WATSAVE AWARDS

Nomination Form[1]

1. Information on Innovation

Innovations / Title (max. 10 words)	Applications of constant flow rate control valve in water saving		
First introduced:(Year)	2017		
Area covered: Ha 20000 Ha		Water saved: MCM/ BCM : 21 MCM per year	
Award category (Please check one)	Technology ❑		Management ❑
	Young Professional[2] ■		Farmer ❑

2. Nominee Information[3]

Nominee (1)	Mohammad Bijankhan		
Position	Faculty member, Assistant Professor		
Organization	Department of Water Engineering, Imam Khomeini International University, Qazvin, Iran.		
Postal Address	Postal-Code: 34149-16818,		
Telephone	+982833901271	Fax	
Email	bijankhan@eng.ikiu.ac.ir	Date of birth	December/1/1984
Citizen of	Iran	Mobile	+989122540315

Nominee (2)	Ali Mahdavi Mazdeh		
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Citizen of	Iran	Mobile	+989133256145

[1] One nomination per National Committee for each award category
[2] Young Professional award does not require wide-spread implementation, but must have been pilot tested in the field.
[3] Please add additional names and addresses as required.

Nominee (3)	Hadi Ramezani Etedali		
Position	Faculty member, Assistant Professor		
Organization	Department of Water Engineering, Imam Khomeini International University, Qazvin, Iran.		
Postal Address	Postal-Code: 34149-16818,		
Telephone	+982833901279	Fax	
Email	ramezani@eng.ikiu.ac.ir	Date of birth	May-16-1984
Citizen of	Iran	Mobile	+989123534254

Nominee (4)	Fatemeh Tayebi		
Position	MSc. Student		
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Postal Address	Postal-Code: 34149-16818,		
Telephone	+982832335460	Fax	
Email	tayebi.1018@gmail.com	Date of birth	Aug-21-1993
Citizen of	Iran	Mobile	+989356077084

Nominee (5)	Narges Mehri		
Position	MSc. Student		
Organization	Department of Water Engineering, Imam Khomeini International University, Qazvin, Iran.		
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Telephone	+982166612442	Fax	
Email	nargesmehri5@gmail.com	Date of birth	Jan-12-1993
Citizen of	Iran	Mobile	+989360595130

3. Nominee Statement of about 1500 Words (in the following format)

(a) Describe the innovation (essential)
(b) Describe how the innovation saves water (essential)
(c) Describe how the innovation was introduced and spread (for Young Professional award, describe how the innovation will be introduced and spread).(essential)
(d) Describe the scope for further expansion of the innovation (essential)
(e) Describe the roles of the individual nominees (optional)

(Note The Nominee Statement forms the central piece of the nomination and shall be filled in very carefully and is essential for adjudication and further dissemination. The nomination shall be rejected if this statement is not self-explanatory.)

4. Documents Attached

(a) Nomination Form

(b) Nominee Statement in English/ French (*Sr. No.3*)

(c) Curriculum Vitae of the Nominee(s)

(d) Recent Digital Photograph of the Nominee(s) (*in high resolution*)

(e) Documents/Reports/Technical Papers/Articles technically describing the innovation (*At least -3 technical documents supporting the Nominee Statement in electronic format*)

5. Authentication[1]

It is hereby certified that the research/application cited in the nominated work is an original work carried out by the authors to the best of knowledge and belief of the National Committee/Committee/Direct Member and hence the nominated work may be considered for the Award under the category of the WatSave Awards for which it is submitted.

(a)	Name of the National Committee	Iranian National Committee on Irrigation and Drainage
(b)	Name of the person	Mehrzad Ehsani
(c)	Position	Secretary general, IRNCID
(d)	Address	No. 1, Shahrsaz St., Kargozar St., Datgerdi St. (East zafar), Tehran, Iran. Postal Code: 1919839713 Tel: 0098 21 22257348 Fax: 0098 21 22272285 E-mail: irncid@gmail.com
(e)	Signature (with Official seal)	

Date 18. June. 2019 Place: Tehran

National Committees / Committee should forward **electronically** the nomination form(s), complete in all respects to The Secretary General, International Commission on Irrigation and Drainage (ICID), 48, Nyaya Marg, Chanakyapuri, New Delhi, India; E-mail:icid@icid.org; Tel +91-11-26116837 / +91-11-26115679, http//www.icid.org.

[1] National Committee must check the originality of the nomination/ submission and should make sure that it has not been submitted earlier/ elsewhere

APPLICATIONS OF CONSTANT FLOW RATE CONTROL VALVE IN WATER SAVING

DESCRIBING THE INNOVATION

Mechanical Choked Orifice Plate (MCOP), is a discharge control valve (Fig. 1*a*). MCOP includes a float-spring blockage system inserted into an ordinary orifice that maintains a quasi-constant flow by being insensitive to both upstream and downstream pressure fluctuations.

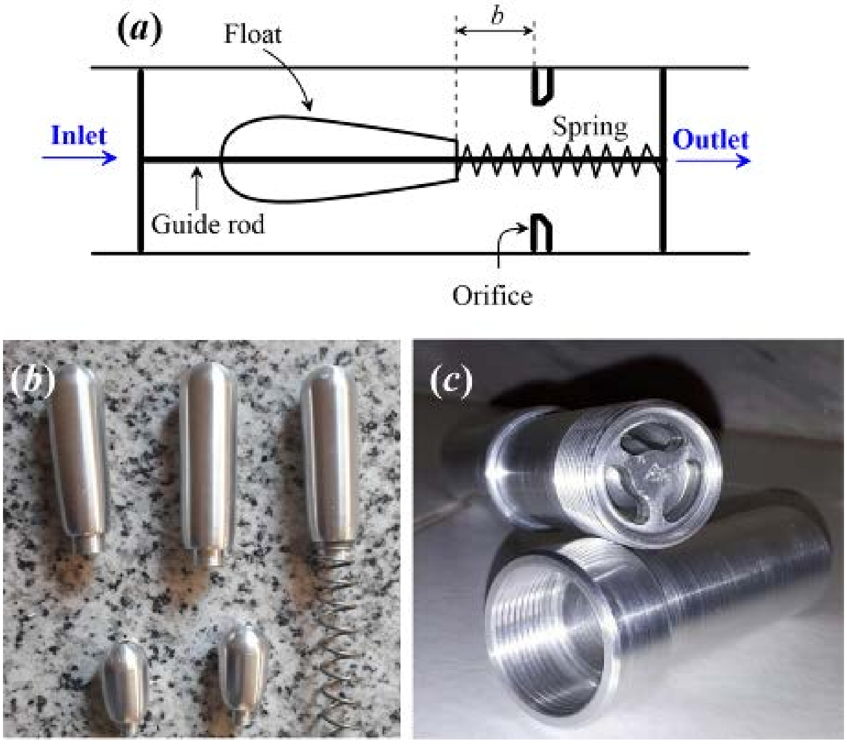

Fig. 1. *a*) MCOP schematic view, *b*) Constructed floats, *c*) A view of the constructed valve

In this study, all MCOP parts are designed and fabricated by the authors (Fig. 1*b* and Fig. 1*c*). As indicated in Fig. 2, although the differential pressure changes, a semi-constant flow rate reveals. Detailed information of the design criteria, are available in the papers Atashparvar et al. (2019) and Rezazadeh et al. (2019) (Attachments #1 and #2) published under the supervision of Dr. Mohammad Bijankhan and Dr. Ali Mahdavi Mazdeh.

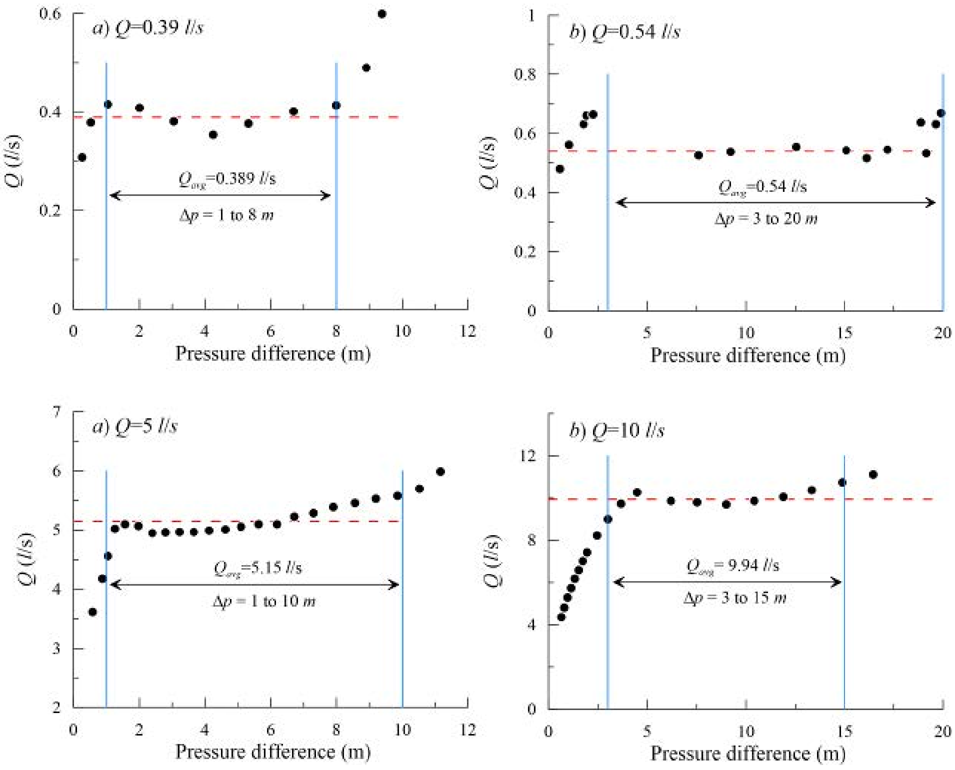

Fig. 2. MCOPs' hydraulic behavior; discharge versus differential pressure

The innovation is to introduce the application of MCOP i) for regulating a single pump with constant rotational speed, ii) in tape irrigation systems, and iii) for fairly distributing water in low head pressurized networks.

It is found that MCOP is a useful tool to regulate the pump operating point at its highest efficiency even if the total head-loss changes. This practical advice results in saving energy and preventing water losses. In tape irrigation system, MCOP prevents tape failures as well as water losses due to high pressures. Finally, MCOP application is successfully verified in this work to distribute water in low pressurized irrigation pipes.

HOW THE INNOVATION SAVES WATER?

Single pump with constant rotational speed

In pressurized irrigation systems, a pump is selected to provide the required pressure for the irrigation system in critical situations, i.e., for an irrigation subunit with the highest head loss and elevation values. Therefore, pump efficiency is affected when it is used to irrigate other irrigation subunits whose friction factors, local head-loss values, and ground elevations are different. In such cases, MCOP can adjust the operating point of the pumping system without requiring electricity.

Taking an area with maximum elevation difference of Δz=4 *m* as the critical irrigation subunit, a one-stage pump (model WKL 65-ϕ192) was tested to deliver Q=10 *l/s*. In this case, system curve (I) represents the system head requirement with the efficiency of 68% (Fig. 3). For another irrigation area with Δz=0 supplying by the same pump, as indicated in Fig. 3, system curve (III) results in Q=12 *l/s* at a reduced efficiency of 61%.

Application of MCOP for the case with Δz=0 is represented by the system curve (II). In this case, MCOP imposes more local head loss and consequently, the associated operating point is located at Q=10 *l/s* with an efficiency of 68%.

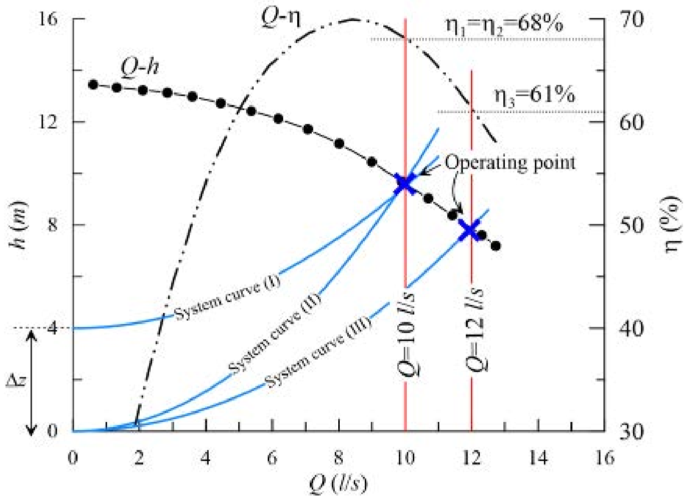

Fig. 3. Characteristics of a one stage high pressure pump (WKL 65-ϕ192)

Therefore, two important advantages of installing MCOP are:

1. Keeping the pump efficiency at the design value, and;
2. Maintaining the flow distribution uniformity for the irrigation subunits with different head-loss characteristics. For the abovementioned case, MCOP leads to save (12-10)/10×100=20% water.

The following advices are also given to use MCOP as a constant speed pump regulating device:

1- Install MCOP at the entrance of each irrigation area;

2- For the cases with different irrigation areas and different water demands, a constant design discharge should be considered and the required demand should be provided by adjusting the irrigation duration;

3- The pump must be able to provide enough pressure with its best performance for irrigating the critical zone.

MCOP application in tape irrigation system

Irrigation tapes are sensitive to pressure fluctuation where no pressure-compensating emitter is used. For such a case, steep slope areas, non-levelled areas, areas close to the pump, are sources of producing pressure fluctuations. In such cases, installing MCOP is an innovative solution.

A field study was conducted. An MCOP of the design discharge of 0.39 l/s was fabricated and installed at the entrance of 2×47 m of tape lines (Fig. 4). Pressures of 10 to 21 m were applied, with and without installing MCOP. For no MCOP installation case, any entrance pressure of greater than

10m resulted in over irrigated condition and runoff

(

Fig. 5a). Further pressure increase until 21 m, made the tape explode

(

Fig. 5b).

Fig. 4. *a*) MCOP with Q=0.39 *l*/*s* connected to two tape lines

Fig. 5. *a*) No MCOP case with over irrigated areas *b*) No MCOP case, tape explosion

The observed discharges per unit length of the tapes are depicted versus the observed lateral pressure values in Fig. 6. It is interesting that although the lateral pressure increases up to about 20 and 30 *m*, MCOP can regulate the flow (Fig. 6). The observed averaged flow rates of 14.25 and 14.86 *l*/*hr*/*m* were obtained which are very close to the design value of 14.17 *l*/*hr*/*m*. Note that, for an entrance pressure of 10 *m*, the total discharge of 0.37 *l*/*s* or 14.17 *l*/*hr*/*m* was observed, i.e. about 2.5 *l*/*hr* per emitter.

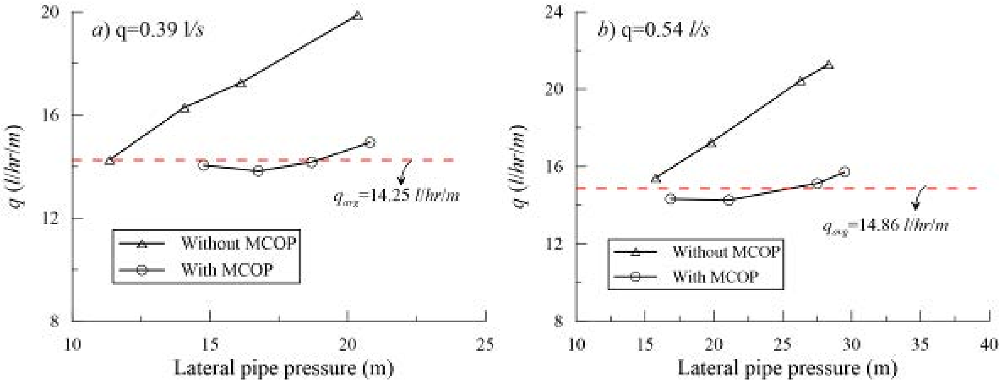

Fig. 6. Discharge per unit length of the tapes versus lateral pressure values *a*) q=0.39 *l*/*s*, b) q=0.54 *l*/*s*

In the case of no MCOP installation, the discharge per unit length of the tapes increases up to 19.88 and 21.28 *l*/*hr*/*m* for the lateral pressure values of 20 and 30*m* respectively (Fig. 6*a* and Fig. 6*b*). Such high discharge values cause water losses as illustrated in Fig. 5. A summary of MCOP applications and the amount of saved water, by comparing the discharge values for the cases with and without MCOP installations, are listed in Table 1. The results indicate that when the lateral pressure increases up to 20 and 30 m, maximum percentages of the saved water by MCOP reach to 31.3 and 50.2 % respectively.

Table 1. Water saving in tape irrigation

MCOP type	Observed values of q_{avg} (*l*/*hr*/*m*)	Average percentage of saved water (%)	Maximum percentage of saved water at highest lateral pressure (%)
Q= 0.39 *l*/*s*	14.25	19.4	40.3

(Fig. 6*a*)			
Q= 0.54 *l*/*s* (Fig. 6*a*)	14.86	31.3	50.2

MCOP application in volumetric water delivery

MCOP application was tested for water delivery in low-pressurized irrigation networks. A laboratory setup, Fig. 7, was constructed. It includes a main pipe with two laterals. The aim is to deliver specific flow rates of 5 and 10 *l*/*s*, when the main pipe pressure changes in the range of 1 to 15 *m*. The main pipe pressure was increased by changing the pump rotational speed then the flow through laterals were measured.

As shown in Fig. 8, although the main pipe pressure changes, the flow through laterals remain almost constant. This confirms that MCOP can be used effectively to fairly distribute water in low-pressurized irrigation networks to prevent conflicts between the stakeholders.

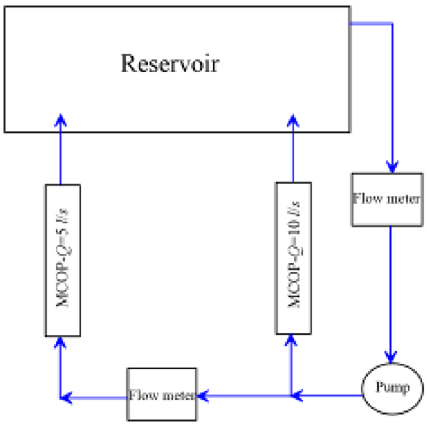

Fig. 7. Schematic view of the experimental setup for testing MCOP performance in volumetric water delivery

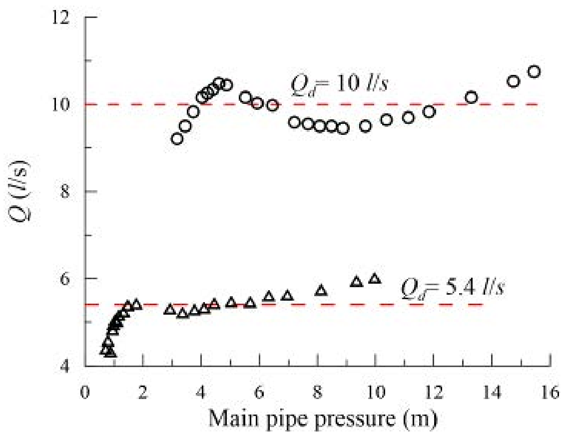

Fig. 8. Discharge values in terms of the main pipe pressure

In Qazvin province, Iran, 20000 *ha* of the wheat-maize rotation fields are planning to be equipped with tape irrigation system. The amounts of 3500 m^3/ha/year and 7000 m^3/ha/year of water should be provided for wheat and maize respectively. Taking into account that MCOP can save only 10% of the total water, about 350 m^3/ha/year and 700 m^3/ha/year will be saved for wheat and maize respectively. In other words, a total of 21 MCM/year can be saved for 20000 ha.

DESCRIPTION OF HOW INNOVATION BEGAN AND DEVELOPED

There are two main reasons of developing a modular device working under low-pressurized networks:

1- There is a big project at south of Iran to modernize 550k *ha* including low-pressurized irrigation networks. To distribute the water between the farmers an offtake called "Do Qolu" was proposed by the consulting companies. This offtake is however sensitive to pressure fluctuations and there are now some conflicts between the stakeholders;

2- Farmers around Qazvin, plant vegetables in small fields. They usually use tankers with the heights of between 5 to 10 m to irrigate using tapes. After visiting the farms, we found that it is very difficult for them to increase the flow uniformity at their farms.

FURTHER EXPANSION OF THE INNOVATION

The potential of the proposed flow control valve for expansion is significant:

1- Pump regulation using MCOP is much cheaper than installing Motor Drives to adjust the pump rotational speed. The published results of this study (See attachment #1) indicated that MCOP can be used to adjust the operating point of pumping system resulting in the best working efficiency as well as the least water losses. A field study to quantify the water use efficiency should be done;

2- Selecting a pilot in 550K *ha* project at the south of Iran, and testing the performance of MCOP for volumetric water delivery is highly helpful to expand the application of such control valve;

3- Designing a self-cleaning version of the valve to use for the muddy water and places with high sedimentation is a topic currently under studying.

THE ROLES OF THE INDIVIDUAL NOMINEES

Dr. Mohammad Bijankhan was the principle investigator of a project supported by Iran National Science Foundation to construct a control valve (Attachment #3). Dr. Ali Mahdavi-Mazdeh and Dr. Hadi Ramezani were co-supervisors of two related MSc theses. Mrs. Narges Mehri and Mrs. Fatemeh Tayebi did the related experiments/fields studies as their MSc thesis.