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Irrigation system management

Advances through mobile data transmission

The further development of irrigation management plays a growing role where farms increase in size. Focal point here is the optimising of irrigation periods (Landtechnik 3/2000) and the operation of the irrigation equipment or irrigators. This paper reports on the possibilities for mobile data transfer from pump stations, irrigators as well as for climate and soil sensors This technology is at the moment being discussed throughout the farm irrigation sector with the aim of improving irrigation management and sinking operating costs.

When irrigation systems are moved, supplying hydrants have to be closed and then re-opened and where pressures are high this can be dangerous. In some types of plant, pumps are automatically shut down through over or under pressure systems when overflow occurs. But manual shutting-down may be still necessary with breakdowns in the irrigation plant or where a section has to be replaced.

Where irrigators are being erected for the first time, all adjustment operations must first of all be carried through before the pump is activated and subsequent control work on the machine is carried out. This demands commuting or travel time.

Available mobile radio controls for pump operation improves reliability and saves time. The farm manager uses his mobile 'phone to dial the number of the pump control, adds a PIN, and then with a predetermined key combination operates the pump control. Such systems are already in action on a few farms.

Further developments should enable signals from the pump station to be sent to the farm manager's telephone. Transmitted in this way could be the working condition, pressure, throughflow, engine temperature, current uptake, position of pusher behind the pumps, position of blow-back valve, or similar information.

Irrigators

On larger farms different irrigator technology is applied on different fields with sometimes long distances between systems. This applies to both mobile and semi-mobile irrigators, the latter being mainly circular-boom units.

The technical equipment of the irrigators and the differing water demand of the crops mean settings for extent of irrigation are variable. In turn this means that very different operation times are required – and that these have to be controlled. Increasing in line with the number of machines per farm is also the frequency of breakdowns which should be identified and repaired as soon as possible. Further, monitoring work, with the driving to the machines involved in this, is demanding in time and energy. Machine stand still periods can also occur which reduce machine capacity (area performance). Mobile monitoring via radio also makes sense where irrigation is applied on single field strips and/or areas far from the steading. All such situations call for mobile communication between irrigator and farm manager.

An evaluation of such a system would, in the future, also have to consider the reliability of the data transmission and the work and energy savings through its application.

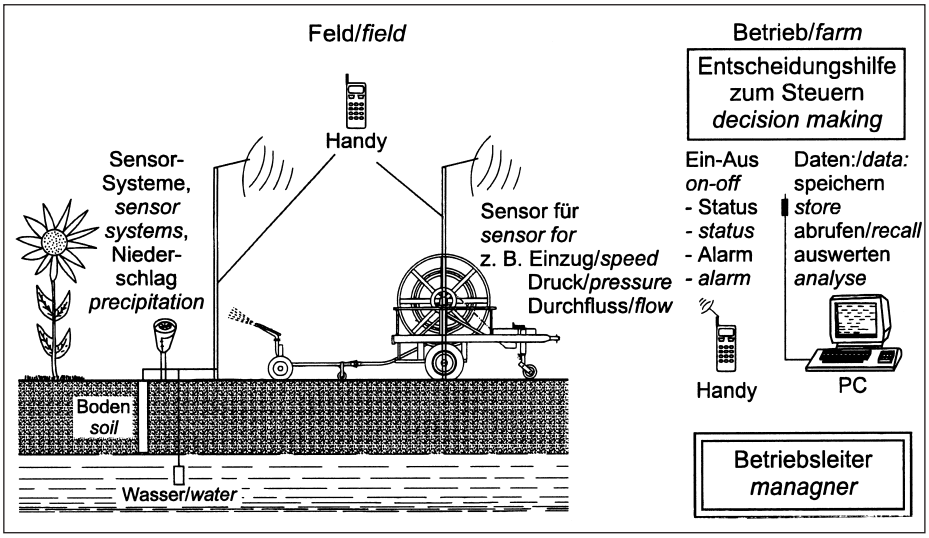

Fig. 1: Cellular phone use for monitoring mobile irrigation machines readings of TDR-sensors

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Mobile irrigators

PE pipeline length, flow rate and intensity of irrigation determine application speeds for the mobile irrigators. The farm manager matches irrigation intensity to crop water requirement and soil conditions. Through this, every system has a separate adjusted application speed with the result that every system completes its irrigation cycle at a different time.

In the irrigation management research programme a function monitoring system based on mobile telephone was for the first time installed in a mobile irrigation system. The simplified construction is presented in *figure 1*.

In the first version inductive approximate sensors for starting the irrigator (irrigation begin) were fitted, then for turbine still stand (breakdown), and for turning-off the turbine or nozzle carriage (end of irrigation). The signals here are carried by a transmitter unit equipped with a SIM card and which then automatically transmits the message regarding the work situation as an SMS to the farm manager's mobile telephone. The message can also be sent as a fax or e-mail from the transmitter.

This institute development means the farmer can turn on his irrigation at a precise time and be informed in the shortest possible time about any breakdown. The D-network and standard mobile 'phone with SMS function – regardless of the company – can be used for this.

The energy for the transmitter was from a 12 V accumulator (min. 28 Ah) and a 6 W solar module. The electricity for stand-by mode – i.e. during irrigating operation – was 110 mA and 570 mA during transmission. The transmission was active without any breakdown under normal conditions twice daily for one to two minutes. Without recharging, a working period – under the given conditions – of five days can be guaranteed.

The presented transmitter has eight signal inlets and two switch outlets. Thus, further sensors can be cost-efficiently added to the system.

Active operating of the irrigator via mobile 'phone can also be considered. This could allow faster or slower water application with the respective effect on amount of irrigation applied. Further developments would apply to the combination of the present system with water application rate control via transmitter to encourage cost-effective solutions in this area too. At the same time further developments must be made in the automatic and energy-sparing supply of energy for the system.

Semi-stationary irrigators

Belonging to the semi-stationary class are the linear and circular-boom irrigation systems. The latter revolve around a fixed central tower when irrigating. Energy for the driving towers comes from the mains or a generator. Thus, compared with mobile irrigators, an easier solution for powering mobile data transmission is right at hand.

Data transmission for monitoring, documentation or operation is practical for the following parameters. Already some of the following solutions are available in individual cases:

- The starting and stopping of the circular irrigator, this switch must be linked to the pump switches.
- Information on running direction of the irrigator with switches to allow directional alterations.
- Information over driving speed, with switches for altering the speed. The variable controls for speed can also be applied for spatial-specific irrigation in cases where the necessary information on plant water requirement is available.
- Information on the actual position of the irrigator boom on the field. In association with field shape and additional equipment on the irrigator, a pressure increase pump can be switched on at the end of the boom to activate an end-irrigator for covering field corners.
- Information on water flow and working pressure at the central tower.

As with mobile irrigators, the given parameters may be recorded via transmitter and GMS, or transmitted via special "control panels" and farm radio network (*fig. 2*). Further developments are still necessary, above all towards a uniformity of data transmission and towards the direct reception of data, e.g., in a field map system. The systems known nowadays still have the character of pilot plants.

Summary and outlook

A series of important applications has been evolved with mobile radio technology in the last few years. This promises a higher standard of security, enables controllable operation of irrigation systems and make possible for the first time an almost automatic "monitoring" of irrigation data. From first pilot systems, pumps, irrigation machines, weather and soil moisture data can already be accessed online, or working conditions called-up. In total, the application of mobile radio technology in irrigation is still at the beginning. This is made clear by the very different transmission technologies available – mostly not compatible.

At the end of 2000 a European standardisation group – CEN/TC 334/WG9 "Integrated management system – Data interchange between management and control systems and field remote terminal units". This has set the target of standardising irrigation management and the transmission of performance and working conditions of irrigators and climate stations. This is important because a future farm management will not be able to do without online data for irrigators – be it for monitoring or for operating.

Fig. 2: Communication links at centre pivot irrigation machine