The Application of CanalSentry™ To the Rocky Ford Highline Canal August 27, 2009

Report Prepared By:

INNOVIUM
Combining Chemistry & Nature

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Executive Summary:

Innovium has developed a product which significantly reduces seepage in canals, is biodegradable and is much safer to use than polyacryamide in this application. CanalSentry™ is a carbohydrate based natural product which contains a small amount of polyacrylamide. When applied at a rate of 3ppm into the canal water, it effectively aggregates small clay, silt, and silicates particles which reside in the water as suspended solids. These small particles are attracted to the negatively charged polymer and form aggregates which drop out of the water and fill the small cracks and crevices in the canal where water is seeping from.

The Rocky Ford Highline Canal Company working with Innovium (Mark Hochwalt, President) applied CanalSentry™ to 4.4 miles of canal, starting from approximately 0.1 miles upstream of HWY 50 and continuing upstream to approximately 0.4 miles below the Rocky Ford Highline Canal Gauging Station. Del Smith, John Osterberg and Patrick Ergers from the Bureau of Reclamation were on hand to witness the application and provide assistance in measuring the effectiveness of the application by taking measurements at the top and bottom of the canal reach before and after the application.

Prior to treating the canal, flow measurements were made at the top and bottom of the reach to assess the flow rates and leakage rate over the reach. The upper reach was flowing at 183 cfs and the lower reach was flowing at 173cfs. There was 0.6cfs being diverted over the reach, so the estimated loss due to seepage was pegged at 9.4cfs.

To treat the canal, a water sample was taken to assess the water turbidity which is an indicator of suspended solids. The sample showed the water's turbidity to be approximately 200 NTU. This represents approximately 240 ppm of suspended clays and silt in the water which is sufficient to get an effective seal.

The dosage of CanalSentry™ need to treat the water and achieve 3 ppm was calculated 89 pounds per lineal canal mile. Because of the difficulty of trying to measure the product in this increment, it was decided to use 100 pounds of CanalSentry™ per canal mile which represents 3.3ppm in the water. 440 pound of the product was evenly dispensed over the 4.4 mile reach. Flow measurements made after the application showed the upper end of the canal was running at 183 cfs and the lower end of the canal was running at 177 cfs. There was still 0.6cfs being diverted from the reach. The loss after the application was calculated at 5.4 cfs. The loss before the application was 9.4 cfs, therefore the application showed a savings of 4 cfs or a 43% reduction in seepage.

The calculated water savings for doing the treatment, assuming that one treatment will last the rest of the irrigation season is as follows:

Water Savings per day = 4 cfs X 3600sec per hour X 24 hours
= 345,600 cf per day / 43560 cf per acre ft
= 7.9 acre ft per day

Water savings for remainder of season = 7.9 acre ft per day X 70 days
= 553 acre ft

Application Details:

A 4.4 mile reach of the Rocky Ford Highline Canal was treated with CanalSentry™, a bio-friendly carbohydrate based canal sealant developed by Innovium LLC. Prior to the application, flow measurements were taken by the Bureau of Reclamation using a Teledyne RDI StreamPro ADCP (Acoustic Doppler Current Profiler). On the day of application the top of the reach had a flow rate of 183 cfs and the bottom of the reach had a flow rate of 173 cfs. There was one off take of 0.6 cfs in the reach, therefore the loss in the reach was calculated at 9.4 cfs.

Treated section of the Rocky Ford Highline Canal

The Rocky Ford Highline Canal Company
Appling CanalSentry™ Through a Plastic Funnel

The canal had 200 cubic feet per second flow traveling at approximately 2 ft per second down the canal reach. The application was conducted starting at the bottom of the reach and traveling up the reach at a rate of approximately 2 miles per hour or 2.93 ft per second. The dosage of CanalSentry™ in the water is calculated from the following formula:

$$\text{Dosage (PPM)} = \frac{2\text{ ft}}{\text{sec}} \times \frac{100\text{ lbs}}{\text{mile}} \times \frac{1\text{ mile}}{5280\text{ ft}} \times \frac{\text{sec}}{} \times \frac{\text{ft}^3}{200\text{ft}^3} \times \frac{1{,}000{,}000}{62.3\text{ lbs}}$$

$$= 3$$

The maximum acrylamide monomer (AMD) concentration in the water can be calculated from the following formula:

$$\text{AMD (PPT)} = 3\text{ ppm CanalSentry} \times \frac{0.166\text{ LA PAM}}{1.0\text{ CanalSentry}} \times \frac{0.0005\text{ AMD}}{1.0\text{ LA PAM}} \times 1{,}000{,}000$$

$$= 249$$

The maximum allowable acrylamide monomer (AMD) concentration in drinking water per NSF Standard 60 can be calculated from the following formula:

$$\text{AMD (PPT)} = 1\text{ppm LAPAM} \times \frac{0.0005\text{ AMD}}{1.0\text{ LA PAM}} \times 1{,}000{,}000$$

$$= 500$$

The acrylamide monomer (AMD) concentration in this application of CanalSentry™ was 50% of the allowable limit for drinking water as outlined in NSF Standard 60.

The following sequence of pictures shows the formation of flocks in the canal water from one point on the canal as the application motor boat was advancing up the canal. Based on the velocity of the boat's travel up the canal and the water flow rate down the canal, we can determine the time and the distance from the point of application before flock formation was observed.

Boat Passing During Application – 2:44 PM

Point 10 minutes After Application – 2:54 PM

Point 11 minutes After Application – 2:55
Flocks beginning to Form

Point 13 minutes after application – 2:57 PM
Water becoming clearer, flock pools more evident

Point 16 minutes after application – 3:00 PM

Point 20 minutes after application – 3:04 PM

Flocks began forming in the water at 11 minutes after the boat passed. Solving two simultaneous equations, one for the travel of the motor boat up the reach and the other for the water flow rate down the reach, a distance can be calculated from the observation point to determine the time it takes to hydrate the CanalSentry™ and begin flock formation.

Solving the two equations the boat had traveled approximately 791 ft up the canal taking approximately 4.5 minutes at a velocity of 2.93 ft/sec, and the treated water took 6.5 minutes to travel back to the observation point at a velocity of 2.0 ft/sec with a total elapsed time of 11 minutes from the time the boat passed the observation point.

Samples taken of the water before and after application show how effective CanalSentry™ is in dropping the sediment out of the water to form a sealing material.

Results:

Preliminary estimates indicated a loss rate of about 5 cubic feet per second over the treated segment of canal with a canal flow rate of about 150 cubic feet per second at the upstream end. An inflow-outflow test conducted earlier this year on this same segment at a flow rate of about 150 cubic feet per second indicated a pre-treatment seepage loss of about 14 cubic feet per second.

The results need to be more carefully analyzed, but this is quite encouraging. This 64% reduction is very similar to the reduction that was measured earlier along this reach using LA PAM.

Conclusions and Next Steps:

It appears from the preliminary result that CanalSentry™ is as effective as LA PAM at reducing canal seepage. The application technique used was extremely low tech and inexpensive, but effective at achieving the desired result. The exposure level to the product using this method when used along with some simple personal protective equipment (gloves and a dust mask) would be very low. The CanalSentry™ appeared to dissolve more easily than LA PAM, with flocks appearing approximately 791 ft or 0.15 miles downstream of the application point.

Next Steps:

- Additional quality assurance check need to be done to determine the accuracy of the seepage measurements.
- Additional measurements over the reach should be taken to determine the longevity of the application.
- Some thought should be given to potentially improving the application method.
- A more controlled study should be undertaken next season to validate the results.
- A controlled study should be undertaken to determine the optimum dosage of CanalSentry™ to get the desired reduction in canal seepage.