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AN ALTERNATIVE FOR ENERGY CONSUMPTION REDUCTION IN DRIP IRRIGATION

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Abstract: The energy consumption in drip irrigation systems as well as in the other irrigation techniques and technologies is an important indicator and an essential part of the operating costs. In contrast to the other irrigation techniques, the irrigation water runoff is smaller because of the fact that only part of the soil surface around the plants is wetted. Nevertheless, taking into account that in most cases the working head in the drippers is 10 m, and there are hydraulic head losses in conducting network, losses in the filters and accessories in the network, then the working head at the beginning of these systems reaches comparatively high values – 35 - 45 m. Taking this into consideration, the author suggests for the first time a new technical solution aimed at the reduction of the working head in the drip laterals and drippers, and more reliable operation of the drip irrigation systems. By now, all companies producing systems for classic drip irrigation in the world offer drip laterals with built-in single and similar nozzles drippers with a long path of the water at the point of water supply, the drippers being of two types - cylindrical and flat. The essence of the suggested solution is that instead of single drippers at the water supply point polynomial drippers are suggested to be built-in, also with a long path of water, consisting of several, located one after another, smaller drippers, connected between each other with a flexible tie (like a chain), both in the cylindrical type and in the flat type. Besides the energy consumption reduction, the new solution features other advantages as well: realization of a larger wetted area of the soil contour and consequently, wetted volume due to the disconcerted water supply at several points of the polynomial dripper; increasing the working flow rate of the drippers for minimum growth of the pressure in them, and a lower probability for termination of the water supply in case of clogging of some of the nozzles drippers; the time for irrigation is reduced.
Keywords: drippers (emitters), head losses along drip laterals, minor head losses, coefficients of uniformity, polynomial dripper

1. INTRODUCTION

The energy consumption in the drip irrigation systems represents a considerable part of the operational costs. Usually, the operational head in the drip laterals and drippers is 10 m but adding the head losses in the transport pipe network, losses in the filtering equipment and accessories, the operational head in these systems reaches 35-45 m. This means that in spite of the reduced irrigation water volume, due to the local form of wetting in this irrigation technique, the energy consumption is comparatively high. This, on the other hand, leads to increased actual power of the pump equipment, and respectively, increased investment. Having this in mind, the author offers for the first time a new technical solution aimed at reducing the operational head in the drip laterals and drippers and more reliable operation of the drip irrigation systems.

2. ESSENCE OF THE OFFERED SOLUTION

By now, all companies producing classical drip irrigation systems in the country and abroad offer drip laterals with inside welded single and similar nozzle drippers with a long path of water at the point of the water supply, the drippers being two types – cylindrical and flat. The essence of the offered solution is that instead of single drippers at the point of the water supply, polynomial drippers are suggested to be built-in, with a long path of water also, consisting of several, successively disposed one after another, smaller drippers, connected to each other with a flexible connection (similar to a chain). The solution of the cylindrical type of built-in drippers is presented in Fig. 1 and Fig. 2, while for the flat type is presented in Fig. 3 and Fig. 4. The number of the successively disposed drippers (2) could be two, three and more, with a flexible connection (3) between them.

The flexible connection between the individual drippers is needed in order to achieve easier roll up when storing the drip laterals in the respective season. Thus, the irrigation water in type of drops (6) comes out through the openings (5) at two, three and more points depending on the number of nozzles in the polynomial dripper. In this way, a disconcerted delivery of water to the soil from several nozzles at several points is realized. This allows the necessary volume of irrigation water to be submitted with much less operating head compared to the conventional (classical) type of drippers, thanks to the suggested polynomial construction. Technologically, at the production line it is possible the connecting flexible tie between the individual nozzles of the polynomial dripper to be dropped off, but

this is a question of technology and technical feasibility for a denser distribution of the built-in drippers in the hoses. But, despite of this, the essence of the offered solution is not changed. The offered solution is claimed for patent in Bulgaria.

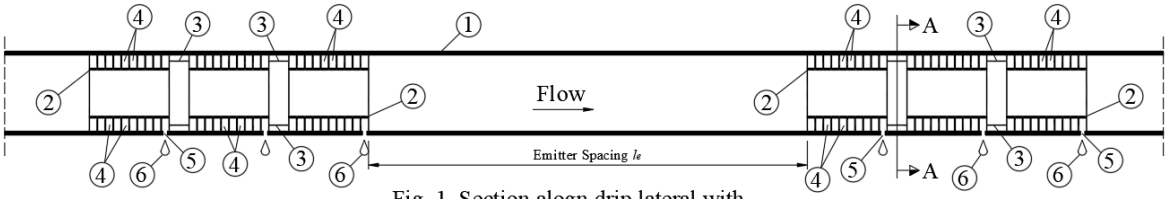

Fig. 1. Section alogn drip lateral with inserted cylindrical long path emitters

① Drip Lateral; ② Long Path Emitter; ③ Elastic Connection;
④ Emitter Flow Path Channel; ⑤ Water Outlet; ⑥ Drops.

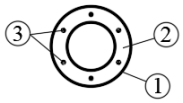

Fig. 2. Cross-Section A-A

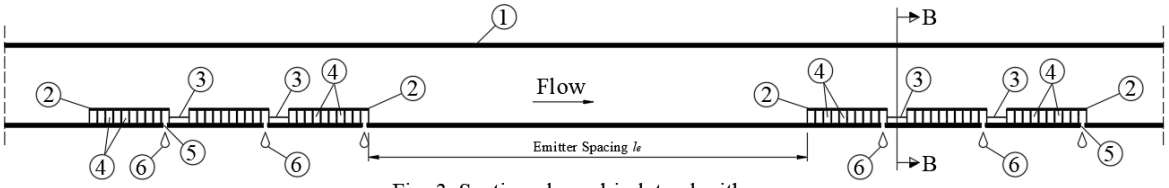

Fig. 3. Section alogn drip lateral with flat long path emitters

① Drip Lateral; ② Flat Emitters; ③ Elastic Connection;
④ Emitter Flow Path Channel; ⑤ Water Outlet; ⑥ Drops.

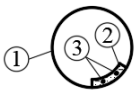

Fig. 4. Cross-Section B-B

3. ADVANTAGES OF THE OFFERED SOLUTION WITH POLYNOMIAL DRIPPERS

In addition to the energy consumption reduction, the solution with polynomial drippers is related to the realization of other advantages, the main ones being as follows:

- With the reduction of the operating head in the drip laterals, the actual power of the pump equipment is also reduced, and, at the same time there is an opportunity for using comparatively lower, naturally given operating heads (frequently available in-situ), and in some cases drip irrigation is possible without using pump equipment; in case of more polluted water, it is necessary to increase the parallel operation of the filtering equipment on the account of the lower operating head in this equipment;
- Where soil allows, there is a possibility for using comparatively higher values of the operating flow rates of the drippers, besides with minimum increase of the head, which, on the other hand leads to greater wetted area of the soil contour, and respectively, greater wetted soil volume. This is also connected with the reduction of the irrigation time and improvement of the organization of the irrigation of the whole massif;
- In the conventional (classical) case when an individual dripper is clogged, the water supply at this point around the individual plant is terminated, while with the new solution, if one of the nozzles of the polynomial dripper is clogged, the others continue to operate and deliver water to the adjacent plant, i.e. water supply is not obstructed;
- Using comparatively low operational head in the nozzles of the polynomial dripper allows the diameter of the operating canal to be increased which reduces the chance of clogging and the rate of water purification, and also reduces the hydraulic losses in the filtering equipment.
- Besides, it is proved [3] that with the reduction of the operating head, the coefficient of non-uniform distribution of the irrigation water in the drip irrigation systems is also reduced, under equal other conditions. In nozzles with an exponent from curve the flow rate vs. pressure relationship of drippers equal to 0.5, this reduction of the non-uniformity is the biggest.

4. DISADVANTAGIES OF THE DRIP LATERALS WITH POLYNOMIAL DRIPPERS

- As a disadvantage of this solution it can be mentioned that the production and welding of the polynomial dripper into the polyethylene hoses is connected with the development and creation of new technological lines but to which extent this is a problem, it can be judged by the respective experts-technologists.
- In case of considerably bigger lengths of the drip laterals and under extreme conditions, the regulation of the flow rate along the length of the laterals can be realized through a modular change of the number of nozzles in the polynomial dripper and their hydraulic characteristics.

5. CONCLUSIONS

The offered solution for the use of drip laterals for drip irrigation with polynomial drippers allows for energy consumption reduction and effective utilization of natural sources with low head.

The disconcerted supply of water to several points of the polynomial dripper is more favorable for plants due to the opportunity of obtaining larger wetted soil surface and wetted soil volume.

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