

CHAPTER 20: Operation and maintenance

INTRODUCTION

The efficient operation of an irrigation system depends mainly on the ability of the farmer to make the best use of it. For every system, depending on the kind and the type of the installation and the way the water is delivered to the farm, there are several steps to be taken and factors to consider in order to ensure the efficient operation and performance of the installation. Sometimes, the irrigation installation fails to give full satisfaction because of poor design, faulty installation, or equipment that does not conform to specification. However, the way both the irrigation system as a whole and its component parts are operated and maintained will determine the success or failure of any properly designed and installed system.

The O&M of the irrigation system is also the key factor for good irrigation management. Farmers need a sound knowledge of the O&M procedures of their installation. This knowledge should be acquired from complete information, demonstration and written instructions from the designers and the suppliers.

OPERATION

When and how long to irrigate

The application of the exact amount of water required by the crops at the right time is the main achievement of the irrigation installation. Farmers normally understand matters concerning the main elements of irrigation programming, such as water discharge and rate, operating hours and irrigation frequency, and they can follow instructions. Properly installed, operated and maintained irrigation networks enable farmers to exercise absolute control over water use at farm level. Thus, it is easy for them to apply irrigation schedules based on crop, soil, weather, and water availability and quality factors.

Starting and stopping the system

Starting and shutting down the pressurized irrigation installation needs to be done very carefully in order to prevent surges and water hammer and to avoid air pockets in the pipelines.

The opening and closing of the valves at the head of the system, the main and submain pipelines, should always be done slowly.

Where there is a pump, engine or motor driven, the supplier's instructions should be followed. Priming the pump, filling the pipes, adjusting the speed and lubricating the pumping equipment are matters of major importance. Manufacturers provide detailed instructions in their literature for starting and operating each pumping unit.

System performance

Frequent observations and checks should be carried out during the irrigation season to ensure the proper functioning and good performance of the system. This involves a number of procedures for simple evaluations based on measurements taken under field conditions.

The equipment needed for this task is as follows:

- a map/sketch of the irrigated area showing the locations of all the system's component parts and the various plots;
- a portable pressures gauge (0–6.0 bars) with a special adaptor and pivot tube adjustment;
- a stopwatch (chronometer);
- a measuring tape, approximately 20 m;
- graduated vessels, capacity 1–5 litres;
- a soil auger, shove or probe;
- a notebook for recording data.

In most closed pipe pressure systems there are a number of factors that should be evaluated to determine the level of operation and that can be readjusted where not satisfactory.

Operating pressures

With the system in operation, pressure measurements are taken at various points on the piping network, preferably at the beginning and at the far end of the main and the submain pipelines. The operating pressures of the first and last emitters on a number of laterals are also measured. All pressures should be within the designed range. The difference in the

emitter pressure should not differ from the recommended average pressure by more than 20 percent on level ground. Any change should be investigated immediately.

Flow rates and water discharge

The flow rates (discharge) of the same emitters whose operating pressures are measured are also determined. This is done by recording the time required to fill up a graduated vessel with water. The figures should be in accordance with the supplier's specifications and the difference between them should be less than 10 percent. The system's rate of discharge is the sum of the emitters' average flow rates.

Uniformity of application and depth of wetting

This may be checked by probing the soil at various locations using a probe, shovel or soil auger. The examination can be made 12–24 h after irrigation depending on the type of soil. Water should penetrate a few centimetres below the root depth. Areas taking less or more water can be easily identified for further investigation.

Visual observations for evaluation purposes of any type should be avoided as they might lead to misjudgements. In addition to the above simple evaluations, the following checks, on-site modifications, re-arrangements and preventive maintenance are necessary:

- Check and repair any leakage in piping or through valves.
- Position the sprinklers vertically to the ground and check spacing.
- Replace or rehabilitate clogged emitters.
- Flush the system network at least three times during the irrigation season when water originates from underground. With reservoir water, flush once every fourth irrigation. An approximate flushing time of 2–3 min for each line will prevent sedimentation on the inner pipes walls.
- Clean the filters of the system thoroughly before every irrigation. During operation, check for the minimum difference in pressure between the inlet and the outlet of the main filter.
- Check the air and check valves periodically for proper functioning.
- Inspect plastic equipment, valves and devices for cracks and other physical damage.
- Flush fertilizer injectors (pump and tank) after each use. Inspect hoses and valves.
- Conduct systematic checks to spot malfunctioning equipment affected by physical deterioration and other possible damage by machinery, animals, etc.
- Make frequent visual checks of the system to ensure that it is in good condition and operating efficiently.

Pump plant

Preventive maintenance of the pumping system is essential during the irrigation season. Equipment manuals contain trouble-shooting chapters which are useful for solving common problems associated with the normal operation of the pumping unit. The following checks and inspections are recommended for most engine or electric motor driven pumps:

- noise;
- vibration;
- leakage;
- temperatures of bearings and windings;
- fuel/power consumption;
- capacity and output (water discharge and dynamic head);
- ventilation screens, clean where necessary;
- oil pressure;
- oil, lubrication, change where necessary.

MAINTENANCE

The long-term operation of the irrigation installation depends upon simple maintenance carried out by the farmer. The periodic servicing of pumping plants and the repair of special devices (filters, injector, etc.) is carried out by trained maintenance and repair personnel.

Maintenance is carried out during a period of non-use to prepare the system: a) for the off-season shut-down; and b) for use before the next season. All equipment requires a certain amount of care in handling for storage and maintenance. For every installation there is a procedure which concerns various aspects of the distribution network and the pumping unit.

System network

The procedure for the network is as follows:

- Flush mains, submains, manifolds and laterals.
- Inspect for possible damage to the network and repair it.
- Open fully and drain completely all valves.
- Remove dirt, corrosion and other foreign material from the component parts.
- Check emitters for possible clogging, damage, wear and signs of deterioration, and replace where necessary.
- Store all emitters in a dry clean place on shelves away from fertilizers, chemicals, oil, grease and lubricants.
- Examine the condition of air and check valves.
- Flush and drain filtration and fertilizer injection equipment.

- Clean all filter elements.
- Check condition of gaskets and seals; remove, clean and store in a dry place.
- Retrieve all portable plastic tubes by rolling them up in coils; store properly.
- Inspect all portable metal pipes for any kind of damage and consult suppliers for repair; store properly away from power lines and wiring.
- Drain completely all pipes left in the open.

Pump plant

Pump plants usually consist of a centrifugal pump of some type and the power unit (electric motor or internal combustion engine). Maintenance instructions are available from manufacturers, pump users associations and other technical organizations. Special care should be taken to protect engines from moisture that can accumulate inside the machines and cause serious damage.

Below is a list of checks, inspections and steps to be taken for the preparation of the pumping plant a) for the off-season period and b) for use before the next season:

Maintenance for the off-season period

Centrifugal pumps

- Drain all the water from pump and connecting pipelines.
- Where possible, remove suction lines and store them.
- Cover shaft and any exposed metal and all oil or grease lubricated bearings with protective lubricant.
- Loosen 'V' belt or flat belt drive and insert piece of greaseproof paper between belts and pulley.
- Loosen packing gland.
- Clean debris and any other material from impeller and volute.

Internal combustion engines

- Run engine to thoroughly warm up oil in the crankcase; stop engine and drain crankcase oil; replace drain plug and refill crankcase with high-grade engine oil; start engine and run slowly for two minutes to complete oil distribution on all surfaces.
- Stop engine; remove all spark plugs; pour 60 ml of engine oil into each spark plug hole; with ignition switch off, crank engine for several revolutions to distribute oil over the cylinder walls and valve mechanism; replace spark plugs.

- Drain oil from crankcase; drain cooling system and close drain cocks; drain all fuel from tank, lines and carburettor bowl; replace all plugs and close drain cock.
- Lubricate all accessories and seal all openings airtight, including air cleaner inlet, exhaust outlet, and crankcase breather tube, with weatherproof masking tape.
- Check oil filler cap, gas tank and radiator cap.
- Spray all accessories and electrical equipment with suitable insulating compound.
- Insert a strip of greaseproof paper under the 'v' belt pulley.
- Remove battery and store fully charged.
- Where the engine is in the open, cover with waterproof material.

Electric motors

- Ensure that all bearings are well lubricated.
- Cover motor to protect against rodents, insects and dust, but provide ventilation.
- Lock control box in 'off' position and cover with a canvas where exposed in the open to protect against moisture and dust.

Preparation for use before the next period

Centrifugal pumps

- Where there is a trash screen, clean and install it properly.
- Ensure foot valve on suction line of horizontal centrifugal pumps operates properly.
- Install suction line of horizontal pumps and/or vertical turbine pumps and/or check they are adequately submerged; check impeller adjustment of deep-well vertical turbine pumps.
- Clean all passages for liquid.
- Tighten packing gland to proper setting.
- Replace bearing oil, or lubricate bearings with grease.
- Ensure pump shaft turns freely without noticeable dragging.
- Start pump and check for normal operation.

Internal combustion engines

- Remove all tape from sealed openings.
- Open fuel tank valve; shut water drain cocks and add coolant.
- Check oil drain plug; replace oil filter and add correct amount of oil to engine.
- Remove spark plugs and spray cylinder walls with a light engine oil.
- Replace spark plugs and crank engine several revolutions by hand to spread oil on cylinder walls.
- Lubricate all engine accessories.

- Where a distributor is used, clean inside and outside of cap; inspect cap and rotor for cracks; lubricate distributor sparingly with suitable lubricant; where a magneto is used, inspect breaker points for wear and gap; lubricate rotor.
- Where oil bath air cleaner is used, clean and fill with correct grade oil.
- Check all terminals and electrical connections.
- Start engine; run slowly for a few minutes; monitor oil pressure; if it fails to come up to correct reading, stop engine and investigate cause.
- Check oil level in crankcase and bring level up to proper mark on dipstick.

Electric motor

- Clean all debris accumulated during the storage period.
- Change motor bearing oil with special type of lubricant, do not overfill, use grease gun to lubricate bearings.
- Change oil in reduced voltage starters.
- Check that motor ventilation vents are open; clean dust and dirt from all moving parts of motor and panel.
- Check and tighten all electrical connections, replace overheated connections with new material; test all coils and heaters for continuity and shorts; clean all magnet surfaces; check for spare fuses of proper size; ensure all conduits or shielded cables are in good condition; check that all conduct points are corrosion free.
- Ensure service cabinet interior is moisture free.
- Operate all moving parts by hand before applying power.

CONCLUSION

Through investment in equipment for improved irrigation techniques, farmers expect to save considerable amounts of water, to increase yields and to improve crop quality.

Professionals and irrigation extensionists in association with manufacturers and farmers have been working for years on the proper O&M of irrigation system installations. Water conservation is and will continue to be a major goal for farmers, industry and governments. All parties concerned should cooperate to achieve this goal.