DISTRIBUTION OF IRRIGATION WATER USING SIPHON TUBES

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1 - INTRODUCTION

Irrigation generally is defined as the application of water to soil for the purpose of supplying the moisture essential for plant growth . However, a broader and more inclusive definition is that irrigation is the application of water to the soil for any number of the following six purposes:

1- To add water to soil to supply the moisture essential for plant growth .

2- To provide crop insurance against short duration droughts.

3- To cool the soil and atmosphere , thereby making more fovourable environment for plant growth.

4- To wash out or dilute salts in the soil.

5- To reduce the hazard of soil piping.

6- To soften tillage pans.

Irrigation water is applied to land by four general methods; namely .

a) Irrigation by surface flooding .

b) Irrigation through furrows .

c) Irrigation by sprinkler.

d) Subirrigation .

Irrigation methods may vary in different parts of the country and on different farms within a community because of differances in soils, topography , water supply, crops , and customs. The most economical irrigation system is that in which water is given to the field with the least possible losses . Water losses due to evaporation can not be avoided, however , that due to seepage must be minimized.

Therefore, the water requirement should not be more than these losses in addition to the water required by the plant itself . Then any additional amount of water is harmfull, because a part goes downwards and raises the water table and the other part , which is excess water at surface, goes directly as surface run off. The main job of the irrigation engineer in genaral and the agricultural engineer in particular is to apply the most convienient water distribution systems which give the optimum water requirements at the least amount of losses .

Two methods , in general may be capable in satisfying this condition ; namely the Sprinkler irrigation methed and the use of siphon tubes.

One of the best surface water irrigation methods, is the use of siphon tubes. This method requires the use of surfaces measured at the entrance and outlet ends of the tube When the tube is flowing free, however, the operating head is the difference in elevation between water surface at the entrance of the tube and the center of the outlet end.

Siphon tube discharge may be computed by the formula;

$$Q = C\ A\ \sqrt{2gh} \quad \ldots\ldots\ldots\ldots \quad (2.1)$$

Where:

- Q discharge in cubic feet per second.
- C discharge Coefficient for the tube .
- A Cross- Sectional area of the tube in square feet.
- g acceleration due to gravity 32.2 ft/sec Sec.
- h operating head in feet.

The coefficient (c) may be computed by the formula

$$C = C_o \sqrt{\frac{d^{4/3}}{5.087\ n^2\ C_o^2\ L + d^{4/3}}} \quad \ldots \quad (2.2)$$

Where:

- C_o discharge coefficient for the tube entrance(about 0.83)
- d inside diameter of tube in inches
- n roughness coefficient.
- L length of the tube in feet. [S.C.S (1962)]

Siphon tubes have the advantage of permitting easily and frequently a change of water from furrow to anthor. They can be used in different diameters. The use of small diameter siphons (48" length curved pipe made of light weight plastic, aluminum , glavanized iron or rubber) enables the irrigator to siphon water from the ditch to furrows and keep ditch banks solid, Israelsen (1962)

Siphon tubes have several advantages:

1- They are portable, and therefore the reduced number of tubes required to irrigate a given area results in a low intial cost.

2- Flow into individual furrows or borders could be effectively controlled by using the number of tubes that will divide total head ditch flow into individual streams of desired size .

3- The tubes are limited to fields with a little cross slope in order to maintain a near constant operating head on each tube.

Their draw back is that need to be primed individually. This priming is the principle labour requirements when siphon tubes are used for surface irrigation, [S.CS (1962)].

2.2 Permeability coefficient (k)

Israelsen (1962), defined the permeability coefficient of soil as velocity of flow caused by a unite hydraulic gradient in which the driving force is 1 Ib. force per Ib of water . He added that the permeability is influnced by the physical properties of the soil such as size and shape of pore spaces through which water flows, specific weight and vis viscosity of soil water.

An article in world Farming (1966), cited after Hendawy (1967), on the movement of water and direction in which water moves and the forces that cause it to move mentioned that because of gravity, water moves downward; because of adhesive and cohesive forces, it moves in small pores by capillarity; because of heat, it vaporizes and diffuces through the soil air.

Israelsen (1950), stated that highly permeable soil tends to cause excessive water losses through deep percolation where asimpermeable soils are difficult to moisture a dequately.

Baver (1940), showed that the distribution and movement of water may be laterally, vertically upward, vertically downward, or at any angle between the vertical and horizontal.

Renk (L879), cited after Hendawy (1967), showed that the size of the pore is at most importance in permeability of the

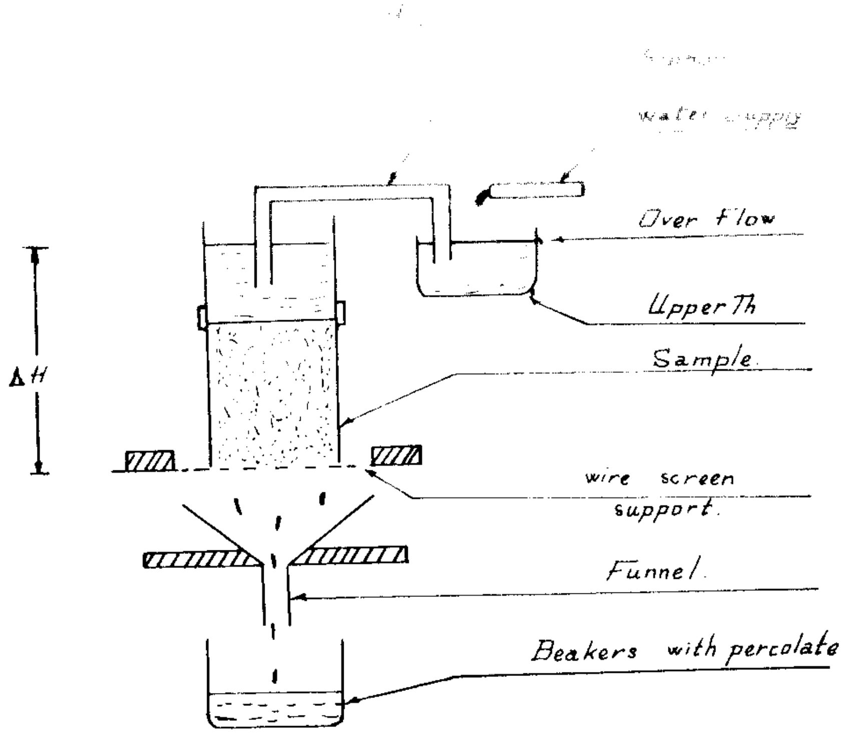

Fig. (1) The constant-head system for Conductivity measurement.

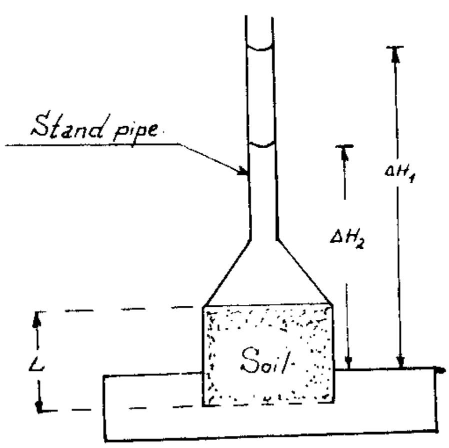

Fig (2) The falling-head system for conductivity measurement.