

Watershed Restoration Notes #2

Limestone Sand: Pros and Cons

Limestone sand (Figure 1) has come into wide use in the treatment of waters acidified by acid rain or acid mine drainage. Its low cost makes it especially attractive, particularly at remote sites. The direct application of high-calcium limestone sand to acidified streams results in increased water pH and alkalinity. Annual replenishment is usually all that is required to maintain favorable water quality.



Figure 1. Typical calcitic limestone sand used for direct application to streams.

Limestone sand amounts are calculated based on several methods that incorporate watershed area and stream water pH prior to treatment. More information on the calculations required to estimate limestone sand dosage may be

found in the cooperative extension publication entitled *Passive Treatment Methods for Acid Water in Pennsylvania*.¹ Limestone sand is typically placed directly into the stream bed (Figure 2).

Increased diversity of acid sensitive aquatic insects has been reported downstream of limestone sand applications by some researchers (Downey et al., 1994) and others have attributed the reestablishment of fish species to limestone sand addition (Ryder and Kimmel, 2002; Clayton et al., 1998).



Figure 2. Direct application of 25 tons of limestone sand to an acidified headwater stream in Westmoreland County.

Summary of Limestone Sand Pros and Cons

Pros	Cons
-No maintenance	-Inconsistent results, especially at high stream flows
-Simple	-Dosage recommendations not clear cut
-Relatively inexpensive	-Must be repeatedly applied from road access
-Effective	-Sand deposits cover stream bottom

1. *Passive Treatment Methods for Acid Water in Pennsylvania* is available from the College of Agricultural Sciences Publications Distribution Center, 112 Ag. Administration Building, University Park, PA, 814-865-6713, e-mail AgPubsDist@psu.edu or online at <http://pubs.cas.psu.edu/freepubs/pdfs/UH157.pdf/>.

Still others report seeing no tangible improvements in fish populations; consequently, some question remains as to the benefits of limestone sand treatments in acidic waters.

Recent research at Penn State by Keener and Sharpe (2005) and LeFevre and Sharpe (2002) have documented some limitations of the use of limestone sand for acid water remediation. It has been widely shown that effectiveness of limestone sand diminishes over time, but recent data suggests a sharp drop in the effectiveness of limestone sand may be seen within a year following application. In addition, there is limited evidence to suggest that limestone sand is only marginally effective at treating episodically acidified streams (streams that are more acidic at high flows). This is thought to arise from the fact that limestone sand deposited higher on the stream bank by high flows is not in full contact with stream water at more moderate flows and, thus, is of little value in neutralizing acidity under such flow regimes.

Another problem with limestone sand is that aluminum and other metals in acidified streams collect as precipitates on the stream bottom as stream water pH increases. These precipitates make stream substrates less hospitable to aquatic insects, thus reducing their numbers. In addition, the limestone sand that collects on the stream bottom fills the spaces between small stones and gravel on the stream bottom for hundreds of meters downstream (Figure 3).



Figure 3. Limestone sand covering the bottom of the stream downstream from the application site.

In doing so, habitat for bottom-dwelling aquatic organisms is severely reduced. Loss of substrate habitat as a result of limestone sand application reportedly reduces aquatic insect numbers and completely eliminates crayfish from affected stream reaches. For more information on these problems, consult the references listed at the end of this fact sheet.

Although the benefits of limestone sand have been widely cited, new research has indicated some problems with this popular acid water mitigation method. The stream to which limestone sand is applied may be impaired for some distance downstream as a result of aluminum precipitates and substrate covering. If such impairment is judged to be acceptable based on overall watershed water quality and aquatic biota restoration goals, limestone sand remains a cost-effective acid water mitigation tool. However, if the negative aspects of limestone sand to receiving waters are not warranted by a realistic assessment of overall downstream benefits, an alternative mitigation method may be more appropriate.

Acknowledgments

Funds for the work upon which this publication is based were provided in part by the Richard King Mellon Foundation and the Penn State Center for Watershed Stewardship. Funding for the production of Watershed Restoration Notes is provided by the School of Forest Resources and Penn State Institutes of the Environment.

References

- Keener, A. L., and W. E. Sharpe. 2005. The effects of doubling limestone sand applications in two acidic southwestern PA streams. *Restoration Ecology* 13(1):108–119 .
- LeFevre, S. R., and W. E. Sharpe. 2002. Acid water remediation using limestone sand on Bear Run in southwestern Pennsylvania. *Restoration Ecology* 10(2):223–236.
- Ryder, R. M., and W. G. Kimmel. 2002. Re-introduction of brook trout into a chronically acidified stream following instream limestone sand (ILS) remediation. American Fisheries Society Annual Meeting, Baltimore, Maryland.

Clayton, J. L., E. S. Dannaway, R. Menendez, H. W. Rauch, J. J. Renton, S. M. Sherlock, and P. E. Zurbuch. 1998. Application of limestone to restore fish communities in acidified streams. *North American Journal of Fisheries Management* 18:347–360.

Downey, D. M., C. R. French, and M. Odom. 1994. Low cost limestone treatment of acid sensitive trout streams in the Appalachian mountains of Virginia. *Water, Air and Soil Pollution* 77:1–28.

Additional Resources

For further information about watershed restoration and water resources management, consult the Penn State Water Resources Extension Web site at:

www.sfr.cas.psu.edu/water

or contact your local cooperative extension office.

Prepared by William E. Sharpe, professor of forest hydrology, and Bryan R. Swistock, extension associate.

Visit Penn State's College of Agricultural Sciences on the Web:
www.cas.psu.edu

Penn State College of Agricultural Sciences research, extension, and resident education programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

This publication is available in alternative media on request.

The Pennsylvania State University is committed to the policy that all persons shall have equal access to programs, facilities, admission, and employment without regard to personal characteristics not related to ability, performance, or qualifications as determined by University policy or by state or federal authorities. It is the policy of the University to maintain an academic and work environment free of discrimination, including harassment. The Pennsylvania State University prohibits discrimination and harassment against any person because of age, ancestry, color, disability or handicap, national origin, race, religious creed, sex, sexual orientation, or veteran status. Discrimination or harassment against faculty, staff, or students will not be tolerated at The Pennsylvania State University. Direct all inquiries regarding the nondiscrimination policy to the Affirmative Action Director, The Pennsylvania State University, 328 Boucke Building, University Park, PA 16802-5901, Tel 814-865-4700/V, 814-863-1150/TTY.

©The Pennsylvania State University 2005