Fertigation with moving irrigation systems

Continuous moving irrigation systems such as centre pivots and lateral movers require the fertiliser to be injected into the irrigation water at a constant rate and concentration to produce uniform distribution.

EASY Liquids are an excellent source of fertilisers to fertigate using travelling irrigation systems.

When injected into the irrigation water, Incitec Pivot's EASY Liquids provide a constant concentration without agitation and are easy to transport and store. These are necessary characteristics for irrigation systems such as the centre pivot or lateral mover that require continuous injection to produce a uniform distribution of the fertiliser for the crop.

Injection systems

EASY Liquids can be injected into travelling irrigation systems by a number of injection devices.

There are also other systems which are used, such as preferential differential (pressurised tank), proportional pumps and metering pumps. Specialist advice should be sought from the suppliers of irrigation equipment in choosing and setting up an injection system.

The two main injection systems used in continuous moving or travelling irrigators are:

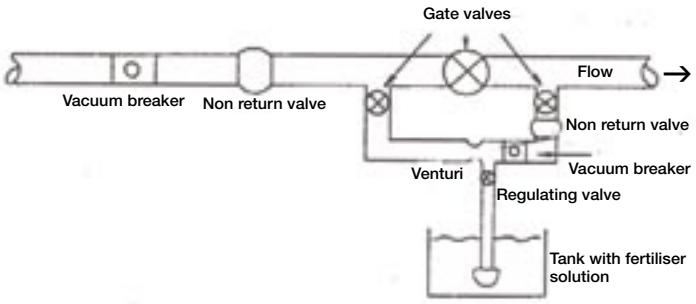
- Venturi injectors
- Positive displacement pumps.

Venturi injectors come in several sizes and can be operated under different pressure conditions. Most venturi systems are set up in a shunt pipeline parallel to the main irrigation pipeline close to the pivot or lateral structure.

Venturi systems generally require at least a 20% differential pressure to work properly. Irrigation water from the main pump is passed through the venturi unit, which creates a pressure differential between the water bypassing the unit and the solution in the tank causing the fertiliser solution to be drawn up into the line. The flow rate and gate valves control the rate of the fertiliser solution applied.

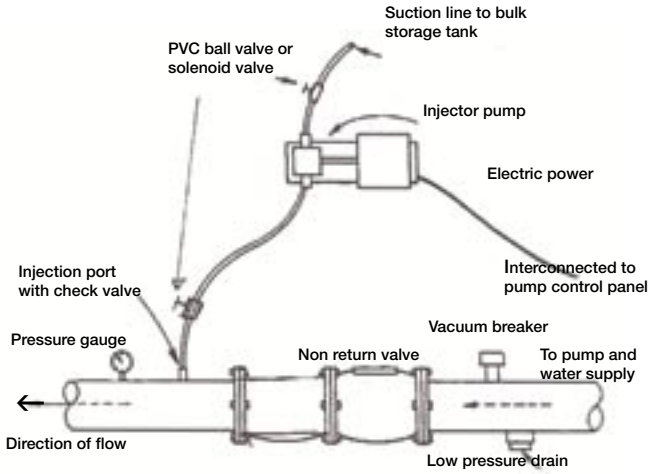
Venturi injectors do not require external power to operate but some units utilise a small booster pump in the shunt pipeline to produce a differential pressure.

Venturi method



Source: NFSA Fluid Fertiliser Manual

Positive displacement set up



Source: NFSA Fluid Fertiliser Manual

Positive displacement pumps are available in two basic arrangements: piston and diaphragm. Both types are marketed by several manufacturers and are available in at least two or more injection rate ranges. A pump should be selected for a given paddock situation so that it will not have to be operated at the high or low end of the injection range. Some pumps may require a pair of injectors to provide the necessary injection rate.

Diaphragm pumps can be adjusted very easily during injecting while piston pumps need to be stopped. Most pump models can operate within a wide range of irrigation system pressures. Three-phase electric motors are the most common source of power for piston and diaphragm pumps. Belt power or fuel can drive some injection pump models.

Tanks

Tanks can be fixed or mobile depending on the situation. They are generally chemical grade plastic or stainless steel. They must be able to cater for the high specific gravity of liquids (e.g. EASY N has a specific gravity of 1.32 kg/L).

Most fixed tanks are sited close to the injection unit and main pump. Fixed tank sites must comply with local authority rules and regulations. Portable tanks and shuttles are normally found nearer to the pivot or lateral structure. They are either wheel or pallet based and can be readily moved.

Fittings should be made of plastic (nylon or polypropylene) but if agricultural chemicals are to be injected as well, stainless steel is recommended.

Copper and copper alloys (brass) can be corroded by fertilisers, e.g. nitrate solutions. As electric motors contain copper wiring and internal combustion engines use copper fuel lines, these should be protected from irrigation spray.

Injection

Fertilisers can be injected at several sites within the irrigation system: at the main pump, at the last lift pump or at the pivot or lateral structure itself. When using liquids the best position to inject the product is at the pivot or lateral structure using a mobile tank – injection unit.

Calculations

Several factors are involved in calibrating an injection meter (positive displacement pump or venturi) for a moving irrigation system like a centre pivot. The factors required are:

- hectares covered by the irrigation system
- hours for the irrigation system to cover the hectares, and
- litres of solution required per hectare.

To calculate the required injection rate of liquid into the irrigation water for a centre pivot use the following:

$$L/hr = \frac{A \times V}{T}$$

where:

L/hr = injection rate of liquid fertiliser in litres per hour
A = area to be fertilised in hectares
V = volume of EASY Liquid needed in litres per hectare
T = time to irrigate/fertigate the field in hours

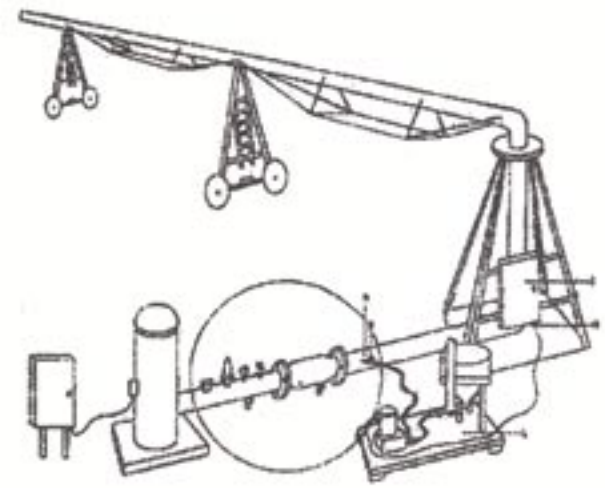
The area (A) of the circle can be calculated by using actual field dimensions eg. Hectares = (πr^2) / 10,000 sq m where r is the radius length

The volume (V) of nutrient per hectare depends on the concentration of the fertiliser source and the desired application rate. For example, to apply 20 kg/ha of nitrogen (EASY N at 42.5% w/v), divide 20 by the analysis as a decimal 0.425 (42.5%) This calculates to 47 litres of EASY N to be injected per hectare.

Total time (T) to irrigate/fertigate the ring should be estimated by measuring the actual time required to operate a complete pass over the circle.

To calibrate the injection meter, first set the meter at the manufacturer's suggested setting for the calculated injection rate (L/hr). Then run an injection test (with only water) into the irrigation system while it is operating. While injecting, measure the amount of water that is being injected over a given time and compare the rate to the calculated rate. If the rates are not the same, readjust the injector meter and retest the system.

Mobile tanks are convenient for fertigating EASY Liquids.



Centre pivot system

Management Tips

Safe and accurate fertigation requires the following:

- Check travel time of the irrigation system and recalculate the fertiliser injection rate for the planned amount of fertiliser.
- Prevent back-flow from the irrigation lines into the water supply. This is more likely to occur where suction systems, on the inlet side of the pump, are used to introduce fertiliser solutions.
- Avoid injection into empty lines.
- With travelling irrigation systems, the fertiliser solution must be injected continuously at a constant rate (and concentration).
- After the fertigation process has started, recheck the fertiliser injection rate.
- Periodically revisit the irrigation system and recheck the operation of the injection meter, operating pressure of the system and water distribution of the irrigation system including the end gun operation on centre pivots.
- At the end of each fertigation application continue running water through the irrigation system until all of the fertiliser has been discharged from the pipeline of the irrigation system. This may take 10 to 15 minutes. Also run clean water through the injection meter, chemical discharge hose and check valve. Flushing after use prevents scale forming and extends the life of gaskets and metals.
- Maintain a neat storage, mixing and injection area. This promotes safe handling and facilitates early recognition and clean up of any spills and leaks.
- Prevent drainage from the injection/storage area into streams, dams or bores.

Material compatibility for EASY Liquid fertilisers

Materials	EASY N	EASY U Sol	EASY PK	EASY Cal	EASY ATS	EASY KS	Coppersol	Zincsol	Mangasol	Topfoliar
Pumps										
Stainless steel mechanical or Vitron seals	C	C	C	C	C	C	C	C	C	C
Stainless steel or polyethylene impellor and casing	C	C	C	C	C	C	C	C	C	C
Aluminium	A	X	X	A	A	X	X	X	X	X
Carbon or Mild Steel	S	X	X	S	X	X	X	X	X	X
Brass or copper alloys	X	X	X	X	X	X	X	X	X	X
Galvanised	X	X	X	X	X	X	X	X	X	X
Valves and Fittings										
Class 9 PVC ball valves	C	C	C	C	C	C	C	C	C	C
Stainless steel	C	C	C	C	C	C	C	C	C	C
Polyethylene – check with supplier for suitability	C	C	C	C	C	C	C	C	C	C
Forged steel	C	X	X	C	C	X	X	X	X	X
Aluminium	A	X	X	A	A	X	X	X	X	X
Cast iron or mild steel	S	X	X	S	X	X	X	X	X	X
Brass or copper alloys	X	X	X	X	X	X	X	X	X	X
Galvanised	X	X	X	X	X	X	X	X	X	X

* This information relates to the storing and handling of **undiluted** fertilisers. Dilution may reduce the potential for corrosion.

Sources: The Fluid Fertilizer Manual Vol 2 p 97 Table 5.1 and Incitec Pivot.

C = acceptable if compatible with container and accessories

X = not acceptable because of chemical incompatibility

S = Fittings and couplings used with mild steel tanks should be compatible with mild steel or galvanic corrosion may occur.

A = If aluminium storage is used, then all fittings, piping and pump parts should be aluminium.

Stainless steel or HDPE fittings are the only other materials that can be used in conjunction with aluminium.