SOFTWARE FOR DETERMINING DRIPLINE IRRIGATION PIPES USING A POCKET PC

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Abstract

This communication presents the development of a freeware for mobile devices (Smartphone and Pocket PC). It was developed with a LabVIEW program, and enables engineers and installers to calculate commercial diameters to be used in laterals of drip irrigation, without the need for being at the personal computer. Input data required: drippers flow rates, number of drippers, spacing between the drippers, medium pressure in the lateral and pressure tolerance. As results, it shows commercial diameters that can be used with diode LED, maximum and minimum pressures for each lateral, and a graphic that shows, on a comparative, wether it exceeds each lateral of the pressure tolerance or not.

Keywords: *Software, Irrigation, PocketPC, LabVIEW*

1. Introduction

Requirements in agricultural production, environmental protection and water resources optimisation have been made farmers to modernize irrigation systems. One of these modernisations is the installation of drip irrigation systems (López, 1996; Valiantzas, 2003).

Drip irrigations system is characterized by high water use efficiency. Another advantage of this irrigation system is the precision in water and fertilizers application under adequate design conditions (Pedras and Pereira, 2001; Holzapfel *et al.*, 2001).

Hydraulic design of drip irrigation subunits is integrated in the drip line calculation. The calculation of the drip line is carried out after the agronomic design. This design is based on several data (characterization of choose emitter, field topography, etc). In order to design an irrigation subunit is necessary to combine the hydraulic calculation (flow, diameters and pressure of drip line and sub main pipes) with irrigation net distribution plane.

Specific agronomic features (plant frame, crop water demand…) are used in drip irrigation systems design. The results of the design are the number and the distribution of the emitters (Medina, 1997). As the crop is growing it is used to add new emitters in order to supply the increasing crop water needs. In some cases, when the farmer wants to increase the plant density or he decides to change the crop and to maintain the existing irrigation system he have

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to adapt to the new situation. This is to change the number of emitters in drip line to the new water requirements. On this case, if flow and pressure required at the beginning of drip line are known, it is very useful to provide software that let it to know if drip line is ready to these changes. It is necessary that this software must be quickly and precise. This software would indicate immediately to the farmer what decision he would take.

Some software under Windows but not in mobile devices is used for agronomic and hydraulic design in drip irrigation (Rodrigo and Cordero, 2003). One adequate solution is the installation of developed software for mobile devices as Smartphone or PocketPC.

In the last years there is a lot of programming languages used in mobile devices. One of this is LabVIEW, that it is a revolutionary system of graphics programming used for applications that includes acquisition, control analysis and data presentation (Lajara and Pelegri, 2007). This software is imposing in engineer applications because its great versatility and simplicity to use.

This paper shows developed software for this kind of Mobile devices using LabVIEW PDA as programming language. This is a freeware, for this reason its use is limited to fed drip lines from the extreme, with no slope terrain. This software could down from the next link:

http://decibel.ni.com/content/docs/DOC-1385.

2. Basis of calculation

Theoretical base of used formulas in the hydraulic design of drip irrigation is considering that flow distribution in a drip line is coming close to a continue distribution. A description of the calculation procedure is described in the next lines.

Head losses hL (m) in a pipe of length L (m) has been calculated with the next equation:

$$\Delta h_L = F \cdot J^* \cdot L \tag{1}$$

Where,

F is the Christiansen's reduction factor and J^* (m. m-1) is the head losses coefficient that includes lineal and singular losses.

The formula used to estimate the Christiansen's reduction factor is:

$$F = \frac{1}{1+\beta} + \frac{1}{2n} + \frac{\sqrt{\beta-1}}{6n^2} \tag{2}$$

Where the value of β is 1,75 in Blasius formula for polythene pipes and n is the number of emitters in the dripline.

Unit head losses J^*, have been determined using an empirical formula that includes the singular head losses of the emitters by means the next expression:

$$J^* = J \frac{e+f_e}{e} \tag{3}$$

Where e (m) is the distance between emitters and y f_e (m) is the equivalent length of the emitter that depends on the kind of the emitter and the diameter of the drip line.

Linear head losses, J (m·m^{-1}), has been determined using the Blasius's formula in polythene pipes:

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$$J = 0,473 \cdot \frac{Q^{1,75}}{D^{4,75}} \qquad (4)$$

where D (mm) is the pipe diameter and Q ($l \cdot h^{-1}$) is the flow.

In order to estimate the singular head losses, f_e (m), has been considered table 1.

$\varnothing_{interior}$ (mm)	f_e (m)		
	Big	Standard	Little
10,3	0,32	0,24	0,18
13,2	0,20	0,15	0,11
16,0	0,14	0,11	0,08
18,0	0,11	0,08	0,06
20,4	0,09	0,07	0,05
28,0	0,05	0,04	0,03

Table 1: f_e values for upperline conexions

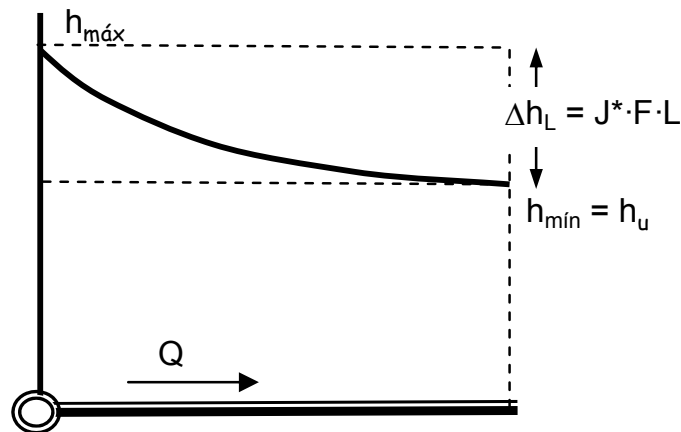The pressure distribution in a drip line is showed in figure 1.

Figure 1: Pressure distribution in a drip line fed by the extreme in a plane zone.

The maximum of pressure coincides with the pressure in the begining of the drip line, h_{max} (m), which is determined by means the next expression:

$$h_{max} = h_a + 0.75 \, \Delta h_L \qquad (2)$$

h_a (m) is the average pressure in the drip line.

The minimum pressure, h_{min} (m), is the same pressure in the last emitter, h_u (m), which is determined by:

$$h_{min} = h_u = h_{max} - \Delta h \qquad (3)$$

If the difference of pressure $h_{max} - h_{min}$ is under the value Δh_p (m), the commercial diameters are adequates.

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3. Software

The graphic interface of the developed software consists of three flaps:

a) In the flap "*Inicio*" is introduced, at the top of the screen, the data for calculation and at the lower part valid commercial diameters are showed the valid commercial diameters by means illuminated leads (Figure 2). Required data are: nominal flow of the emitter q_e ($l \cdot h^{-1}$), number of emitters N_e, drip line length L (m), distance between emitters E_e (m), average pressure in the drip line h_a (m) and pressure tolerance h_p (m). After the data introduction the button named "Cálculos" have to be pressed in order to show the results in the frame.

Figure 2: Initial flap.

b) The flap named "*Resultados*" shows, in every commercial diameter, the head losses in the drip line Dh (m), maximum pressure h_{max} (m) and minimum pressure h_{min} (m). At the lower part, is showed a comparative graphics that indicates if the allowed pressure tolerance h_p (m) is exceed or not, for every drip line (Fig 3.).

Figure 3: Flap of results.

c) The last flap "*Ayuda*", shows the contacting data for the authors.

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The block diagram of this software is developed under while loop structure that allows ending the software execution by means the button "*Salir*" (Figure 2). This button determines the true and false values of a case structure included in the while loop. Pushing this button the case structure takes the true value and the internal programming is carried out. In figure 4, is showed the block diagram used to determinate if the pipe with a diameter of 13.2 mm could be used in the drip line considering general data entry.
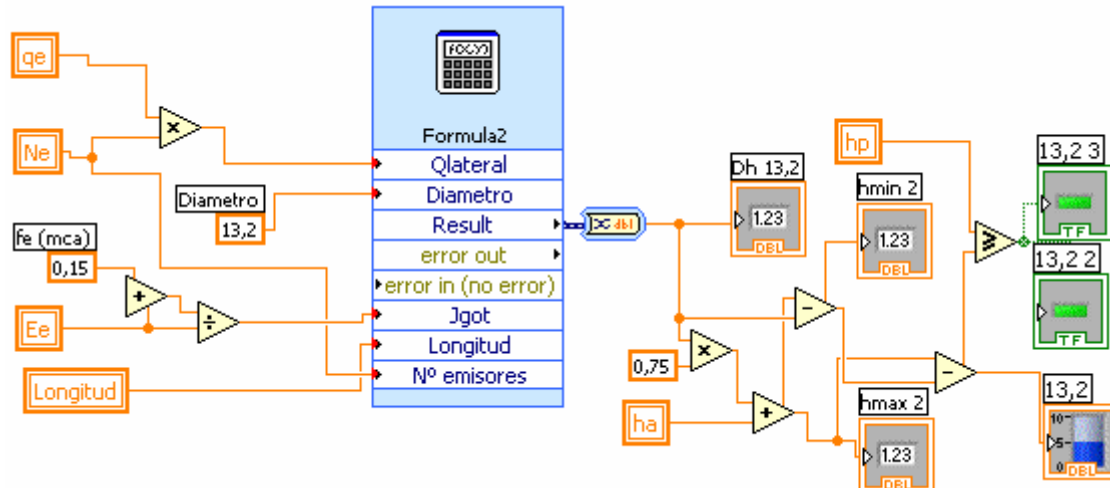

Figure 4: Block diagram to determinate the use of a pipe with a diameter of 13,2 mm in the drip line.

A similar block diagram (Fig. 3) has been developed for every commercial diameter (10.3; 13.2; 16.0; 18.0; 20.4 and 28.0). This diagram determines what diameters of commercial pipes could be used for the drip line and the results could be compared.

After calculations, this could be showed in the console.

4. Conclusions

Software has been developed with LabWIEW PDA. This software allows installers and engineers of drip irrigation companies to calculate in the field commercial diameters used in drip lines.

This is an accessible freeware, contacting with authors or from the link http://decibel.ni.com/content/docs/DOC-1385

This software version is limited to drip lines fed by the extreme in a horizontal land

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