ABSTRACT

The main aim of this thesis is to create a model for analysing the hydraulic behaviour of drip irrigation subunits. To accomplish this task, an exhaustive literature review was conducted, from which a set of expressions, formulas, methods and procedures were established and incorporated into the proposed model. The analysis, conducted by applying the proposed model, is very realistic because it considers most of the variables involved in the performance of the subunits.

Emitter response is one of the most important factors, so it was necessary to test a set of commercial emitters in the Laboratorio de Riego Localizado del Departamento de Ingeniería Rural. Using the results from the tests, expressions were obtained to predict the flow rate emitted, as well as the manufacturer's coefficient of variation. The key to study the hydraulic behaviour is to consider all emitters independently, studying the distributions of the fit coefficients, both using the potential and the parabolic versions.

Another crucial aspect is the consideration of the randomness of the emitters, from which a virtual population of emitters can be generated. Using the distributions of the fit coefficients, which are assumed to be normal, a random is extracted. The size of the random sample matches the total number of emitters of the studied subunit. This sample is also distributed randomly across all the possible positions of the emitters, resulting in the simulation of a real case.

The hydraulic aspects of the subunits were also treated with profusion, especially with respect to the calculation of head losses, both continuous and localized. These losses, coupled with differences in elevation and kinetic heights, define the operating pressures of all emitters. Using the individual fitted equations, it is possible to predict the flow rate emitted by each unit.

Once the distributions of pressure and flow rate have been defined, it is very important to determine the distribution uniformity of irrigation water, which is accomplished by applying various uniformity coefficients, both for analysis and design purposes. This allows one to confirm if an irrigation subunit meets the uniformity criteria established.

Since the generated model incorporates all of these aspects, it is quite complex and hence was developed by means of a software application in Windows® using the programming language Visual Basic 6.0 ®. This application, called ANASUB, allows for quick and easy simulations of real subunits.

An important finding is that the coefficient of variation of an emitter depends on the inlet pressure, and since variation trends are different for each emitter in question, laboratory testing is important. The predictions for the coefficient of variation that were produced by using the proposed theoretical model are quite reliable and reduce the errors inherent to the test procedure.

Another important finding is that commonly used coefficients of uniformity are sometimes difficult to interpret because their variation range is very narrow, so it is best to use the overall coefficient of variation of the subunit as an indicator for the distribution uniformity of irrigation water. Furthermore, this new coefficient disaggregates flow rate variability resulting from hydraulic causes and manufacturing causes.

Finally, this thesis concludes that the best approach to designing and verifying subunits is to limit the relative difference in flow rate between plants to a maximum of 10%, which is consistent with the relative difference of flow rate between emitters that are limited to 20%.