Benthal Deposits (1954)

Walter A. Lawrance

Bates College

Follow this and additional works at: http://scarab.bates.edu/lawrance

Part of the Earth Sciences Commons, and the Environmental Sciences Commons

Recommended Citation

ANDROSCOGGIN RIVER and POOL STUDIES

SPECIAL PROJECT

1954

ADDITION of ALKALI to BENTHAL DEPOSITS

in the

ANDROSCOGGIN POOL

Lewiston, Maine
November 1954.
SUMMARY

1. Equipment has been designed to permit the addition of alkali within Benthal deposits. Field tests indicate that this equipment will function even under adverse conditions.

2. The addition of a soluble alkali to an area in the "Narrows" does not appear to have been successful. Considerable alkali left the area with the flowing water, however, Residual pH's of the Benthal were slightly higher.

3. A suggestion is made that an effective alkalization might be accomplished by using a slurry of calcium hydroxide.

4. Five tons of dead burnt lime were added to a section of Bay 16. The effect of this liming will be determined in 1955.

5. There is some evidence that the higher pH of Androscoggin river water may be producing a somewhat lower acidity in the Benthal layer.
ADDITION OF ALKALI TO BENTHAL DEPOSITS

in the

ANDROSCOGGIN POOL

1954

Introduction. The liming of Benthal deposits was first studied in Bay 16 in the Androscoggin Pool in 1949 as a project of the National Council for Stream Improvement. Additional work was done in 1951 and 1953. In the Spring of 1954 the Androscoggin River Committee decided to make this work one of their own responsibilities. The results obtained, prior to 1954, may be summarized as follows:

(a) Microbial activity with alkaline pH's produce methane and carbonates. The benthal blackens, is less gelatinous and becomes "aged".

(b) To be effective the alkali must penetrate deep into the Benthal deposit. Previous experiments failed to accomplish this.

(c) Once sufficiently alkaline, reversion to an acid condition has not yet been observed.

(d) The requirements for obtaining an alkaline state in the Benthal is much in excess of that determined in the laboratory.

1954 Objectives. The chief objective of this year's work was to study ways and means of obtaining penetration of the alkali into the Benthal deposits. Another objective was to lime the area adjacent to the west end section of Bay 16 which was treated in 1953.
Bay 16. The Benthal deposited in the Western end of this bay was treated with lime in 1953. On July 23, 1954 these Benthal deposits were sampled and the pH determined. The results tabulated below indicated that the alkali added last summer had converted much of the Benthal in this small area of the Bay into an alkaline or neutral condition. It was decided not to add any more lime to this area in 1954 and to test it again in 1955 to determine the permanency of the alkaline state.

<table>
<thead>
<tr>
<th>Station</th>
<th>pH</th>
<th>Station</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>334-1</td>
<td>6.98</td>
<td>336-2</td>
<td>6.25</td>
</tr>
<tr>
<td>335-1</td>
<td>6.44</td>
<td>332-3</td>
<td>6.72</td>
</tr>
<tr>
<td>336-1</td>
<td>6.37</td>
<td>333-3</td>
<td>6.28</td>
</tr>
<tr>
<td>333</td>
<td>9.29</td>
<td>334-3</td>
<td>6.62</td>
</tr>
<tr>
<td>334</td>
<td>8.51</td>
<td>335-3</td>
<td>6.31</td>
</tr>
<tr>
<td>335</td>
<td>7.29</td>
<td>336-3</td>
<td>6.42</td>
</tr>
<tr>
<td>336</td>
<td>6.45</td>
<td>332-4</td>
<td>7.01</td>
</tr>
<tr>
<td>332-2</td>
<td>6.40</td>
<td>333-4</td>
<td>7.00</td>
</tr>
<tr>
<td>333-2</td>
<td>8.28</td>
<td>334-4</td>
<td>6.95</td>
</tr>
<tr>
<td>335-2</td>
<td>9.03</td>
<td>335-4</td>
<td>6.84</td>
</tr>
<tr>
<td>336-2</td>
<td>6.96</td>
<td>336-4</td>
<td>6.45</td>
</tr>
<tr>
<td>340</td>
<td>6.41</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Station 340 is outside the limed area. The "empty" bags were shaken over the water at this location.

The first application of alkali was made in 1949 using calcium carbonate from Brown Company. This was furnished as a powder, about 150-200 mesh. The results were very unsatisfactory as much of the lime floated away with the current and that which sank did not penetrate into the Benthal. Another addition was made in 1951 using small lump calcium oxide. This material did not penetrate much below surface due to the rapid reaction between the lime and water which converted the lumps
into small particles of hydrate. In 1953 a much coarser lime was used but the results were approximately the same.

This summer a decision was made to employ coarse lump dead burnt lime. The advantages gained were:

1. Easier handling and less irritation to the workers.
2. Reaction between the water and lime is delayed.
3. In ten feet of water fragmentation occurs about the time the surface of the Benthal is reached, hence
4. Somewhat better penetration.

The area in Bay 16, extending from stations near 337-341 to stations near 347-351, just east of the area limed in 1953, was chosen as the site for this years experiment. Scattered pH determinations gave lower Benthal acidities than had been expected.

**TABLE #2**

**BAY 16 JULY 31 1954**

<table>
<thead>
<tr>
<th>Station</th>
<th>pH</th>
<th>Station</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>337</td>
<td>5.0</td>
<td>342</td>
<td>5.6</td>
</tr>
<tr>
<td>338</td>
<td>6.2</td>
<td>343</td>
<td>6.2</td>
</tr>
<tr>
<td>340*</td>
<td>6.8</td>
<td>345</td>
<td>6.4</td>
</tr>
<tr>
<td>341</td>
<td>5.7</td>
<td>346</td>
<td>5.4</td>
</tr>
<tr>
<td>337A</td>
<td>6.8</td>
<td>347</td>
<td>5.7</td>
</tr>
<tr>
<td>338A</td>
<td>6.8</td>
<td>348</td>
<td>6.4</td>
</tr>
<tr>
<td>340A</td>
<td>6.2</td>
<td>350</td>
<td>6.2</td>
</tr>
<tr>
<td>341A</td>
<td>5.6</td>
<td>351</td>
<td>5.9</td>
</tr>
</tbody>
</table>

* See note Table #1

On August 16 this area was limed with five tons of lump dead burnt lime spread as uniformly as possible. This type of lime which varied in size from that of a walnut to about four inches in diameter, sank quickly and usually did not fragment until the Benthal layer was reached about six to twelve feet below the surface. Fragmentation was violent and doubtless forced some of the particles downward. How effective this penetration was is not now known but the tests will be made in 1955 to obtain
the necessary information.

Adequate penetration of the alkali into the Benthal layer by application at the surface has not been achieved by any method or material used to date. In June 1954 an entirely new method was evolved and equipment built to test it. It was considered that a soluble alkali might be added from a pipe which would be inserted into the Benthal near the bottom of deposit. After assembling and testing several pieces of equipment trial runs were made with the apparatus described and illustrated in figure #1.

Soda ash* (sodium carbonate) was dissolved in river water in fifty gallon drums until near saturation. These drums together with supplies of soda ash were kept on the large boat. The solution was transferred to fifty gallon drums on the small boat. This alkaline solution was then pumped from the drums through the equipment into the Benthal layer at a predetermined depth, usually about three inches above the river bottom. The speed of the small boat was that of the throttled down outboard motor which was estimated to be about one mile per hour.

A great variety of obstacles were encountered, boulders, "dead heads", stumps, branches of trees and even automobile tires. The spreader was rugged enough to withstand obstructions and continual use for several days proved the soundness of the design.

The addition of soda ash solution to the Benthal material was made in the area best described as the northerly section of the Western side of the narrows. This region lies between mile markers 4.5 and 4.75, stations 235 to 243. It was about five hundred feet long and about one hundred and fifty feet wide.

* Supplied by Oxford Paper Company
ALKALI DISTRIBUTING
EQUIPMENT

50 gallon drum.

Centrifugal pump.

Rubber hose

wire to boat

wire to boat

wire to boat

Approximate Scale
1 foot = 1 inch.

Copper tubes for distribution

Angle iron adjustable

Runners

and view
The depth of water varied from about six to twenty feet. The Benthal depth varied from six to twenty-four inches.

The pH determinations on Benthal samples were made on August 10 before the addition of any alkali. The absence of determinations below five may be significant, and perhaps due to the higher pH of the river water.

**TABLE #3**

**NORTH-WEST SECTION of the NARROWS**

**pH of BENTHAL**

**August 10 1954**

<table>
<thead>
<tr>
<th>Station</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>230</td>
<td>5.7</td>
</tr>
<tr>
<td>230A</td>
<td>5.8</td>
</tr>
<tr>
<td>231</td>
<td>5.7</td>
</tr>
<tr>
<td>231A</td>
<td>5.3</td>
</tr>
<tr>
<td>232</td>
<td>5.5</td>
</tr>
<tr>
<td>235</td>
<td>5.6</td>
</tr>
<tr>
<td>236</td>
<td>5.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Station</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>237</td>
<td>5.3</td>
</tr>
<tr>
<td>240</td>
<td>5.7</td>
</tr>
<tr>
<td>241</td>
<td>5.3</td>
</tr>
<tr>
<td>242</td>
<td>5.2</td>
</tr>
<tr>
<td>243</td>
<td>5.3</td>
</tr>
<tr>
<td>244</td>
<td>5.6</td>
</tr>
</tbody>
</table>

The addition of two tons of soda ash was begun on August 18 and completed on August 28. Two men worked together and the project required eight full working days. Considerable time was required travelling to and from the site of operations, learning the use of the equipment, best operating boat speed, rate of pumping etc. etc. On September one, Benthal samples were taken at locations in the area. The results, as recorded in Table #4, indicate the sodium carbonate treatment produced very little change in acidity.
TABLE #4
NORTH-WEST SECTION of the NARROWS
pH. of BENTHAL
September 1 1954

<table>
<thead>
<tr>
<th>Station</th>
<th>pH</th>
<th>Station</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>235</td>
<td>5.8</td>
<td>240</td>
<td>6.0</td>
</tr>
<tr>
<td>235A</td>
<td>5.5</td>
<td>240A</td>
<td>5.7</td>
</tr>
<tr>
<td>235B</td>
<td>6.0</td>
<td>242</td>
<td>5.8</td>
</tr>
<tr>
<td>236</td>
<td>5.9</td>
<td>243</td>
<td>5.9</td>
</tr>
</tbody>
</table>

Observations:

1. The spreader equipment has to be kept level in the Benthal if not most of the alkali is pumped out of the tubes at the lower end.

2. Pump pressure must not be too great otherwise Benthal is scattered and the soluble alkali dispersed into the water and much of the effectiveness is lost.

3. Speed of the boat is very important. It must be sufficient to keep the wires holding the equipment to the boat uniformly tight yet not too fast to cause damage when an obstacle is contacted.

4. One limiting factor was the time required to dissolve the soda ash and transfer it to the small boat. Usually two drums of solution were made while the large boat was travelling from the landing to the Narrows. Transfer to the small boat was necessary as the turbulence produced by the propeller on the large boat was a serious interference in less than twelve feet of water.
5. Tests made during and after the work was completed appear to indicate that soluble alkali is not very effective with the equipment employed. The change of pH in the Benthal (about two weeks later) was slight. (cf Table 4) The alkalinity of the water moving out of the treated area indicated extensive diffusion into the water layer.

Conclusions. (1) The equipment as finally designed is well adapted for adding alkali in Benthal deposits.

(2) Soluble alkali does not appear to be suitable for reducing the acidity of the Benthal owing to relatively high diffusion losses.

Suggestions. (1) The present equipment should be used to test the feasibility of using an aqueous dispersion of calcium hydroxide and/or calcium carbonate for alkalizing Benthal deposits.

(2) Serious consideration should be given to the problems involved in large scale liming of critical areas.