Automation playing key role in surface irrigation interest

by Allan Humpherys
contributing editor

"Turbulent fountain" circular trash and weed seed screen.

Surface irrigation is receiving increased attention because of its low energy requirements and cost. Current improvements are aimed at reducing the amount of labor required and increasing system efficiency. Researchers at the USDA's Snake River Conservation Research Center in Idaho are developing new and improved irrigation techniques and equipment to achieve these objectives. These improvements use automation in one form or another along with accessory equipment such as trash screens and energy dissipaters.

Automated furrow systems use gated or ported pipe laid on the ground surface to distribute water to individual furrows. Irrigation is either sequenced from one set to another with automated valves; or is accomplished with a continuously moving cablegation set.

Solid state electronic timing controls are being developed, some of which can be battery-powered. Surge irrigation is a new technique which can enhance the effectiveness and efficiency of an automated system. New and improved self-cleaning trash and weed screens help irrigators overcome one of their most persistent problems. Design data are being obtained for orifices and butterfly discs that are used to dissipate excess energy in sloping gated pipe systems.

Automated Valves

Automated valves having internal diaphragms or bladders filled with either air or water to close the valve have been marketed for several years (Econogation and Hastings). More recently, air-operated butterfly valves have been developed. These low pressure valves, commonly used in gravity irrigation systems, are usually hand operated, but can be automated by attaching an air cylinder.

Portable air tanks, pressurized to about 125 psi, are used to supply air to the cylinders. With no air leaks and the pressure regulated to about 45-60 psi, one tank of air can last a full irrigation season. A 4-way pilot valve is used to control air flow to and from the air cylinder. The pilot valve can be controlled by 24-hour mechanical timers as shown in the photo. Elecable in the future.

Components for the valve package are commercially available, but cannot be obtained from any one single source. Cost for the parts in small quantities, without any assembly labor, varies from about $300-350, depending upon valve size. The valves, field tested for two years, are installed on risers from buried pipe lines or at field turnouts from a canal or farm reservoir. They control the flow of water to gated pipe and sequence irrigation from one gated pipe set to the next.

Another valve that uses an air-inflated rubber pillow beneath an alfalfa valve cover was developed by USDA engineers at Fort Collins, Colo. A commercial version of the valve, combined with an alfalfa valve hydrant, is expected to be marketed soon. The pillow is inflated from either a central air supply through a buried air line or from a portable air tank. It is controlled by an electronic controller. When the pillow is deflated, water flows from the valve into a gated pipe line with preset gate openings.

Automated Single Pipe Systems

Long-length, gated pipe lines are used for both water conveyance and distribution and function as single pipe systems. Considerable labor is required to manually close one group of gates and open another group at each irrigation set change. Automated single pipe systems both convey and distribute water to the field, but do not require

Cablegation, developed by Doral Kemper and his associates at the Snake River Conservation Research Center near Kimberly, Idaho, is one of the most exciting developments in automated irrigation. The system uses a single pipe as both a supply and distribution line at the head of a field.

A moving plug inside the pipe causes water to flow from openings in the pipe upstream from the plug. The rate of movement of the plug is controlled by a cable attached to a reel whose rotational speed is governed by either hydraulic mechanisms or a D.C. motor-driven gear reduction assembly.

Water is diverted through openings near the top of the pipe for some distance upstream from the moving plug. Thus, water is applied in a continuously moving set across the top of the field. The amount of water applied is controlled by the plug's rate of travel which in turn is controlled by the mechanisms controlling the cable reel.

Recent improvements include the development of hydraulic controls for the reel. One system consists of a pair of hydraulic cylinders connected to a crank such that they act as a brake to control the rotational speed of the cable reel. Another system uses a hydraulic motor for this purpose. Another system uses a water-driven paddle wheel in the supply line. The paddle wheel shaft, connected to the cable reel through a chain-driven gear assembly, can provide a range of cable

Various types of gates and adjustable discharge control devices are being tested to control the rate of water flow to individual furrows. One outlet is designed to discharge the sediment bed load carried in some pipe lines.

Modifications to the moving plug allow it to be used in conventional gated pipe. One such system, in operation this past summer, uses pvc gated surface pipe.

Since the grade or slope on which the pipe is installed must be carefully controlled, one contractor uses laser guided equipment to install the pipe. A system ¼-mile long for a 40-acre field can be installed for about $100-125 per acre.

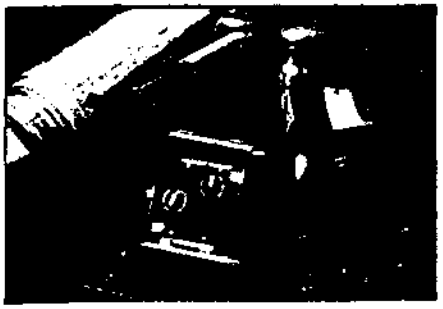
Cablegation can also be designed for border systems and at least one such system is in operation.

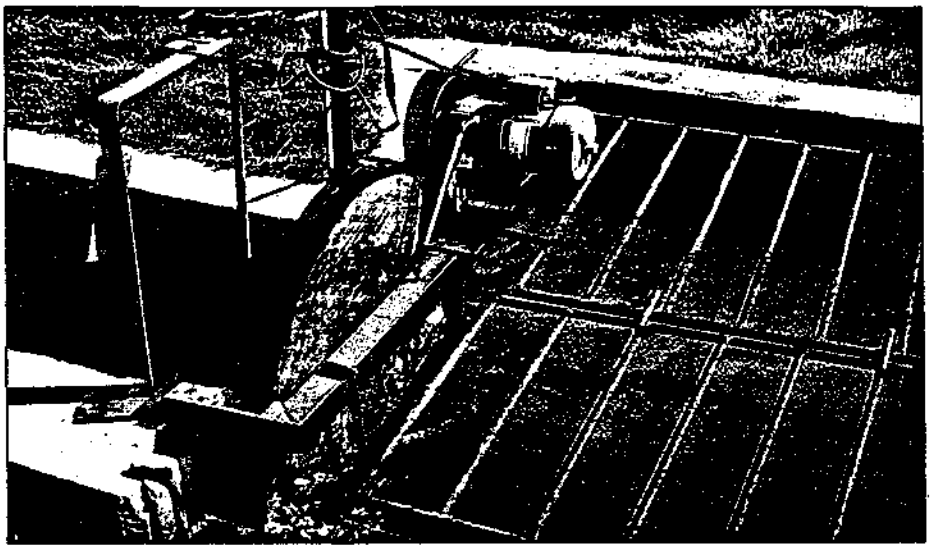
Modified "Miniwai" is a system that gets its name from a similar one used in Hawaii several years ago. A flexible rubber membrane or liner was used to cover discharge openings in a conveyance channel or pipe. A modified system is being tested which uses a nylon reinforced, flexible rubber tube liner inserted into conventional gated pipe. Water flow is diverted either into, or on the outside of, the flexible tube by a diverter valve.

In the irrigation mode, flow is diverted to the outside of the tube and flows from the gated pipe openings to individual furrows. When the pipe is used for conveyance, the flow is diverted into the tube through which it is conveyed to another downstream set or section of pipe. Flow from the gated openings is automatically shut off when water is diverted into the tube. A diverter valve is installed in the pipe line at the upstream end of each set.

The end of the tube liner at the downstream end of each set is clamped into the gated pipe so that water can pass through the tube but not around it at that point. The tube is held in place within the pipe by a retainer strip and passes through all of the pipe lengths which comprise one irrigation set.

The diverter valve is controlled by a 24-hour mechanical timer and is operated by a manually reset torsion spring. A 6-in. gated pipe system was successfully tested during this past summer.





Motorized wheel-type trash screen on a farm canal turnout.

This system can automate existing, long pipe lines to avoid having to manually open and close pipe gates at each irrigation set change. Valves and components are being developed for 8 and 10-in. pipe lines.

Surge irrigation, a relatively new concept developed at Utah State University, is the intermittent application of water to the field surface in a series of on and off surges or pulses. It is an operational technique which can improve the performance and versatility of surface irrigation systems. The permeability of the soil's surface layer appears to be reduced following a short 10 to 20-minute drainage period between surges.

Water applied intermittently advances rapidly over the wetted portion of the furrow at each surge and characteristically reaches the end of the furrow in less total accumulated time than if applied continuously. Thus, furrows can be prewet with less water and irrigation uniformity is improved since the depth of water applied at the upper and lower ends of the furrow is more nearly the same. Although most soils exhibit this characteristic, its effect is variable for different soils.

The greatest benefit from surge irrigation will likely occur during the first irrigations of a season, or following cultivation when soil intake rates are high. Stream advance at these times is often slow with deep percolation near the upper end of the field. Surge irrigation can also help overcome the differences in soil intake rates between tractor wheel-traveled and non-traveled furrows.

Automation is essential for the practical application of the surge technately from one set to another. Irrigation controllers and timers designed for this purpose are not yet available; however, irrigators can still use this method in a limited way with the automated equipment presently available.

For example, a series of irrigation sets can be programmed to occur with a given 8 to 12-hour period. The timing controls are then reset to repeat irrigation of the same sets.

Each intermittent application constitutes one surge, and can continue throughout the irrigation, or only until the furrows are wet throughout their length. After the furrows are wet, reduced or cutback continuous streams can be used to complete the irrigation. Cutback streams can be obtained by irrigating more furrows or sets of furrows than for the initial irrigation with the same water supply.

Wynn Walker at Utah State University and researchers at several other state agricultural experiment stations and USDA locations are conducting studies to determine the effectiveness of surge irrigation on different soils and ways to use this technique most effectively.

Self cleaning trash and weed screens are essential to the proper functioning of an automated irrigation system. Recent developments include design modifications for conventional horizontal screens to improve their performance and the development of new screens.

James Bondurant improved rectangular horizontal screens by adding deflectors and turbulence inducers to broaden the area of water impact on the screen and to break up the jet of water with increased turbulence. He used small wheels and wooden deflectors under the jet of water for this purpose.

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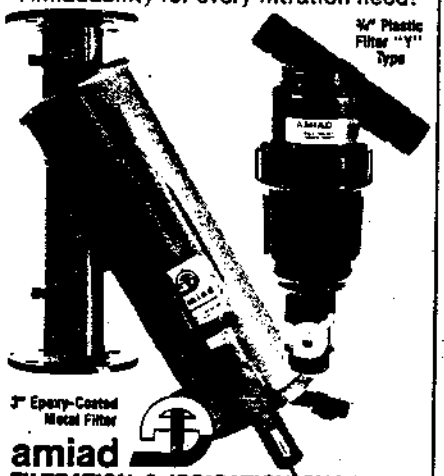

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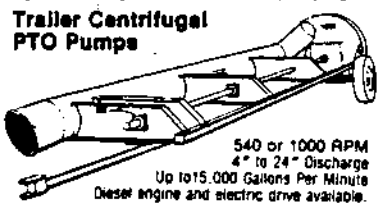

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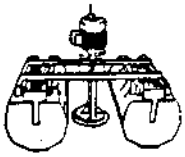

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Cargill offers four hybrid wheats

Four hard red winter hybrid wheats will be available on a limited basis in Kansas, Oklahoma, Colorado, Texas and Nebraska for fall seeding from Cargill. The introduction culminates a 16-year program to find, incorporate and evaluate genetic materials that would improve wheat yields.

"We believe these initial hybrids have the potential to provide an economic return to farmers," said George Jones, president of Cargill's Seed Division. "But our decision to market hybrid wheat is based on our confidence that our genetic research program will continue to produce even better hybrids that will be profitable for top farmers."

Research comparisons were evaluated on Bounty hybrids (BH) 100, 200, 300 and 310 and these varieties: Newton, Larned, Vona, TAM 101, Centurk 78, Triumph 64 and TAM 105. Nine trials were done on irrigated wheat, 15 on dryland locations over four years.

Overall, the irrigated hybrid wheat yielded over a four year average approximately eight bushels more than the wheat varieties: 77 bushels versus 69 bushels. On 15 dryland locations, the hybrid wheat outyielded the varieties approximately 52 to 44 bushels, again an eight-bushel difference.

Frank Remley, research and development manager for the Cargill Seed Division, estimated that a minimum five-bushel advantage for hybrid wheat over current varieties is needed to offset the increased cost of the hybrid wheat. He valued market wheat at $3.50 per bushel.

"Yield data for our 1982 hybrids and results from state trials and about 300 farmer cooperators show hybrid yield improvements of up to 10 bushels per acre or 20 percent over the top varieties," Remley said. "But we're even more encouraged by results from hybrids now being tested that should be available in 1983 or 1984. Those hybrids show a 5 to 10 percent additional yield increase, so it's the upward trend that's important."

The best bet for increased profits for wheat growers, Remley suggested, will be for those growers now getting yields in the 50, 60 and better bushel yields with their varieties. Those growers, under normal growing conditions, should reach that five-bushel threshold with hybrid wheat. He estimated that yields 10 to 12 bushels higher are possible.

Remley said the highest yield difference between irrigated hybrids and irrigated varieties was in Dumas, Texas, where BH 100 yielded 127 bushels and Vona 102. Remley added that the company is still investigating why the average increase in irrigated hybrid wheat over wheat varieties isn't higher.

"We're not sure yet what exactly the limiting factors are to significantly higher yields with irrigation," Remley explained. "We hope to make better progress in our irrigated plots."

The hybrids vary in seed size, Jerry Dohrman, product manager, said. He advised producers to carefully adjust their drills to make sure they seed at correct rates. "Drills should be adjusted so at least 50 pounds of seed are planted per acre with larger seed sizes," he said.

Low seed stock availability will limit sales to about 1,000 farmers. Company officials estimate the present potential for hard red winter wheat hybrids at about 5 million acres. Last year the amount of hybrid wheat planted in the country was less than 1%, Remley noted.

"Our first spring wheat hybrids are expected for testing next year," Remley added. He estimated that hybrid barley may come in about five years.

Automation

(Continued from page 7)

zontal screens were also recently developed by Kemper and Bondurant. Water is discharged from the top of an inlet pipe onto a circular horizontal screen. These screens are generally self cleaning and work well where a limited amount of head is available, since they require only about 5 to 6 in. of head loss. They are well adapted to inlet structures supplying gated pipe systems.

New, self-cleaning, wheel-type screens are being developed for use at farm turnouts where electrical power is available. They are installed in front of a farm canal turnout and present amount of head loss is negligible and they can be removed easily if needed for canal cleaning.

The wheel-type screens are well suited for use in systems with little or no available head loss or where automated valves downstream from a turnout close, thereby stopping or rejecting the flow of water from a canal. When horizontal screens are used on canal turnouts, water must continue to be taken from the turnout unless a custom designed structure incorporating a float valve is used.

These and other future developments can make low energy, surface irrigation a viable alternative to other