micon, Munhall, PA
Mine & Process Service, Inc., Kewanee, IL
MineSafe Electronics, Sturgis, KY
Mt. Vernon Electric, Inc., Mt. Vernon, IL
Naylor Pipe Company, Chicago, IL
NIOSH (National Institute for Occupational Safety & Health), Morgantown, WV
Oberjuerge Industrial Products, Maryland Heights, MO
Rice Supply Company, Madisonville, KY
S&K Air Power Tool & Supply, Mattoon, IL
Taylor-Atkinson, Inc., Mt. Vernon, IL
The Mine Supply Co., Mt. Vernon, IL
Tricon Metals & Services, Lexington, KY
Ulmer Equipment Company, Fenton, MO
W. M. Hales Co., West Frankfort, IL

CONSTITUTION AND BY-LAWS*

ARTICLE I.

Name and Purpose

The Illinois Mining Institute has for its object the advancement of the mining industry by encouraging and promoting the study and investigation of mining problems, by encouraging education in practical and scientific mining, and by diffusing information in regard to mining that would be of benefit to its members.

ARTICLE II.

Membership

Section 1. Any person directly engaged or interested in any branch of mining, mining supplies, mining appliances, or mining machinery may become an active member of the Institute. Any persons desiring to become a member of the Institute shall fill out a blank for that purpose giving name, residence, age and occupation. This application shall be accompanied by the current year's dues as established by the Executive Board.

Section 2. Honorary Member—Annually, one or more members recommended by a committee and approved by the Executive Board who has rendered outstanding service to the Illinois Mining Institute, and thereby to the coal industry of the state may be elected as an Honorary Member with dues being waived.

Section 3. The annual dues for active members and registration fees for the annual meeting shall be determined by action of the Executive Board. Any person in arrears on October 1, of the current year, after having been sent two notifications of dues, shall be dropped from membership. Members in arrears for dues will not receive the printed proceedings of the Institute.

Section 4. Any active member may become a life member by the payment of twelve times annual dues and shall be exempt from further payment of dues.

**Last changed during 97th annual meeting, September, 1989. Previously amended at Annual Meetings of 1926, 1929, 1935, 1938, 1964, 1970, 1971, 1975, 1980 and 1983.*

ARTICLE III.

Officers and Executive Board

Section 1. The officers shall consist of a President, First Vice-President, Second Vice-President, and Secretary-Treasurer. The services of all officers shall be without compensation.

Section 2. Nominations for officers and the Executive Board shall be made by a nominating committee of three (3) appointed by the President at least thirty days before the annual meeting, provided that anyone can be nominated on the floor of the meeting for any office for which an election is being held.

Section 3. The President, First Vice-President, Second Vice-President and Secretary-Treasurer shall be elected annually by the members present at the business meeting of the regular annual meeting and shall hold office for the ensuing year.

Four Executive Board members shall also be elected and shall hold office for the ensuing three years.

Section 4. In case of death, resignation, or expulsion of any officer, the Executive Board may fill the vacancy by appointment until the next regular meeting, when the vacancy shall be filled by regular election. In case of a vacancy in the office of President, the duties shall devolve upon the First Vice-President.

Section 5. The Executive Board shall consist of the officers, the 12 elected Board members, and three ex-officio members. The three ex-officio Board members are the current director of the State of Illinois Department of Mines and Minerals, the President of the Illinois Coal Association and the retiring President of the Institute.

ARTICLE IV.

Duties of Officers and Executive Board

Section 1. The President shall perform the duties commonly performed by the presiding officer and chairman and shall, with the Executive Board, exercise a general supervision over the affairs of the Institute between sessions.

Section 2. The First Vice-President shall preside in the absence of the President and perform all the duties of the President. The Second Vice-President shall perform all duties of the First Vice-President in the absence of the First Vice-President.

Section 3. The Secretary-Treasurer shall keep a record of each meeting, shall read and file all resolutions and papers that come before the Institute, sign all orders for money, and shall purchase necessary supplies.

The Secretary-Treasurer shall keep a true record of all money received and payments made on account of the Institute; shall pay out no money except on personally signed order, and shall retain these orders as vouchers;

shall give bond in such sum as the Institute may provide, the premium on said bond being paid by the Institute.

The Secretary-Treasurer shall act as editor-in-chief for the Institute and may furnish the newspapers and other periodicals such accounts of our transactions and discussions as are proper to be published. The Secretary-Treasurer's own judgment is to prevail in such matters unless objection is lodged at a regular meeting or by the Executive Board.

Section 4. The President shall appoint an auditing committee annually to audit the accounts of the Secretary-Treasurer, and said audit shall be submitted to the annual meeting of the Institute.

Section 5. The Executive Board shall perform the duties specifically prescribed by this constitution; it shall supervise the expenditures and disbursements of all money of the Institute, and no expenditure other than current expenses shall be authorized without first having the approval of the Executive Board, and shall perform such other duties as may be referred to them by regular or special meeting of the Institute.

Section 6. The Executive Board may delegate work responsibility to Institute committees, appointed by the President, for conducting selected business of the Institute, but with all actions being subject to Executive Board approval.

ARTICLE V.

Meetings

Section 1. The annual meeting shall be held in the fall of each year and on such days and in such places as may be determined by the Executive Board of the Institute. Notice of all meetings shall be given at least thirty days in advance of such meetings.

Section 2. Meetings of the Executive Board shall be held on the call of the President, or at the request of three members of the Executive Board, the President shall call a meeting of the board.

ARTICEL VI.

Amendments

Section 1. This Constitution may be altered or amended at any regularly called meeting by a majority vote of the members present, provided notice in writing has been given at a previous annual meeting of said proposed change of amendment.

ARTICLE VII.

Order of Business

At all meetings, the following shall be the order of business:

(1) Reading of minutes.
(2) Report of Executive Board.
(3) Report of officers.
(4) Report of committees.
(5) Election of new members.
(6) Unfinished business.
(7) New business.
(8) Election of officers.
(9) Program.
(10) Adjournment.

ARTICLE VIII.

Dissolution

In the event of complete dissolution of the Institute, the cash assets of the Institute will be distributed to universities where the Institute has provided past scholarships, on an equal basis, for support of scholarships in Mining Engineering. Equipment will be donated to any not-for-profit organization that the Executive Board may determine to be worthy recipients.

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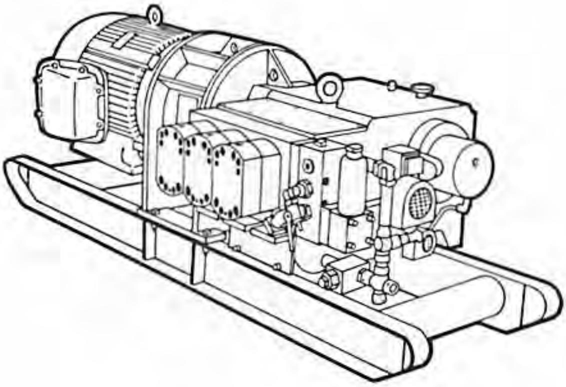

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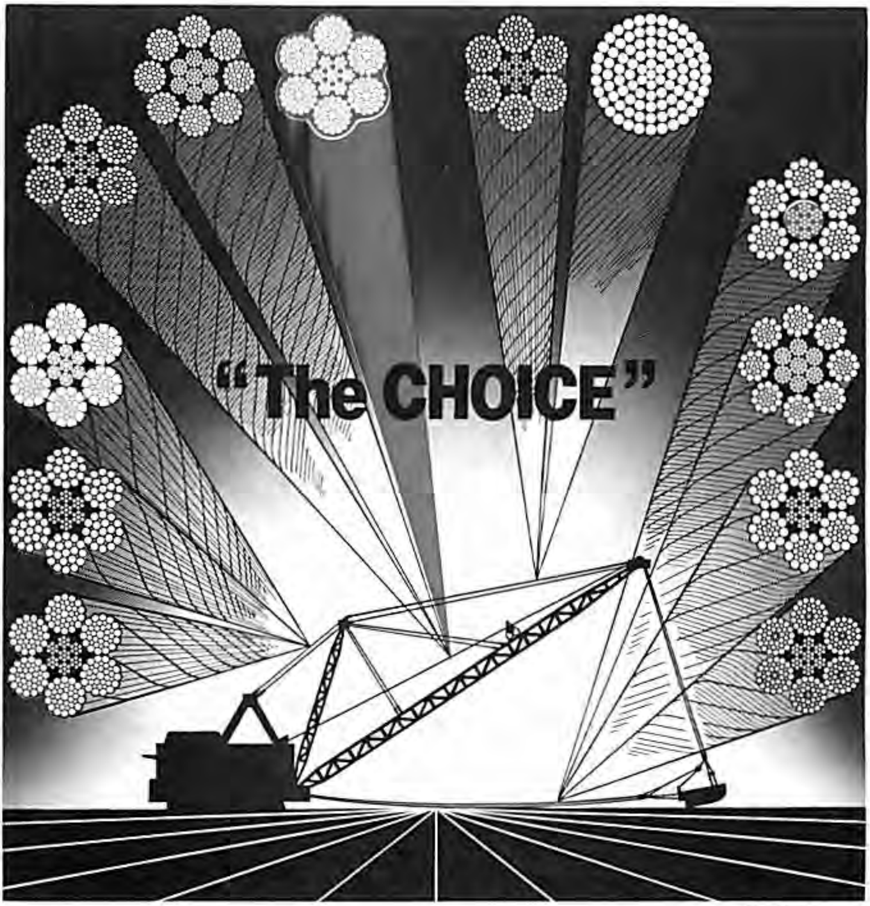
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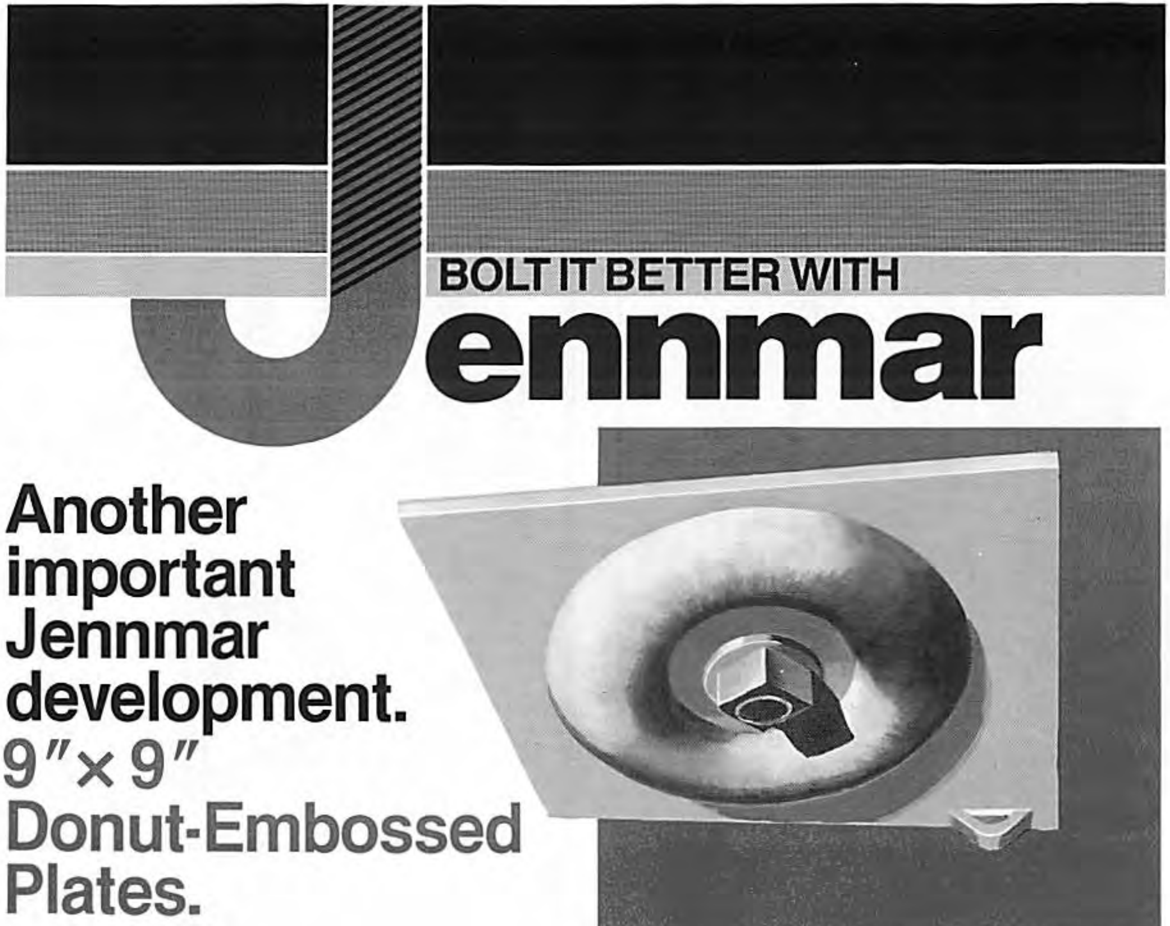
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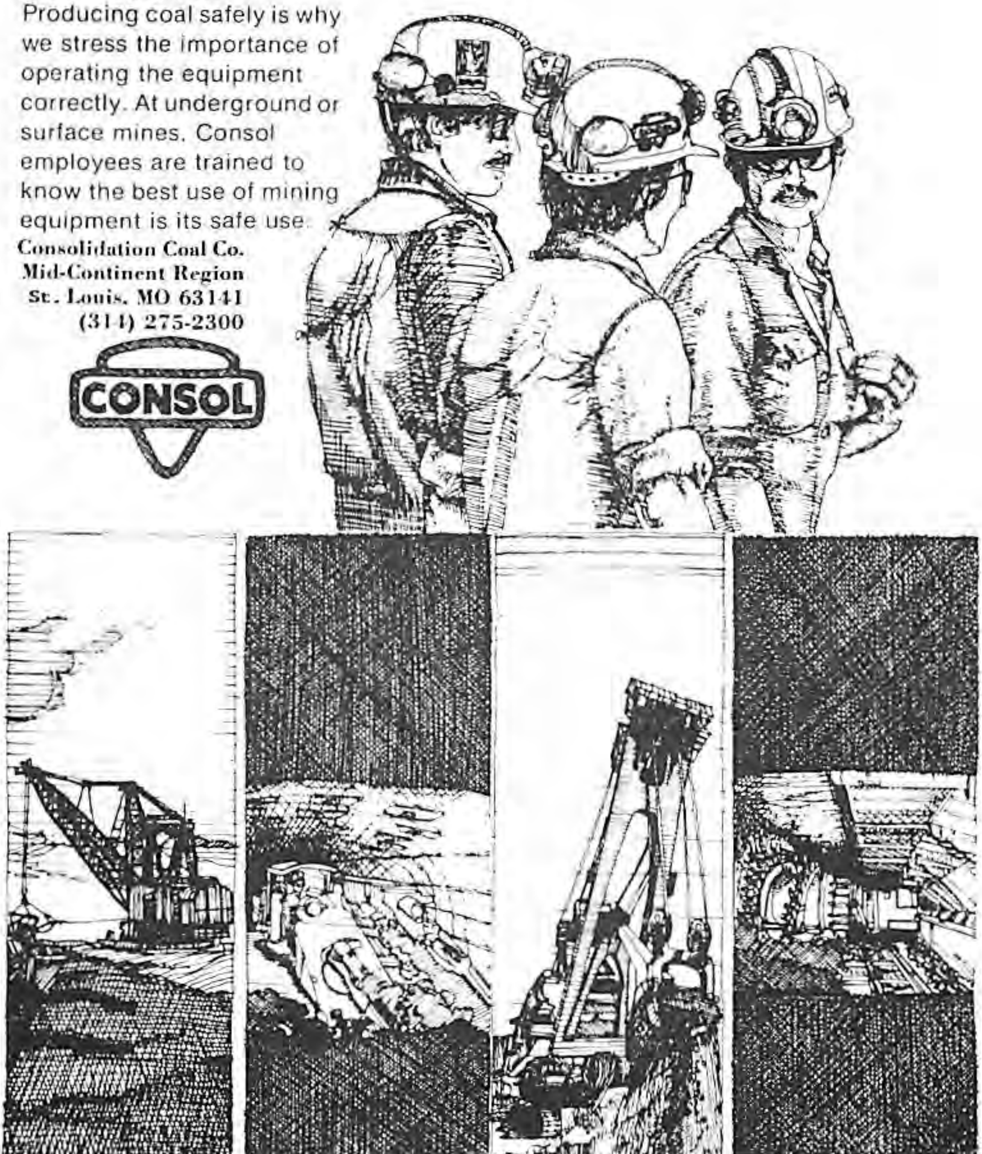

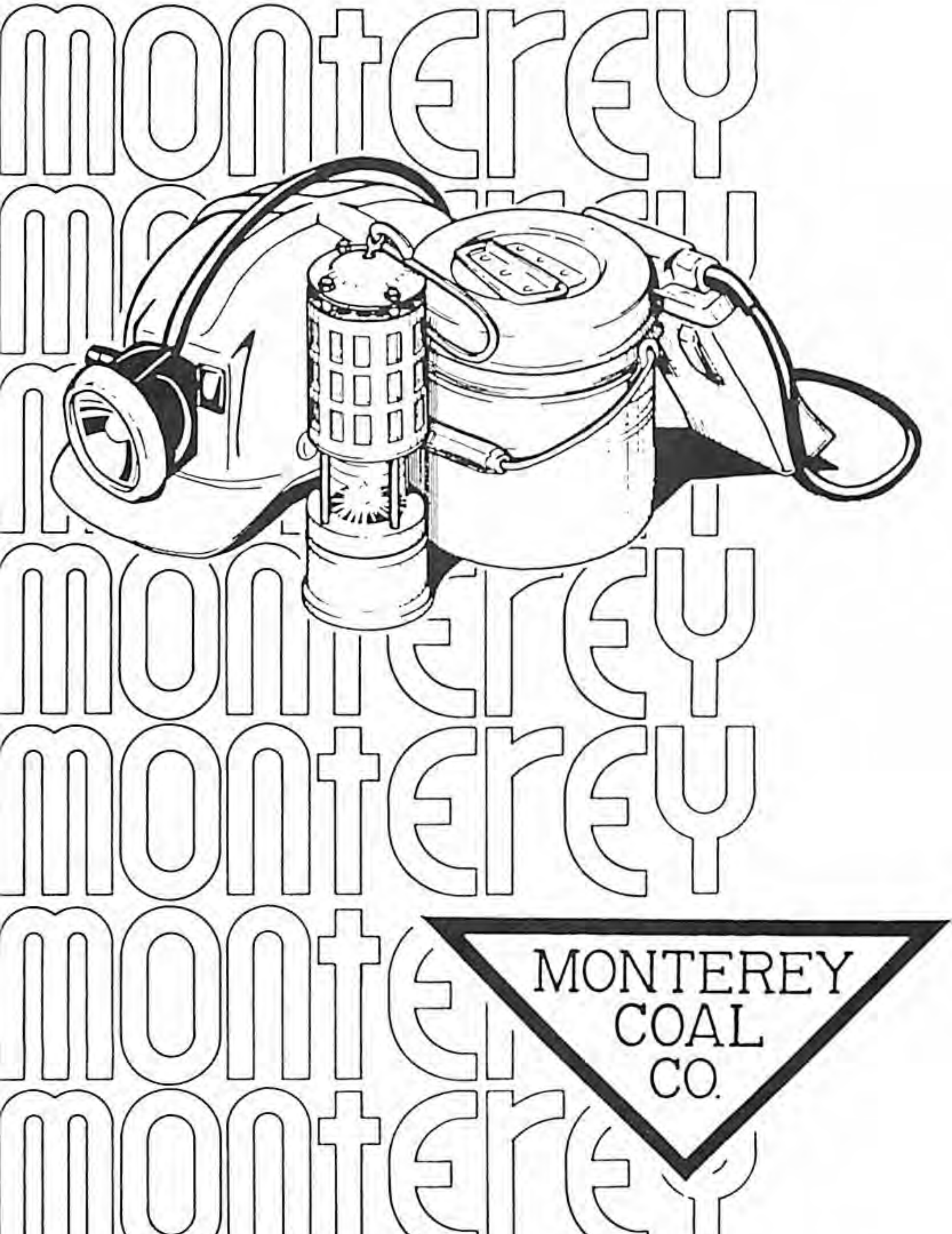
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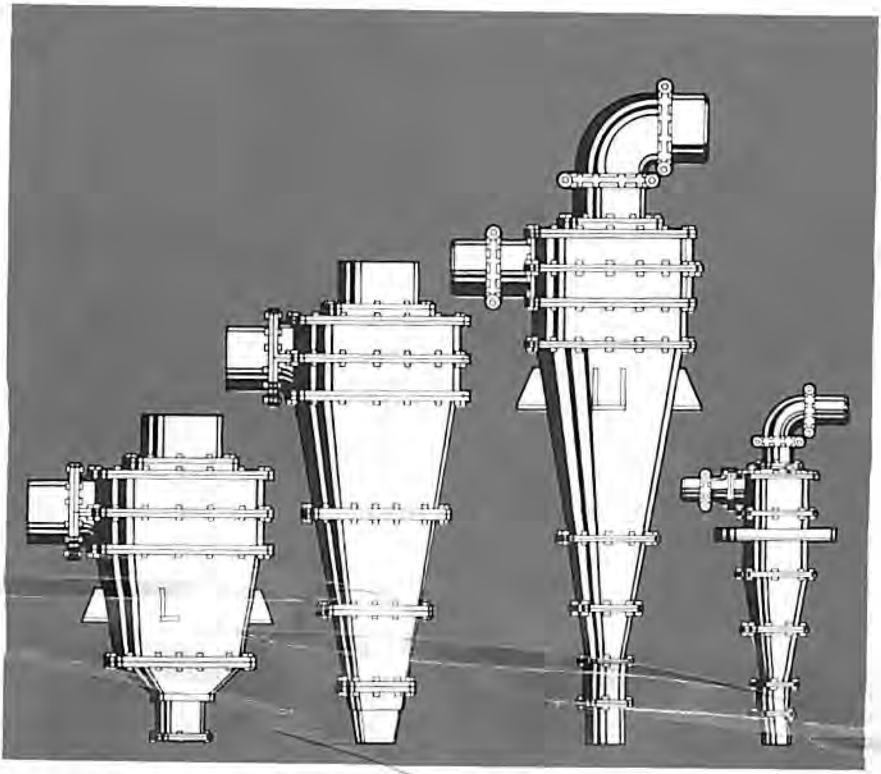

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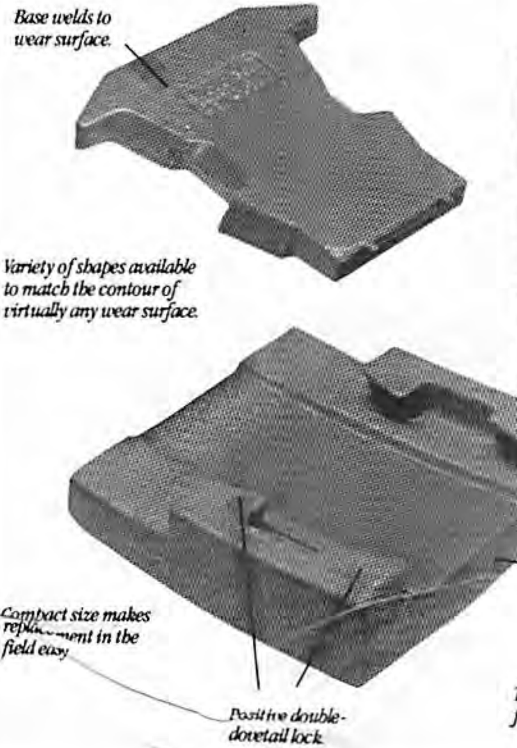

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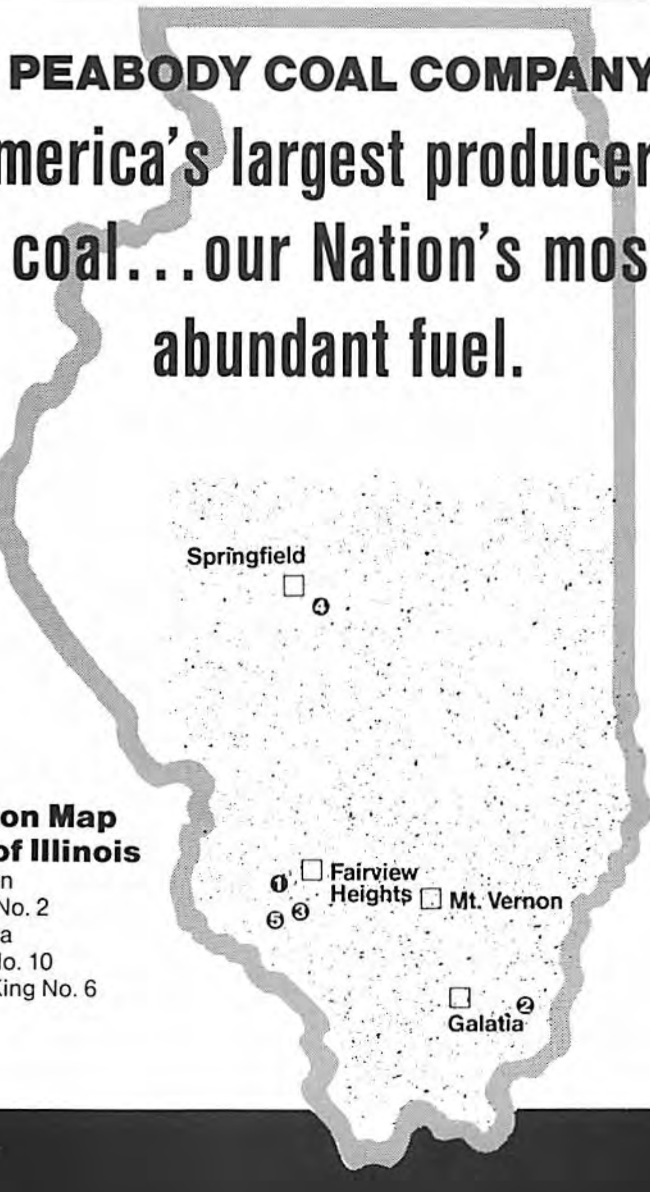

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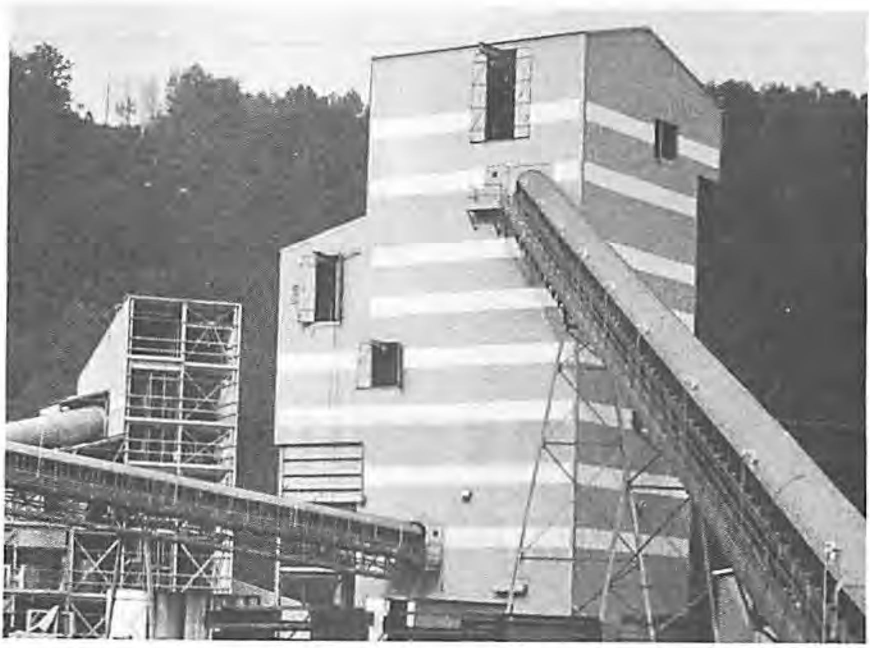

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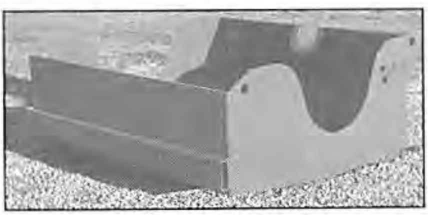

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