RECLAMATION Managing Water in the West

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The Knowledge Stream
Research Update

Affordable Self-Cleaning Trashrack

Irrigation districts can now build their own self-cleaning, solar-powered trashrack

Bottom Line

This research project developed a self-cleaning, low-head, low-energy trashrack system that effectively removes debris from irrigation canal systems.

Better, Faster, Cheaper

This system can reduce time, labor, and money invested in canal maintenance. Head loss across the self-cleaning trashrack is reduced from the head loss associated with self-cleaning screen mechanisms. As this system is solar-powered, it can be installed in remote locations.

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Problem

Removing debris from water flowing in canals is an operational issue for virtually any open-channel conveyance system. Materials such as tree leaves and branches, tumbleweeds, aquatic plant matter, dead fish and animals, along with human-created trash are typically carried along with water flowing in a canal. Stationary trashracks are commonly installed to serve as a debris collection point, but these must be cleaned to prevent excessive head loss and/or overtopping of the upstream canal banks as the debris mat accumulates on the rack.

The accumulated debris must be removed manually or mechanically, manually at most trashrack sites. Under adverse conditions (i.e., windy weather or rapid growth of aquatic plants) a trashrack may require cleaning every few hours—or in extreme situations—multiple times per hour. Keeping a trashrack cleaned can tie up an irrigation district's staff time resources as they travel to, and spend time on, a site. Existing automated trashrack cleaning systems typically have significant power requirements and represent a level of investment that has only been feasible for high volume sites on large water delivery systems. Automated cleaning systems have not been an economically viable alternative for most irrigation water delivery systems.

Solution

Reclamation researchers have developed a trashrack system in which the rack bars themselves function as the cleaning mechanism. A self-cleaning prototype was constructed and tested in a laboratory flume. The prototype rack bars were constructed of ½-inch-wide by 3-inch-deep steel bars spaced 3 inches apart on center. The bars are oriented at a 3:1 (horizontal:vertical) slope with the canal invert sloping upward in the direction of flow. The upper edges of the bars were cut in a saw-toothed shape. Each bar is able to travel back and forth in the direction of the rack slope at a distance of approximately 1 foot.

The bars are mechanically linked to synchronize the motion of every third bar. Three 12-volt DC gear motors power the motion of the bars. Each motor is linked to a shaft that passes under the upper end of the rack perpendicular to the bars. Sprockets mounted on the respective shafts are in line with every third bar and engage in sections of roller chain welded to the underside of the bars.

As a cleaning cycle is initiated, all bars are moved in unison toward the upper end of the rack. After this advance travel stroke, two thirds of the bars remain stationary while one third of the bars retract to the original position. Once the first group of bars has been retracted, a second group of bars retracts, and then the third group retracts. During each phase of the retraction, two of every three bars remain stationary. The saw-toothed shape of the bars tends to grip against the debris mat as it is being advanced, and the debris mat is held in place by stationary bars during the retraction. The saw-toothed shape also allows the retracting bars to slip back

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under the debris mat with minimal grip. Photograph 1 shows the prototype rack in the laboratory flume. Photograph 2 shows the shaft/sprocket drive mechanisms.

Automation components include a programmable logic controller along with a water level sensing system capable of monitoring water levels upstream of, and downstream from, the trashrack. The system is programmed to perform a cleaning cycle once the level differential across the trashrack exceeds a target value.

Application

During 2012, the self-cleaning trashrack was tested in the laboratory. The first test used synthetic aquatic plants, followed by tests with sago pondweed, and then filamentous algae materials collected from field sites. Following laboratory testing, the prototype unit was installed at a site on the Tetsel Ditch delivery system in northeastern Colorado. Photograph 3 shows a mat of debris that has been transported off the upper end of the rack and deposited onto a holding deck at the Tetsel Ditch site.

The prototype unit was operated continuously in automated mode beginning in mid-June and continuing through the end of the 2013 irrigation season. For this small-scale site, accumulated debris is deposited on a holding deck. The ditch rider manually clears the deck on his daily rounds. The unit operates entirely on solar-charged 12-volt DC power.

Future Plans

The Reclamation research project team are in discussions with the Angostura Irrigation District (Angostura) in southwestern South Dakota, along with the Dakota Area Office Water Conservation Field Services Program, to explore the possibility of installing a similar unit at Angostura's Cheyenne River inverted siphon entrance. Historical debris accumulation problems at this site are a key issue that led to development of the self-cleaning trashrack concept. With the solar-charged power configuration, this system can be suitable for sites where debris accumulation is a problem at almost any open channel location. The team estimates that total costs (including concrete placement) for a structure similar to the prototype unit (~3-foot-wide channel) will range from $20,000 to $30,000.

Photograph 3.—Prototype trashrack installation and operation at the Tetsel Ditch site in northeastern Colorado.

"After seeing this device installed, I wondered how it worked. Now that I have seen it operate during a cleaning cycle, it is really a simple system that works well."

Herman Neiman
Ditchrider for the
Tetsel Ditch Company

More Information

www.usbr.gov/research/projects/detail.cfm?id=3107

Photograph 1.—Saw-toothed edge rack bars.

Photograph 2.—Shaft/sprocket drive system.