SEALING PROJECTS + Sharply Reduce Stream Pollution From Abandoned Mines

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MINE-SEALING projects carried on by the Works Progress Administration have resulted in the sealing of over 1,000 abandoned bituminous operations and the closing of more than 47,000 separate openings in Pennsylvania, Ohio, West Virginia and Kentucky since a cooperative campaign to reduce stream pollution from acid mine-water discharge was launched late in 1935. Actual tests before and after sealing show reductions of not less than 50 per cent as a minimum to well over 90 per cent in many cases in the sulphuric-acid flow from the abandoned mining properties.

The problem of stream pollution and the part played in it by mine-water discharge is an old one. Government agencies have been studying the question for years. R. D. Leitch, chemical engineer, U. S. Bureau of Mines, in 1928 reported that it seemed likely that "sealing abandoned mines would result in decreasing the acidity of drainage from them sooner than if they were allowed to remain open."[1] The evidence seemed conclusive, he declared two years later, that sealing worked-out or abandoned sections inhibited acid formation. Considerable trouble and expense could be saved operators, he pointed out, if areas from which drainage was normally acid were sealed as soon as worked out or abandoned.[2]

Thus, while the problem was recognized and sealing conceded to be the only practical answer, officials of the four States named were in a quandary as to how to mitigate the serious health menace and enormous economic losses attributable to stream pollution, because State laws seemed to offer no avenue for effective action. Here Uncle Sam stepped in. At a conference of health officials of these States in the autumn of 1935, Surgeon-General Hugh S. Cumming proposed that they submit mine-sealing projects to the Federal Emergency Relief Administration. Projects thus formally submitted by the Ohio River Board of Health Commissioners in October were quickly approved and in operation by Dec. 1. When WPA was formed, arrangements were made to carry the work forward.

Positive evidence is now being received from many sources that these projects have achieved amazing results in ameliorating the health menace and in reducing direct financial losses. Many cities and towns in the affected areas report an appreciable reduction in the cost of treating public water supplies. Where new waterworks construction is contemplated, sanitary engineers hope to be able to build at much less cost than formerly was the case, when expensive special acid-proof materials were necessary. Railroads and industrial plants report reduced cost of water treatment.

Recreational use of some streams has been restored and other streams are being cleared up rapidly. Sponsors of the projects are certain that time will reveal other benefits from the reduced flow of sulphuric acids from the abandoned mines. They believe disintegration of metal and concrete culverts and bridge abutments will be greatly diminished, if not eliminated. They know that stock watering in some of the streams has been resumed and they are certain that grazing will be resumed along a number of other streams as the program goes forward.

Owners of steamboats plying the Ohio believe that corrosion of metal hulls resulting from action of the acid on places where the metal is scraped clear of paint or other protective coating in low water will be

Cistern overflow air trap

[1] Report of Investigations, Bureau of Mines No. 2895.
[2] Report of Investigations, Bureau of Mines No. 2994.

Erosion channels from subsidence need water diversion

Cover traps to keep out leaves and forest rubbish

greatly lessened. Officers of the Corps of Engineers believe the future will show much less damage from the acid to the federally owned dams built to aid navigation along the Ohio and that expenditures for repairs will be appreciably lowered.

The first step in the mine-sealing projects submitted by the Ohio River Board of Health Commissioners was the making of surveys of the mining fields. Many of the abandoned mines were not shown on geologic maps and it became necessary to inspect the coal regions to find not only the mines but also outcrop holes and crevice openings, for it was obvious that unless all the openings were closed the mere sealing of the mine entrance would do no good. From one to more than 700 openings to each of the mines were found by the searchers.

One operation near Latrobe, Pa., had more than 700 openings and 18,000 ft. of crevices. These have been closed and a native stone wet seal erected at the entrance. Tests made before sealing showed this mine was discharging on the average more than 3,000,000 gal. of water a day containing 2,300 lb. of acid. Tests made after sealing show that it drains less than 100,000 gal. of water, containing less than 100 lb. of acid.

The survey or data obtained from previous investigations showed the following to be the estimated sulphuric-acid drainage from abandoned mines along tributaries of the Ohio River:

State	Drainage of sulphuric acid in pounds per day
Pennsylvania	5,000,000
West Virginia	1,877,300
Ohio	2,700,000
Kentucky	2,848,545
Total	12,425,845

After the surveys were completed, actual work was started. On large jobs crews of about 30 men were employed. On the smaller jobs, six men usually were employed for each, although in West Virginia it was found more practicable to limit crews to five.

Safety measures for the protection of the men were emphasized by WPA. The supervisor and district engineer were required to agree in advance on safety measures for each job undertaken and it was the task of the supervisor to see that they were followed. Foremen were required to make sure that no gas was present in the workings and to make a test for gas each day before the men went to work. The men were to be supplied with the proper tools, which were to be kept sharpened. Goggles, life lines and gas masks were to be supplied when necessary and boots were always provided when the men had to work in water.

Underground workings were kept well timbered; ditches were to be kept carefully shored; and hand rails were to be provided on all bridges and walk-overs. Steps were to be cut on all steep grades, especially where material went up or down. The shotfiring was to be done by competent men, preferably by the use of detonators and electric batteries. In all cases, first-aid kits were to be available. The result has been an exceedingly low number of casualties.

In Pennsylvania, the projects gave employment to 1,700 men, most of them unemployed miners eligible for WPA employment; in West Virginia, 500; in Ohio, 600; and in Kentucky, 800. The labor of these men represented almost the total cost of the projects. In Pennsylvania, for example, 96.4 per cent of the money expended went to workmen.

The surveys had shown that originally there were 4,100 abandoned mines to be sealed in Kentucky; 4,500 in Ohio; 3,450 in Pennsylvania and an estimated 3,800 in West Virginia. At last reports, the following has been accomplished:

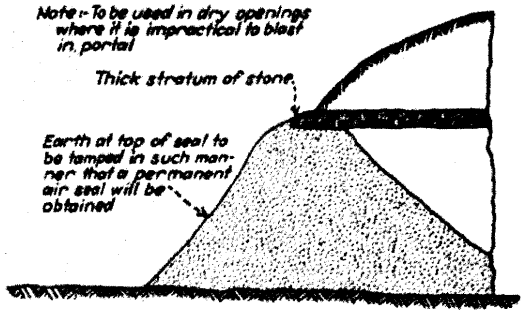
State	Mines Sealed	Openings Closed
Kentucky	124	652
Ohio	184	13,000*
Pennsylvania	208	30,000*
West Virginia	507	3,644
Totals	1,023	47,296

*Estimated

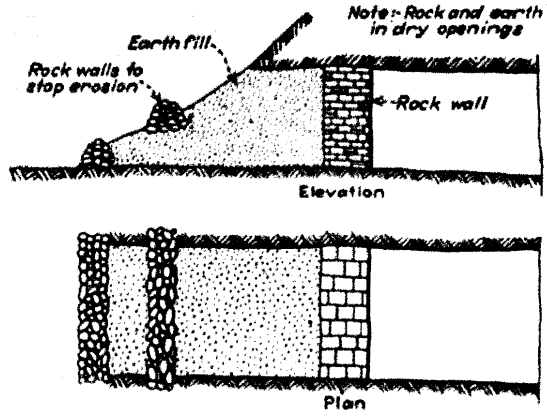
More than 90 per cent of the mines had drift openings. Shaft mines offered little difficulty, as a rule. They were simply blown out. However, this method sometimes was objected to by landowners, both surface and subsurface, especially where active mining was still being carried on in the neighborhood. Some mines were so small that it was possible to seal them simply by filling, with ashes or earth. In other cases there were so many outcrop holes to be filled that the engineer in charge simply ordered a job of landscaping. Not a few farmers found themselves by this process of an acre or more of tillable land reclaimed from land formerly unfit for use.

Methods of construction of the seals varied with the topography of the land in which the mines were situated, and native materials were used wherever possible. However, following are some of the better known methods used for wet sealing after all openings had been closed except the one through which the drainage flowed (if there were more than one drain from a mine, engineers arranged to cut them together):

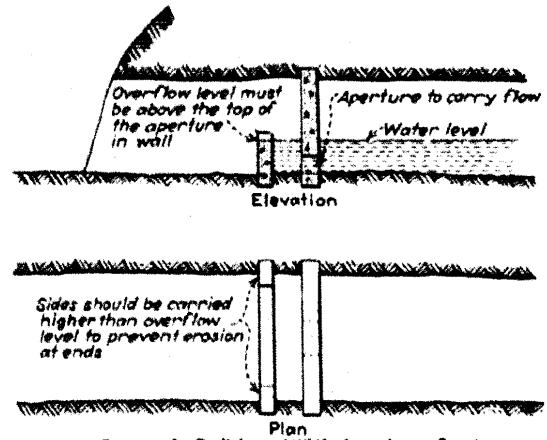
1—Erect curtain wall with trap



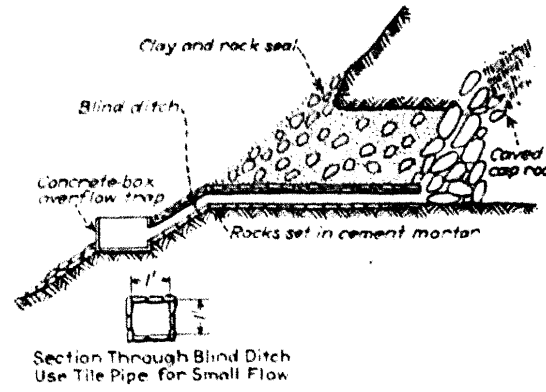
Earth Air-Trap Seal for Dry Openings



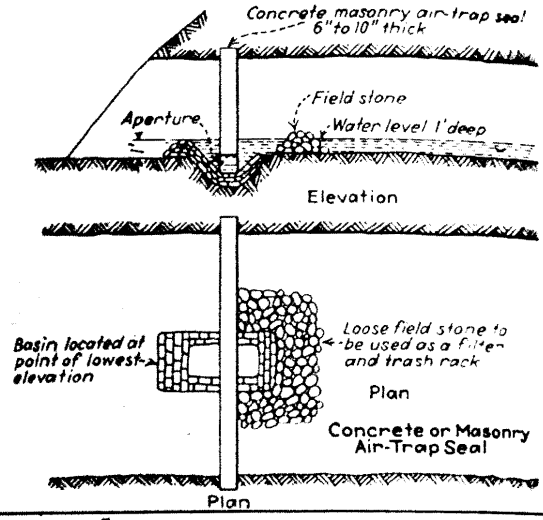
Rock and Earth Fill Air-Trap Seal

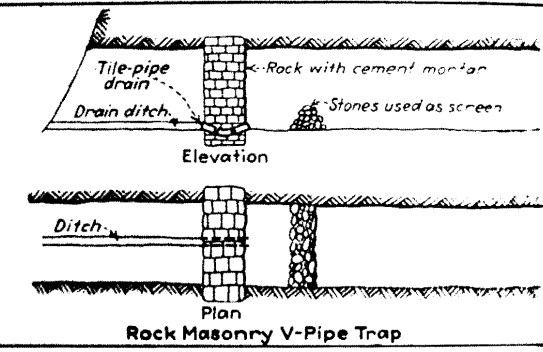


Concrete Bulkhead With Aperture for Large Volume of Water and With Dam to Create Seal

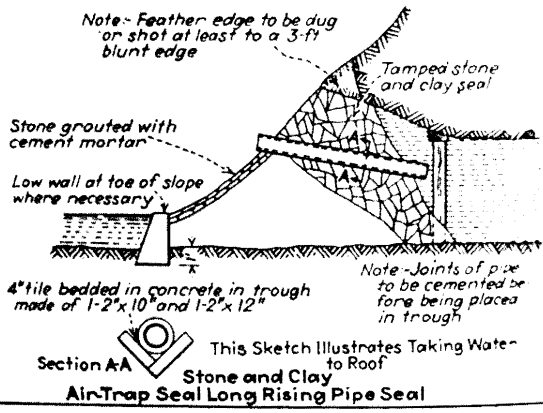


Clay and Rock Water Seal for Caved Pit Mouth

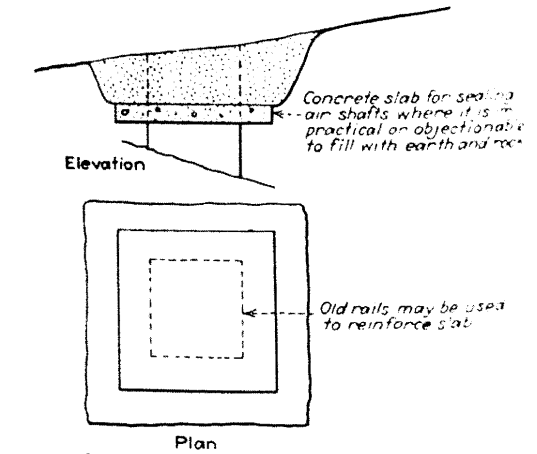




Rock Masonry V-Pipe Trap



Air-Trap Seal Long Rising Pipe Seal



Concrete Air-Shaft Seal

TYPES OF SEALS USED IN WPA PROJECTS

formed by an opening through the wall at the bottom and force the mine drainage to flow over two short walls (one on either side of the curtain wall) whose tops are higher than the curtain-wall openings. This will accommodate large flows.

2—Erect curtain wall with trap formed by pipes placed at such an angle that the outlet is higher than the inlet. This is for small flows.

3—Erect curtain wall with sewer pipe lead from the mine to the outside and to box trap. Will handle flow up to capacity of pipe.

4—Erect dam-type seal, or impounding seal, which causes water to flow over the seal or dam at a point higher than the coal top. This can be built with or without a French drain, and usually is used for a limited flow and where the entry to the mine is badly curved.

5—Erect modified dam and rip-rap seal where the water flows through a stone fill over a low weir wall.

Of these, the first two methods were the most generally used.

In every case where a wet seal was used, weirs were installed for the accurate measurement of the drainage. Tests were made both before and after sealing, and in cases where the drainage, after sealing, did not show a marked decrease in sulphuric-acid content, the ground about the mines was gone over carefully to check for openings that had not been found in the first and subsequent surveys.

Sealing Shows Results

That the sealing of the mines would accomplish its purpose—the virtual elimination of the sulphuric-acid discharge from the abandoned mines—was shown early in the program. J. W. Paul, in a paper prepared for presentation before the Coal Division of the A.I.M.E. in October, 1934, said that sealing 42 mines in Pennsylvania, West Virginia and Ohio had cut the discharge of water from 3,504,000 to 1,421,000 gal. per day and the acid discharge from 72.636 to 20,644 lb. per day—a reduction in acid discharge of 26 tons a day.

C. L. Chapman, West Virginia State Board of Health, reports among other improvements, that Coal River is now alkaline twelve months a year and fishing is good all summer; fish used to leave with low water. Monongah No. 3 drain stocked eighteen months, after having been sealed eighteen months, with black bass and fish still thriving. "Tygart River—Mouth Roaring Creek down, red color gone and red deposit on rocks nearly gone; tannery black, precipitated previously in mile below Roaring Creek, now visible six miles further downstream at Junior; not now enough acid to neutralize."

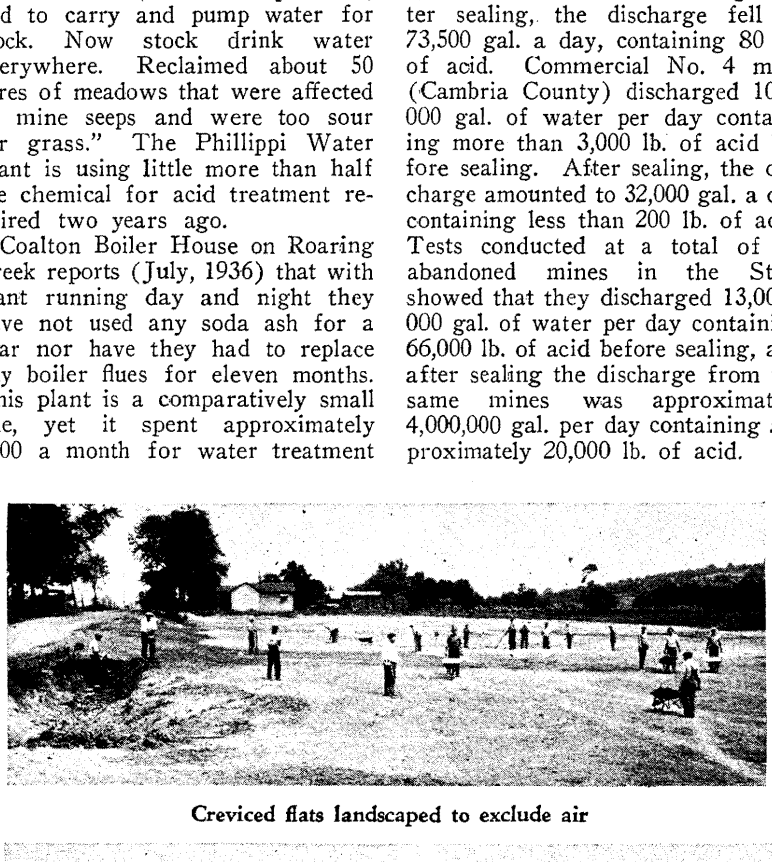
For the first time in 25 years fish have come down stream three miles below first mine pollution at head of Roaring Creek. Acidity in Beaver and Browns creeks has decreased about 50 per cent. The Clarksburg Water Co., which formerly used Browns Creek water in a natural mixture to start coagulation process, now must construct a coagulation basin and add mineral alum to process.

"Fish were all killed out of Elk Creek above Gnatty Creek some ten miles. Now fish are living in stream clear to Spall Run, or nine miles of formerly bad stream. Farmers near head of stream, source of pollution, had to carry and pump water for stock. Now stock drink water everywhere. Reclaimed about 50 acres of meadows that were affected by mine seeps and were too sour for grass." The Phillippi Water Plant is using little more than half the chemical for acid treatment required two years ago.

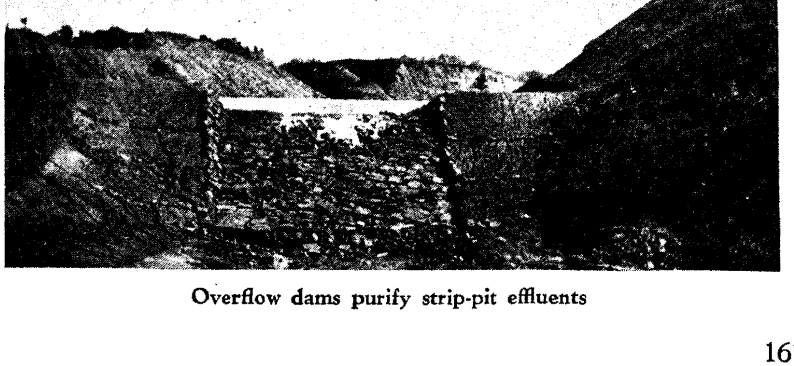
Coalton Boiler House on Roaring Creek reports (July, 1936) that with plant running day and night they have not used any soda ash for a year nor have they had to replace any boiler flues for eleven months. This plant is a comparatively small one, yet it spent approximately $300 a month for water treatment prior to the mine-sealing prograr Morgantown Water Plant raw wat used to run 40 p.p.m. This pa summer, during the drought perio the highest recorded was 6 p.p.r acidity.

The State Health Department c Ohio reported tests on seven strean before and after sealing abandone mines which drained into them. I each case, the former red color ha disappeared and the acidity of th streams was reported reduced by ap proximately 50 per cent of thei aluminum content, and their iro content by approximately 60 pe cent.

Checks made in Pennsylvani showed the efficiency of sealing t eliminate acid. The Pioneer No. mine, in Indiana County, was dis charging daily more than 3,000,00 gal. of water containing more tha 2,300 lb. of acid before sealing. Af ter sealing, the discharge fell t 73,500 gal. a day, containing 80 lb of acid. Commercial No. 4 min (Cambria County) discharged 105, 000 gal. of water per day contain ing more than 3,000 lb. of acid be fore sealing. After sealing, the dis charge amounted to 32,000 gal. a da containing less than 200 lb. of acic Tests conducted at a total of 9 abandoned mines in the Stat showed that they discharged 13,000, 000 gal. of water per day containin 66,000 lb. of acid before sealing, an after sealing the discharge from th same mines was approximatel 4,000,000 gal. per day containing ap proximately 20,000 lb. of acid.



Creviced flats landscaped to exclude air



Overflow dams purify strip-pit effluents