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FILTER NOZZLE TESTING BY THE INSTALATION WITH COLUMN AND MANOMETER

ABSTRACT:
This paper deals with filter nozzles which are used for water treatment. They are applied in many sectors including drinking water, water demineralization process, urban and industrial waste water treatment, filtration of river or well water for irrigation, water for swimming pools, etc. The filter nozzles are made from the thermoplastic material, with different number and widths of gaps at the head of the nozzles. It is necessary to determine performance curve of filter nozzle before it is installed. The performance curve actually represents the nozzle water gauge head as a function of flow rate. This performance curve has been traditionally determined by measuring of hydrostatic pressure above the nozzle with level meters (graduated scale, ultrasound, capacity etc.). In order to measure a couple of meters water gauge head, a reservoir is necessary. This research is aimed to examine possibility to apply the installation with column and manometer instead of the reservoir, in order to determine filter nozzle performance curve. The water gauge head is measured by manometer and flow rate through the filter nozzle by mass method. Authors are of the opinion that installation with column and manometer could be successfully applied to determine filter nozzle performance curve. In comparison with the reservoir, the installation with column and manometer is more compact and comfortable.

KEYWORDS:
Filter nozzle, column, filtration, washing

INTRODUCTION

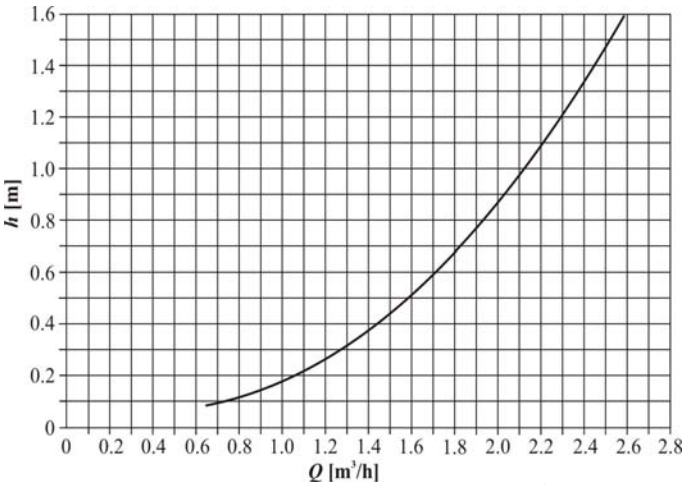
Filter nozzles are placed in:

- *open systems - for preparation of drinking water, industrial waste water treatment, filtration of river or well water for irrigation, water for swimming pools and*
- *closed systems - for preparation of feed, technological and cooling water.*

The filter nozzles are made from the thermoplastic material, with narrow gaps at the head of the nozzles. They enables preparation of water using ion exchangers. The number and width of the filter nozzle gaps vary by model. Thanks to the installed nozzle, this kind of filter has very fast filtration. Filter nozzle enables collection and drainage of filtrate evenly. In the process of washing, nozzles make possible water and air to be evenly distributed. In this way filter nozzles contribute to fast, stabile and economic exploitation of filter stations.

One of the most important characteristic of filter nozzle is to deliver sufficient volume of water in processes filtration and washing. In order to check filter nozzle it is necessary to conduct test before installation. Also is necessary to determine performance curve of filter nozzle before installation. The performance curve actually represents the nozzle water gauge head vs flow rate. This performance curve has been traditionally determined by measuring of hydrostatic pressure above the nozzle with level meters (graduated scale, ultrasound, capacity etc.). In Fig. 1 is shown performance curve of model with 40 narrow gaps, 0.2 mm in width at the head of the nozzles (producer BRAN & LUBBE) [2]. In order to measure a couple of meters water gauge head with this method, a reservoir is necessary.

This research is aimed to examine possibility to apply the installation with column and manometer instead of the installation with reservoir, in order to determine filter nozzle performance curve. The hypothesis of work was that installation with column and manometer could be successfully applied to determine filter nozzle performance curve. The report on filter nozzles testing of models RV001/A, RV001/B and RV001/D (producer RAVEX) provides background for this paper [2]. The RAVEX Company from Vrbas, Serbia, is a leader of filter nozzles production in the Balkan region [3].



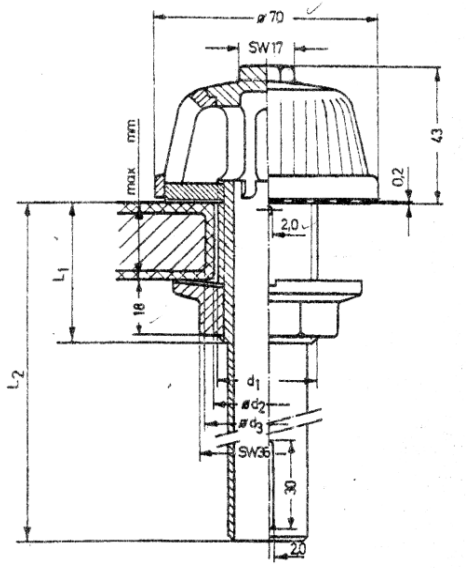


Figure 1. The performance curve of filter nozzle of model with 40 narrow gaps, 0.2 mm in width at the head of the nozzles (producer BRAN & LUBBE) [1]

METHODOLOGY OF INVESTIGATION

An installation with column and manometer for filter nozzles testing has been designed at the Faculty of Technical Sciences, Laboratory for Fluid Mechanics. The filter nozzle model RV001/A was tested to verify method with proposed installation. The model RV001/A corresponds to model in Fig. 1, 40 narrow gaps, 0.2 mm in width at the nozzle head [3]. The tests were carried out for two processes: filtration (Fig. 2) and washing (Fig. 3).

In Fig. 2, Fig. 3 and Fig. 4 are: 1-valve, 2-rubber hose, 3-regulator, 4-housing, 5-manometer, 6-filter nozzle, 7-bottom with threaded connection, 8-built in piece, 9-screw nut, 10-nozzle neck, 11-vessel, 12-precision balance, 13-data acquisition and 14-stopwatch.

The length of the housing is $h_k = 550$ mm*, which is more than the length of the nozzle neck (*$h_d = 400$ mm*). Regulation of water flow rate (*$\dot{m}$*) was carried out by balance valve (3). The pressure at the position 5 was measured by manometer of producer YOKOGAWA, model EJA530A [4].*

The measuring range of manometer is $p = 0 \div 400$ mbar*, with uncertainty of* $\pm 0{,}35\ \%$*. The change of filter nozzle position for two testing processes (filtration in Fig. 2 and washing in Fig. 3) was enabled by bottom with threaded connection 7 and built in piece 8. The mass of water (m) was measured with precision balance (12) with uncertainty of* $\pm 0{,}02\ \%$*, while the time (t) was measured with digital stopwatch (14).*

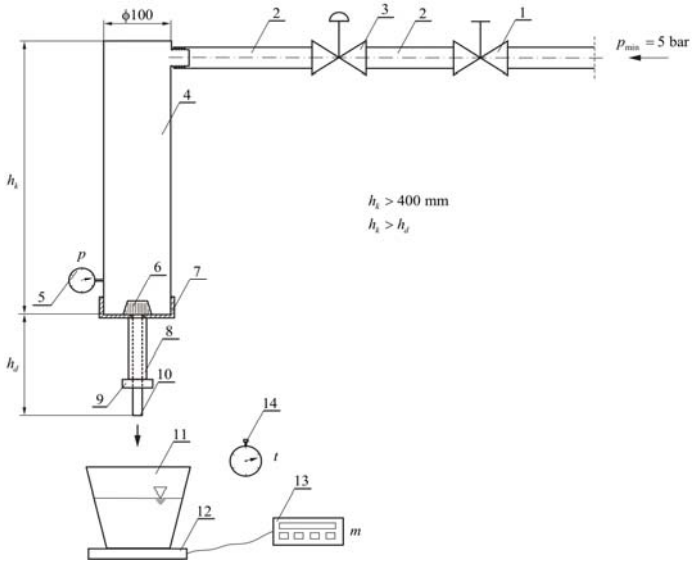


Figure 2. Scheme of installation with column and manometer for filtration process

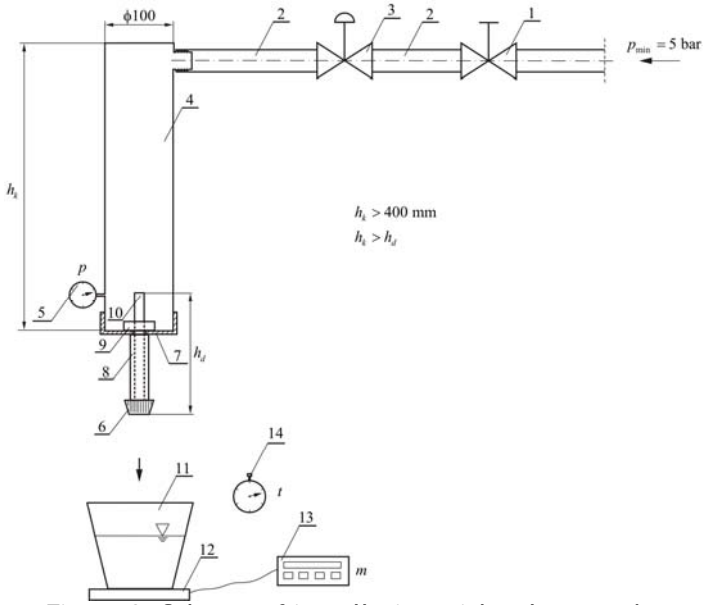


Figure 3. Scheme of installation with column and manometer for washing process

Mass flow rate is as follows: $\dot{m} = \dfrac{m}{t}$.

Volumetric flow rate is: $Q = \dfrac{\dot{m}}{\rho}$.

The water gauge head is: $h = \dfrac{p}{\rho g}$,

where are:
p - preassure [Pa];
ρ - density of water [kg/m^3];
g - earth accelaration [m/s^2].
The water gauge head (h) depends on determined volumetric flow rate (Q). The flow rate was varied by regulator and relation equation $Q = f(h)$ was formed.

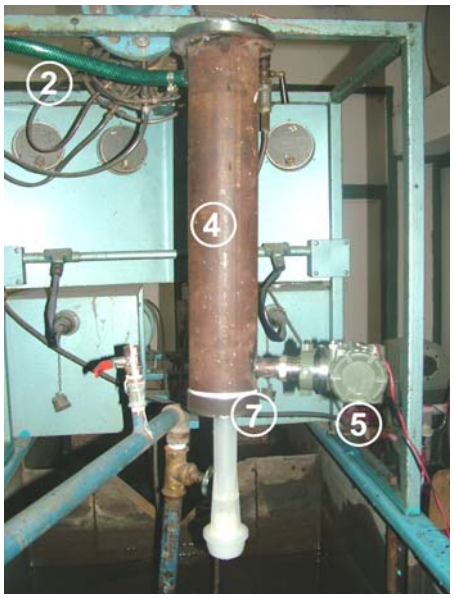


Figure 4. View of installation with column and manometer for washing process

EXPERIMENTAL RESULTS AND ANALYSIS

The results of filter nozzle testing of producer RAVEX, model RV001/A are shown in Fig. 5 and Fig 6. In the Fig. 5 is shown performance curve for the filtration process and in the Fig. 6 performance curve for the washing process.
The gained performance curves for filtration and washing processes in Fig. 5 and Fig. 6 were expected. These curves thoroughly suit curves for filter nozzles with 40 narrow gaps, 0.2 mm in width at the nozzle head.

In this way hypothesis of work was proved and installation with column and manometer could be successfully applied to determine filter nozzle performance curve. In comparison with the reservoir, the installation with column and manometer is more compact and comfortable. The performance curve in filtration process which was determined by installation with the reservoir had up to 1.6 m water head gauge, as shown in Fig.1. It means that maximal level of water in the reservoir is 1.6 m. The performance curve in filtration process which was determined by installation with column and manometer had up to 3 m water head gauge, as shown in Fig. 5. For the same water head gauge, the level of the water in the reservoir should be 3 m. On the other hand the height of column was only 0.5 meter.

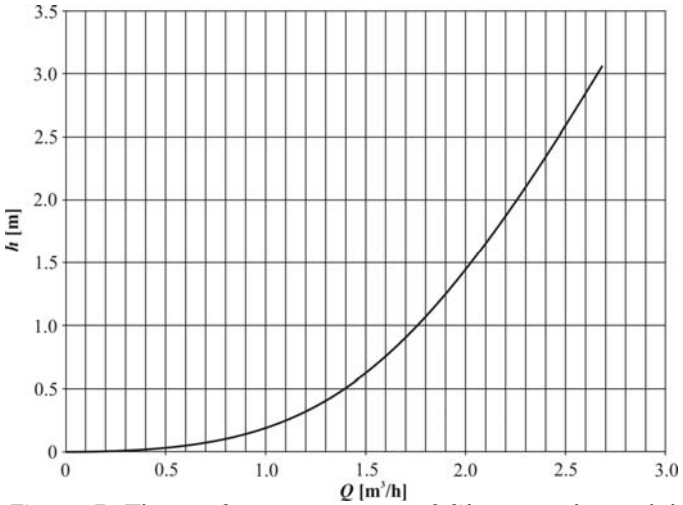


Figure 5. The performance curve of filter nozzle model RV001/A for the filtration process

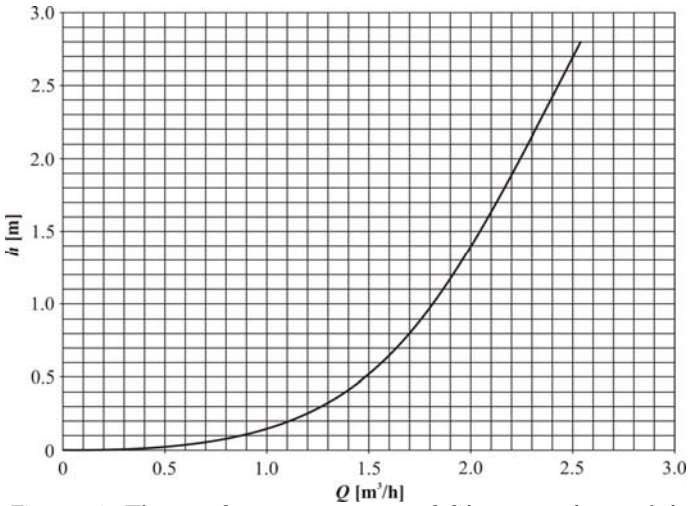


Figure 6. The performance curve of filter nozzle model RV001/A for the washing process

CONCLUSIONS

The same model of filter nozzles was tested with the help of the installation with reservoir and the installation with column and manometer, respectively. Very good agreement between these two performance curves was obtained.

Authors are of the opinion that column could be successfully applied to determine filter nozzle performance curve. In comparison with the reservoir, the installation with column and manometer is more compact and comfortable.

ACKNOWLEDGMENT

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