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# OPTIMIZATION OF THE OPEN FAST FILTERS EXPLOITATION FROM A SURFACE DRINKING WATER STATION

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**Abstract: This paper proposes an approach to the exploitation of opened fast filters in a drinking surface water station. The paperwork studies the opportunity of using ascendant filtration in drinkable and industrial waters clearing technology.**
**Keywords: ascending filtration, descending filtration, multiple homogenous layer, exploitation, optimization.**

## GENERAL PROBLEMS

Filtering is the process of clarification that ensures separation of suspensions from water by passing it through granular or porous media, particularly in relation to the flowing water and the intended use.

Depending on the size of the filter velocities, the water flow direction, the nature and structure filte media differ : slow filters (v=5-10m/day), fast filters (v=5-10m/h) or high-speed filters (v=20-100m/h), ascending, descending or radials, homogeneous or inhomogeneous, with single layer or multiple layers (multilayer).

In the framework of the current rinsing technologies in water treatment plants are used mainly descending fast filters with single layer of sand.

Rapid filtration in water treatment technology, in drinking and industrial purposes is used either as a single step fining, as preliminary step (prefiltration) or final step, finishing indicators of water quality [1,2,11].

Fining processes through fast filters are very complex phenomena arising from: the characteristics of substances dispersed in purified water (nature, size, concentration and their aggregation state in water); filter media characteristics (nature, type and mineralogical structure of layers, size and grain shape, porosity and thickness of the layer (s); hydrodynamic conditions of the process (filtering speed, direction of movement, washing efficiency homogeneous, mono or multilayer filter media [10].

Theoretical and experimental research in the rinsing processes through the fast filtration aim:

- increase the retention capacity of filter layers;
- choice of filtering materials with high absorption capacity, inexpensive and readily available;
- increasing filtration velocity to increase flows without diminishing the effluent quality;
- increase at the same flow filtration cycles, but without diminishing the effluent quality;
- exloatare reduction filtering installations;
- reduction exploitation of filtering installations ;
- filtration installation automation to reduce personnel and exploitation expenses;
- filtering processes optimization using laboratory and the pilot installations to establish the determining parameters which contribute to a more uniform load of loads and load losses in filtering mass;
- improving the design methodes through a judicious choice of filtration velocity, of the granulometry and the height of filter media so that the quantity and quality are delivered to be as big as the limit imposed by the consumer;
- washing process improvements using washing with small and large ejectors, by countercurrent with water or water and air or using the vacuum washing;
- microsite use, of filter media composed of two or more layers;
- choice based on economic and functional criteria how to operate fast filtering instalaltions (with constant flow or variable flow);
- development of filtering theory to determine optimum design and exploitation criteria.

Ascending fast filtering through multiple homogeneous and inhomogeneous layers is in line with current requirements and guidance on increasing productivity and enhancing the degree of clarification through enhancing the use of filter layers,, while increasing speed and filtration cycles [7,8].

Technical achievements in water clarification have been directed towards promoting both filtering membrane filter and the ascending filter through granular homogeneous mass in order to ensure

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uniform detentions distribution throughout the filter thickness.

Distribution of selected suspension by type of filtration and filter media structure are shown in Figure 1.

To ascending filtration through hmogeneous layer of sand, suspensions distribution in filtering mass is similar to that of the descending filtering through multiple inhomogeneous layers. If descending filtration, filtering layers can be achieved by schemes played in Figure 2. [2,10,11,12].

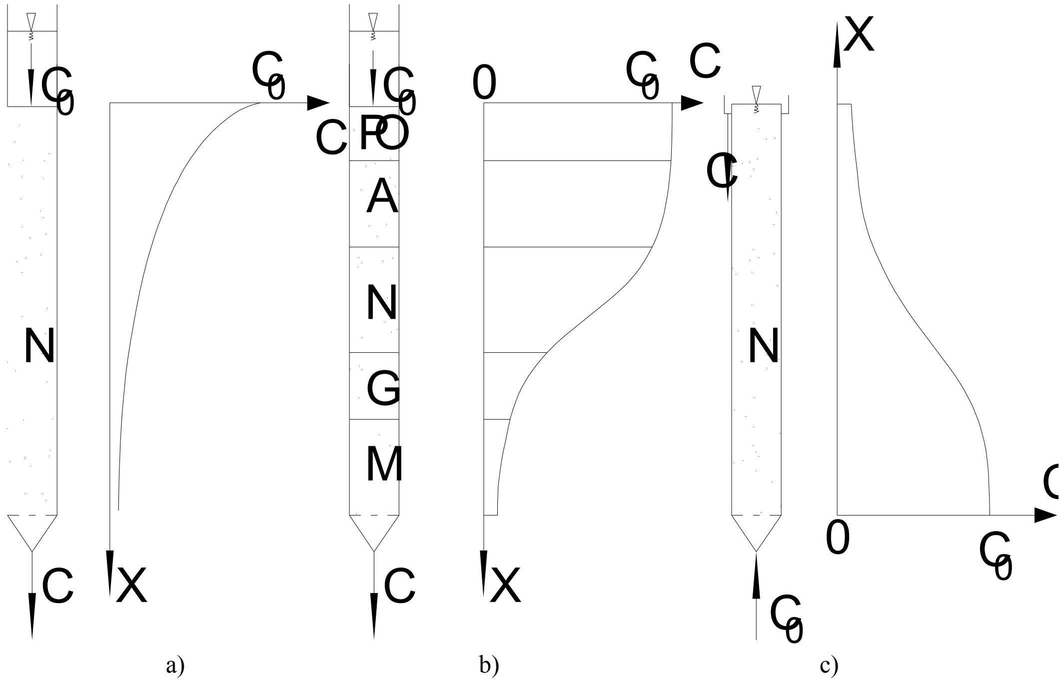


**Figure1.** Distribution of retained suspensions in filtering mass
a). Descending filter with homogeneous layer of sand;
b). Descending filter with inhomogeneous layer;
c). Ascending filter with homogeneous layer of sand.

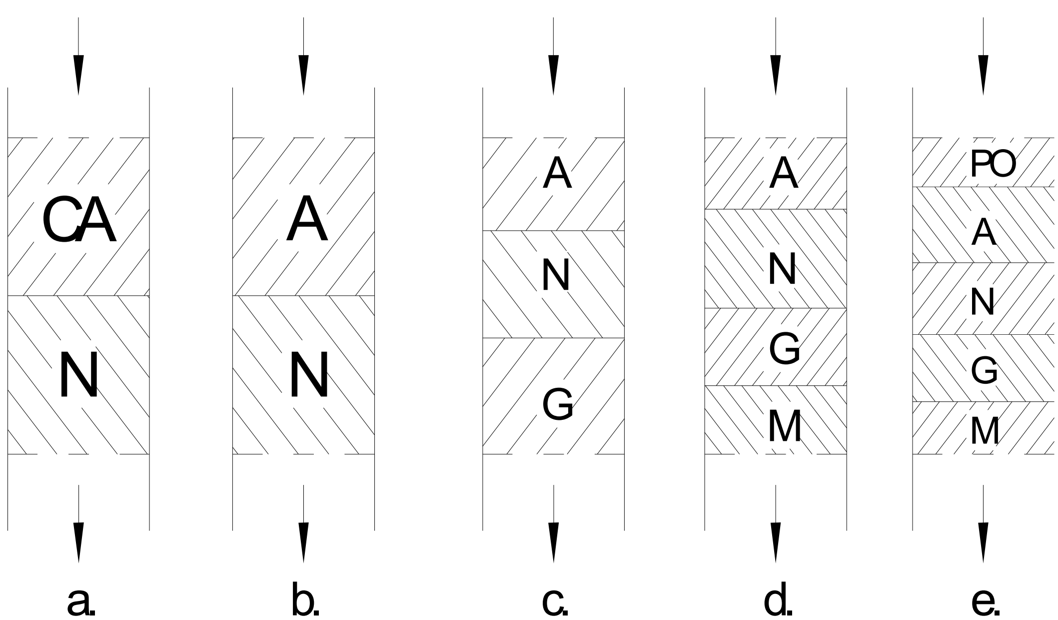


**Figure 2**. Inhomogeneous material structures for descending filtration
CA – charcoal; A- anthracite; P- polyesters; N- quartz sand; G- garnet; M – magnetite



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**EXPERIMENTAL DETERMINATION AND INTERPRETATION OF RESULTS**

Experimental investigations were conducted in water supply laboratory at the Hydraulic Engineering Faculty of Timisoara, during 2000 - 2005 using an experimental stand (Figure 3), consisting of a plexiglass tube with D = 150 mm and H = 1100 mm, equipped with 10 double sockets used to collect water samples and measuring the pressure loss.

Experiments were performed with water captured from the Bega basin, matured suspensions prepared from pumping station basin.

In the experimental program were studied in parallel rinsing processes through ascending and descending filters, for different concentrations of suspension (C) and filtration speeds (v). Studied filtering layers thick was at 50 cm and respectivelly 60 cm.

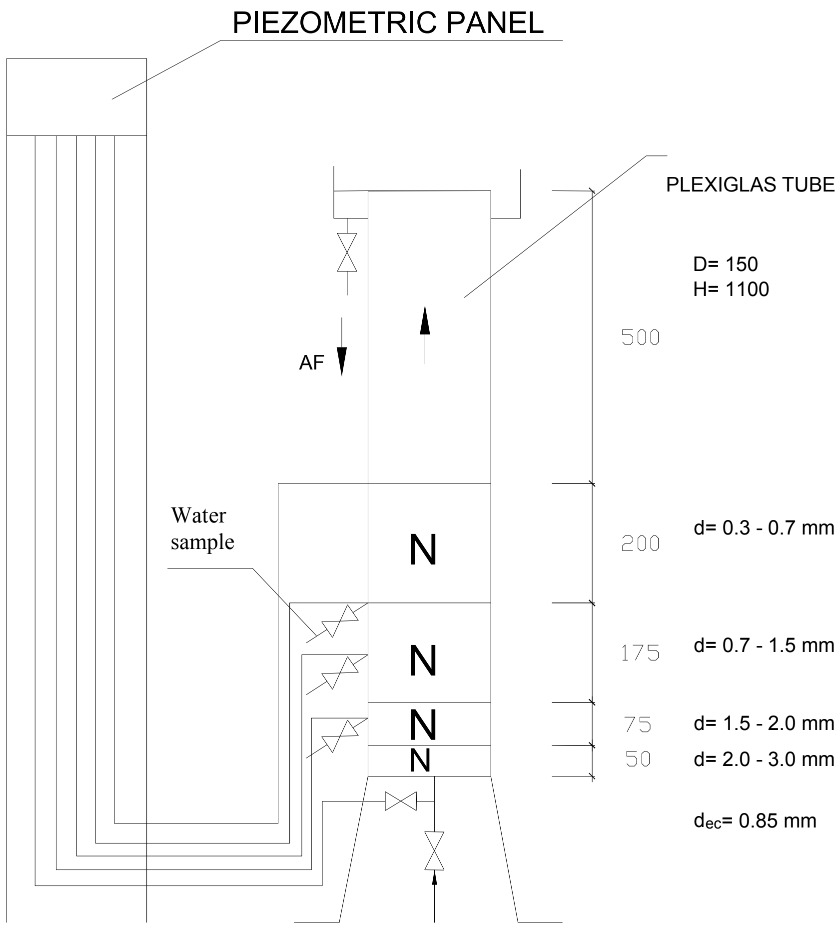


**Fig. 3.** Experimental stand scheme for ascending filtration

Figures 4, 5 and 6 are shown qualitative changes over the filtration cycles, for the turbidity of 53, 57, and 58 NTU at speeds of 5, 10 and 15 m/h. Filtering small velocities determined for the same load, higher filtration cycles, but with a lower penetration heights.



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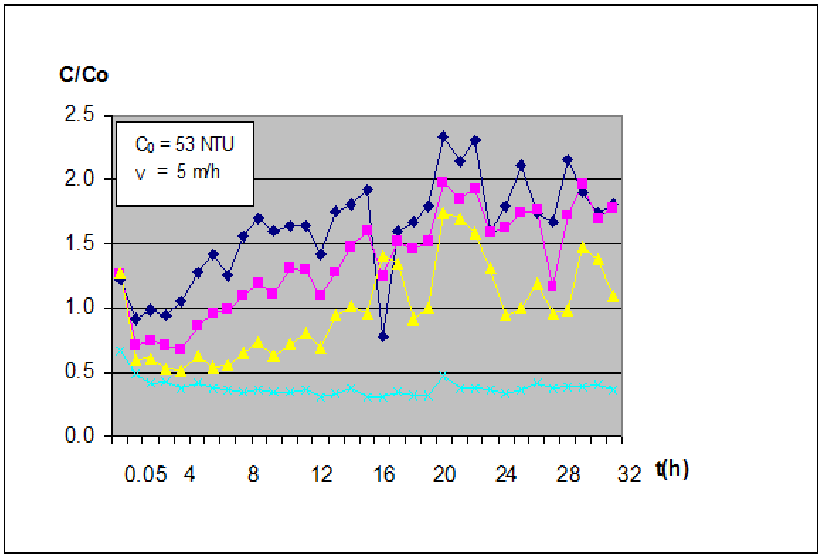


Figure 4. Qualitative changes over the filtration cycles for v = 5 m/h

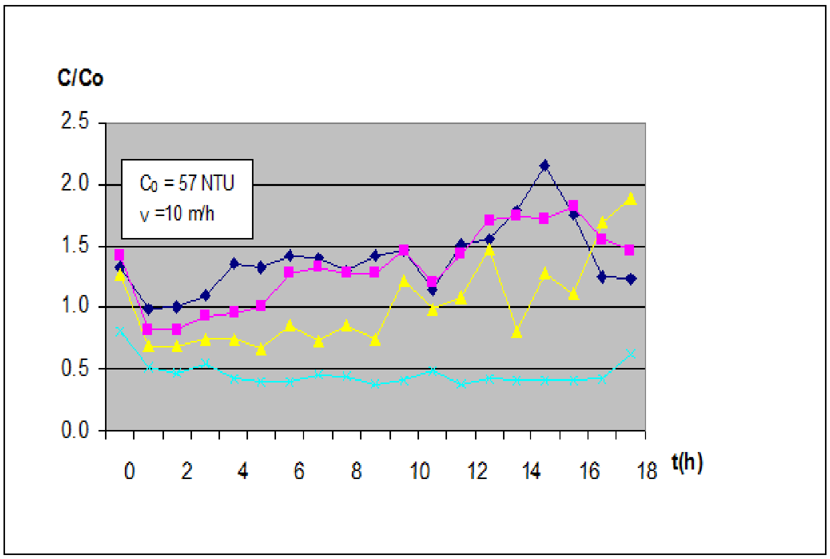


Figure 5. Qualitative changes over the filtration cycles for v = 10 m/h

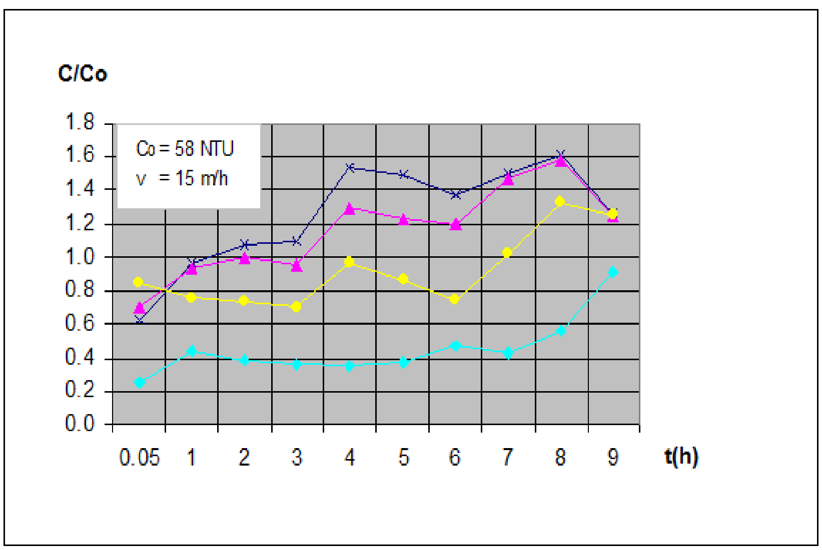


Figure 6. Qualitative changes over the filtration cycles for v = 15 m/h



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## RECOMMENDATIONS ON THE FAST FILTERS EXPLOITATION

Before putting into service of filtration station is recommended to disinfect vats with chloride of lime. Solution with concentration of 20 g/m3, must remain in filters for 24 h followed by successive washes with clean water.

Commissioning drinking water filters is made after obtaining the written opinion of sanitary organs after 5÷10 days to discharge the conditions of drinkable required by standards.

The reception is preceded by rigorous control, which include following elements:

- dimensions and compliance rates mounting in projects;
- adhering assembly and proper functioning of equipment, valves, measuring and control devices;
- endowment with measuring and control equipment;
- compliance of the protection measures and occupational safety

On reception will participate, necessarily, as a delegation member of the unit which will provide exploitation and maintenance of filtering station.

Commissioning, requires prior taking the following measures:

- establishment of sanitary protection zone;
- obtaining the sanitary authorization working;
- training of exploitating personnel and checking the ownership regulation by them;
- organization operating records;
- ensure a proper system of information and data transmission;

Commissioning will be done in the presence of the designer who will attend at least the first 5-10 days of continuous operation, which will then check the exploitation mode by key parameters researching.

In the first period of operation will always check how the staff has acquired the technical rules for operating.

Functioning filtering station is due mainly to the following conditions:

- Ensure technology and construction conditions required by the project:
- quality filter material and thickness;
- horizontal position and adjustment of drainage system;
- providing intensities of air and water washing;
- location and correct installation of the intake valve and control device;
- horizontal position of the edges discharged of the collect gutters of washing;
- tightness of installation fittings.

All these are regularly checked and recorded.

- Timing when filtration is necessary to stop and start washing operation:
- when loss of pregnancy through the filter has reached 2 m, without exceeding the total height;
- when flow decreased by 40% from baseline;
- when operating cycle reached 72 hours.

- Washing make should ensure:
- uniformity washing;
- intensity of washing with water and air as designed;
- complete evacuation of dirty water in the space between the sand and washing troughs.
- Filling the filter with water and put back into service after washing.
- Maintaining filtration speed to the project values.
- Visual inspection of drainage condition by observing the filter surface during washing and detection places where drainage was disturbed, including its repair.
- Checking the filter thickness monthly and expanding its.
- Ensuring recovery of washing water reserve between two successive washes in the tank.
- Filtered flow keeping the operations of cleaning and washing water volume consumed.

Washing will be done initially by prescription designer, being corrected in the first period of exploitation so as to ensure better efficiency, with minimum consumption of water and electricity.

If the analysis indicates a filtered water turbidity >5 NTU, the filter operation is deemed unsatisfactory, seeking the cause of this situation.

Poor quality of filtered water may be due to:

- low temperatures in winter;
- changing raw water quality;
- inadequate washing of filters;
- granulometric composition change of the filtering layer during washing;
- drainage system damage;

Reducing cycle time filtering occurs in conditions:

- a high content of suspended in raw water;
- incomplete and inconsistent washing filter.

Depending on the cause of the phenomenon, operating personnel will work to eliminate the deficiencies, reducing the filtered water at appropriate turbidity.

## GENERAL CONCLUSIONS

Fast ascending filters equipped with homogeneous granular material consisting of quartz sand are a good alternative to replace conventional descending filtration in order to standardize the retention capacity of filter media, while increasing speeds and filtration cycles.

In the current to optimize opened fast filter exploitation existing to a drinking surface water station following strategies are proposed namely:

F1. opened fast filters automation through management, monitoring and control by computer, without major intervention in the existing technology;



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F2. opened fast filters automation through management, monitoring and control by computer, interference with existing technology;

F3. opened fast filters refurbishment.

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