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Innovations
In Water Clarification

Kentucky Lake
Spring 2007

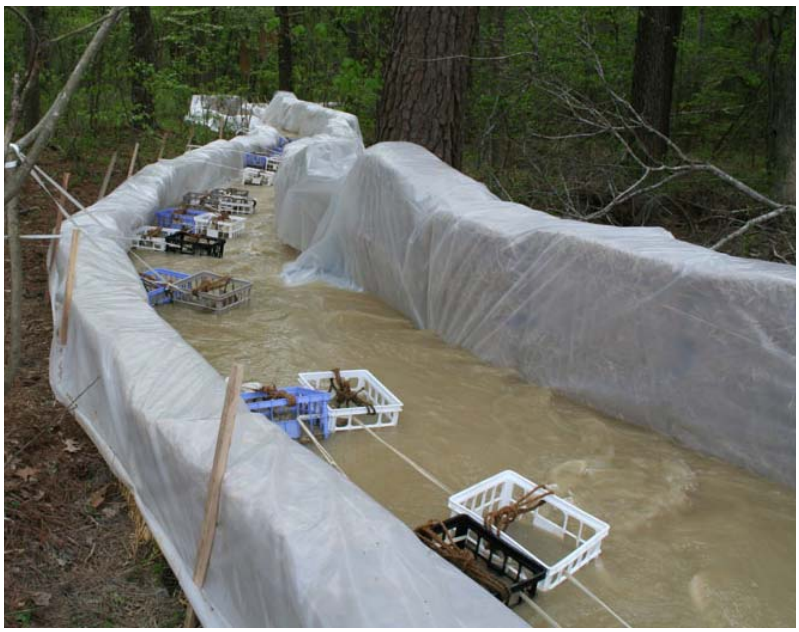
Kentucky Lake is the largest man-made lake in the eastern US. It contains over 2,000 miles of shoreline and 160,000 acres of surface water. It is part of the Tennessee Western Valley Watershed, which drains approximately 1,800 square miles and empties into the Ohio River. The watershed contains over 2,000 miles of streams and 100,000 acres of lakes in the Tennessee portion alone.

The lake was created in 1944 when the Kentucky Dam was constructed to provide flood control. The lake provides flood protection to 6 million acres on the lower Ohio and Mississippi Rivers and reduces the frequency of floods on an additional 4 million acres. However it has many other economical, ecological and recreational benefits as well. Numerous state parks, wildlife refuges, and recreation areas dot the shoreline.

Siltation is the deposition of sediment in bodies of water, and cause areas of deposit to become shallower. Such was the case in a privately owned cove on one of the inlets of Kentucky Lake. The sediment had filled in the cove, leaving only a few feet of water at the winter high points. The homeowner wanted to dredge out the cove, removing 450,000 cubic feet of accumulated sediment.

The dredge spoils discharged into the stilling pond through the pipe on the left and discharged through the riser pipe on the right.

The plan was to dredge out the cove and deposit the spoils into a large stilling pond where the sediment would settle out. The excess water would discharge from the pond, filter through a wooded area, and eventually return to the lake. The wooded land belonged to the Tennessee Valley Authority (TVA), and they had the project shut down over concerns of elevated sediment loads in the water returning to the lake as well as erosion through the woods due to the high volume and velocity of the discharged water.



The soil-specific Floc Logs were secured into plastic crates in the mixing/reaction portion of the treatment system where the polymer would react with suspended sediment.

With the possibility of fines for violations of discharge limits the contractor was urged to consider the use of polymers as part of the corrective actions to be taken. The contractor turned to the expertise of Applied Polymer Systems and Jen Hill for help to get the project back on track. Samples of the turbid water in the stilling pond were sent to APS labs to find the exact soil-specific polymers to treat the water. After consulting with Applied Polymer Systems and Jen Hill, a polymer enhanced flow-through chemical treatment system was designed to safely convey and treat the water coming from the stilling pond on its way back to the lake.

The treatment system consists of two parts. The first part was the mixing/reaction portion, where the polymer reacted with the suspended sediment and caused flocculation, and the particle collection portion, where the flocculated particulate was collected and removed from the water. The water entered the treatment system after allowing the high sediment loads of the dredge spoils to settle in the stilling pond. The water discharging from the stilling pond into the treatment ditch flowed at a rate of 3,500 gallons per minute, and needed to be treated as a continuous flow to allow work to continue on schedule.

The dredge spoils entered the stilling basin with 15% solids. Within the stilling basin the heavy sediment (silt and sands) dropped out of suspension. However the water was still cloudy as the colloidal clays and fine sediment were still in suspension. The turbidity of the water discharging from the stilling basin through the riser pipe was measured at 500-600 NTU. As the turbid water reacted with the Floc Logs in the treatment system, and the reacted particulate was collected, the fine sediment and clays were removed and the turbidity dropped drastically to only 21.0 NTU. The clarified water slowly filtered through the remainder of the wooded area and reentered Kentucky Lake without any turbidity plumes.

The mixing/reaction portion of the treatment ditch was placed at the outlet of the riser pipe, and was constructed with two rows of straw bales placed 4-5 feet apart and covered with plastic sheeting. The mixing ditch was 140 feet long, and was built on top of a layer of geotextile fabric to protect the plastic sheeting from punctures.

The site-specific Floc Logs were secured in plastic crates and placed in a series running down the treatment ditch. The turbulence caused by the narrow ditch and the high flow rate ensured that the turbid water could flow over and around the Floc Logs allowing for dissolution. The dissolving polymer mixed and reacted with the suspended sediment, causing particles to form. The turbulence along the ditchline increased the mixing and allowed the particulate to build up and collect the fine sediment and swelling clays.

The treated water passed across the jute dispersion field before passing through the SRB (sediment retention barrier) filled with straw and polymer where final polishing occurred.

After treatment and clarification, the water discharged into a dispersion field where it spreads out and slowed down in a stabilized area before being allowed to re-enter Kentucky Lake. The particles that had formed in the reaction portion were collected and removed, allowing clarified water to return to the lake. By reducing the velocity, the erosive potential of the flowing water was greatly reduced to minimize the disturbance to the vegetated areas.

The clarified water re-entered Kentucky Lake without any turbidity impacts.

The treatment ditch discharged into a dispersion field lined with open weave jute matting applied with the appropriate soil-specific Silt Stop powder. The jute fabric provided a surface area for the reacted particulate to adhere to while providing structural support to the underlying soil surface to prevent erosion or cutting in the forest floor. The Silt Stop powder enhanced the particle collection capabilities of the jute matting. The water spread out and slowed down as it was discharged into the 8,100 sq. ft. dispersion field, ringed by a polymer enhanced Sediment Retention Barrier (SRB). The water pooled in the dispersion field, slowly filtering through the SRB and releasing at a greatly reduced velocity and returned to Kentucky Lake.

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