# KANSAS GEOLOGICAL SURVEY
# OPEN-FILE REPORT 40-8

## WATER POLLUTION FROM MINE WATERS PITTSBURG AREA AND CHERRY CREEK , CHEROKEE COUNTY, KANSAS

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OF
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## Water Pollution from Mine Waters

## Pittsburg Area and Cherry Creek, Cherokee County, Kansas

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Cherry Creek rises a few miles southwest of Pittsburg, follows a southwesterly course for twenty-five miles and empties into the Neosho river a few miles above Oswego, Kansas. The flow was estimated July 16, 1940 to be 1,200 gallons per minute at the mouth. The name Cherry Creek arises from the color of the iron bearing waters and the iron precipitated along the creek bed. Oxidation of iron pyrites and marcasite, especially in the older mines, creates iron sulphate and sulphuric acid. In the upper one third of Cherry Creek valley there are many coal mines, mostly of the shaft variety.

The basal part of the Cherokee shale outcrops a few miles east of, and at a greater elevation than Cherry Creek, and dips slightly to the northwest. It contains various coal beds. These beds lie at a lower elevation in the Cherry Creek valley than is the case farther east. Mine water to the east stands at a higher level than water in the same beds beneath Cherry Creek. Where mine shafts have penetrated these latter beds, hydrostatic head is sufficient to cause water to rise and overflow into the drainage area of Cherry Creek.

Analyses of Cherry Creek Water
(July 16, 1940)

| No. | Location | pH | Iron Total P.P.M. | Iron In solution P.P.M. | Acidity P.P.M. |
|---|---|---|---|---|---|
| 1 | T. 32 S., R. 24 E. NW$\frac{1}{4}$, Sec. 7 | 3.55 | 150 | 75 | 425 |
| 2 | T. 32 S., R. 23 E. SW$\frac{1}{4}$, Sec. 14 | 2.9 | 185 | 100 | 670 |
| 3 | T. 34 S., R. 22 E. SW$\frac{1}{4}$, Sec. 6 | 3.3 | 1.7 | 1.7 | 52 |

Sample one. - Mine water overflow entering near head of Cherry Creek. Town of Scammon above concrete bridge, east side. Flow est., 500 gals/min.

Sample two. - From Little Cherry Creek. Said to be most southerly point where mine water enters Cherry Creek drainage area. Flow est., 700 gals/min.

Sample three.- Cherry Creek. Taken 16 miles downstream from number two. The relatively low iron and acid contents should be noted. Flow here estimated at 1000 gals/min. It is reasonable to believe the stream may have traversed a limestone formation somewhere between where samples two and three were taken. The pH might be due to carbon dioxide formed in the neutralization of sulphuric acid by limestone. These theories were not investigated further.

Attempts to estimate the damage due to the polluted condition of Cherry Creek were not particularly successful. Residents have become accustomed to the condition and there appeared to be no general complaint. The most serious damage in the past has been due to floods which occur every few years. At such times the acid mine water is distributed over adjacent farm lands, destroying crops. However, when the landowners were asked, several years ago, to vote on the question of contributing financially for the elimination of this menace, the proposition failed to carry.

## Corrective Measures

The following ideas have been suggested to reduce mine water pollution in Cherry Creek, and other locations.

1. Sealing mine shafts to prevent the escape of mine waters.
2. Flooding old mines and filling old exposed pits with water to the surface.
3. Diluting with alkaline stream water.
4. Treating with chemicals.

The first idea is sound in principle but would prove expensive. There are many old mine shafts discharging water. Most of these have broken and badly weathered formations at the collar. It would be difficult to concrete these water tight and even then water might reach the surface through vertical cracks in the surrounding strata.

The second idea is good and is being used with success in old pits from strip operations. Filling with water to the surface in order to keep pyratic formations submerged greatly retards oxidation of the latter. This has been done in one large area, north of Pittsburg, known as the Crawford County State Park. The water here has been greatly improved and now supports aquatic life. The plan would work in some shaft mines; in others, it would not unless the mine could be sealed as suggested above. In this connection it should be noted that a certain amount of employment is afforded those who still carry on small scale operations in mines which have ceased large scale production. Flooding the mines would stop this work and public sentiment appears to be against such action.

The third idea, diluting with alkaline water, which originated in this investigation, is good in theory and might be utilized in practice. Lightning Creek parallels Cherry Creek somewhat on the west and they are at approximately the same elevation. At one point, near Mineral, the two watersheds are separated by but three or four miles. Laboratory tests show that five volumes of Lightning Creek water will neutralize and precipitate the iron from one of Cherry Creek water, such as that of sample 2. Provided there were no legal objections, and if circumstances warranted, water could be pumped from Lightning Creek to Cherry Creek for purification purposes. Both streams enter the Neosho River.

Analysis of Lightning Creek Water

| Location | pH | Iron Total | Iron In solution | Alkalinity |
|---|---|---|---|---|
| T. 32 S., R. 22 E. SE¼, sec. 18 | 7.4 | 15. | 0.07 | 74 |

The fourth idea, treatment with chemicals, would work in the case of stream purification, but is probably prohibitive in cost. Limestone will neutralize acid and precipitate iron hydroxide from ferric sulphate solutions. If in the future, iron hydroxide can be sold locally as a substitute for iron ore, this proposition would look more attractive.

At a coal washing plant near Mineral the waste water is run in large basins before being discharged into Cherry Creek. Solid refuse is settled out. This place was not visited and it is not known if any iron is removed by oxidation.

## Conclusions

The pollution of Cherry Creek by mine waters can be controlled or remedied by use of one or more of the methods mentioned above. Any of these corrective measures would be costly to apply. It appears very doubtful if the benefits derived would warrant the necessary expenditure. There is no public demand for improvement. No active corrective measures are recommended at this time.

The time allowed for this investigation did not permit a consideration of other possible cases of mine water pollution in the Pittsburg district. If such exist, there seems to be no public agitation on the subject.

## NEUTRALIZING ACID MINE WATERS

### Comparative Cost of Various Chemicals Used in Neutralizing Acid and Precipitating Iron

| Chemical | Cost per Pound Cents | Assumed Purity | Pounds per million gals. per P.P.M. Acidity removed | Pounds per million gals. per P.P.M. Iron precipitated | Estimated Cost million gals one P.P.M. removed | |
|---|---|---|---|---|---|---|
| | | | | | Acid | Iron |
| $Ca(OH)_2$ | 0.5-1.0 | 90% | 7.0 | | $0.035-.07 | |
| CaO | 0.5 | 88 | 5.4 | | 0.027 | |
| $CaCO_3$ (10 mesh) | 0.1 | 95 | 9.0 | 24.1 | 0.009 | $0.024 |
| $Na_2CO_3$ | 2.0 | 98 | 9.2 | | 0.184 | |
| NaOH | 2.0 | 100 | 6.8 | | 0.136 | |

All the figures above (except those for iron) are from U. S. Public Health Service, Office of Stream Sanitation, Cincinnati, Ohio. The Carthage Crushed Limestone Co. of Carthage, Missouri, 8/6/40, gave the following quotations on limestone in car lots.

| No. | Mesh | Price per ton | Price per pound | Remarks |
|---|---|---|---|---|
| 18 | 18 | $ 3.75 * | $ 0.19 * | In bulk |
| 24 | 24 | 3.75 | 0.19 | In bulk |
| 200 | -200 | 9.75 | 0.48 | 100-lb. paper bags |
| 230 | 92%= -200 | 7.75 | 0.38 | 100-lb. paper bags |

*All prices include freight, which from Carthage, Missouri, to Baxter Springs, Kansas, is $0.75 per ton.

### Example of Cost of Treatment with Limestone

Ballard Mine: 1 million gallons, 4100 P.P.M. acid, 1000 P.P.M. iron.
Limestone 0.1 cent per pound.

| | | | | | |
|---|---|---|---|---|---|
| Acid Removal | 4,100 | x | \$.009* | = | \$ 36.90 |
| +Iron Precipitation | 1,000 | x | .024* | = | 24.00 |
| Total Cost 1,000,000 gallons | | | | = | \$ 60.90 |

*This is on the basis of 10 mesh limestone at 0.1 cent per pound, a doubtful figure.

+This assumes the iron is in the ferric condition. Ferrous iron would not be precipitated with limestone. In neutral solution, however, it quickly oxidizes in air to the ferric condition.

With limestone at 0.19 cents per lb., the cost would be \$ 115.71

The Ballard Mine, Baxter Spa., Kans. is said to be pumping 2,800,000 gallons daily.

To treat this with 0.1 cent limestone would cost \$ 170.52 daily.

To treat this with 0.19 cent limestone would cost 323.98 daily.

The above figures do not include the cost of unloading or feeding the limestone.

Useful Information

To neutralize one pound sulphuric acid requires 1.03 pounds limestone assuming the latter is 100 per cent efficient.

$$CaCO_3 + H_2SO_4 = CaSO_4 + H_2O + CO_2$$

(100.81) (98.07)

$$\frac{100.81}{98.07} = 1.03$$

To precipitate one pound of iron, as $Fe(OH)_3$, requires 2.68 pounds of limestone, assuming the latter is 100 per cent efficient.

$$Fe_2(SO_4)_3 + 3H_2O + 3CaCO_3 = 2Fe(OH)_3 + 3CaSO_4 + 3CO_2$$

(111.68) (300.27)

$$\frac{300.27}{111.68} = 2.68$$

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One part per million = 0.0001 per cent

100 parts " " = 0.01 " "

1000 parts" " = 0.10 " "

One gallon = 3.78 liters

One liter water = 1000 grams = 1 kilogram

One liter water, or one kilogram = 2.2 pounds

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