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OPTIMIZATION OF THE LONGITUDINAL HORIZONTAL SETTLING TANKS EXPLOITATION WITHIN A DRINKING SURFACE WATER STATIONS

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Abstract: This paper proposes an approach to the exploitation of longitudinal horizontal settling tanks stations within a surface drinking water. In the paper are presented programs which showing the sedimentation process of longitudinal horizontal decanters and their efficiency.
Keywords: drinkable, sedimentation, exploitation, optimization.

1. GENERAL PROBLEMS

Natural water is never completely pure, its quality is generally determined by the total mineral or organic substances, dissolved gases, particulate matter and living organisms present.

Therefore, the burden of different sources of natural water treatment is the treatment plant, which through various construction and installation performed a chain of processes (technological flow) that ultimately, the water distributed to consumers falls within the potabilization rules.

A development locality in conjunction with the requirements of increasingly stringent on drinking water quality implies constant upgrading and rehabilitation of drinking water production plants.

Criteria underlying the choice of water resources for drinking purposes they use are: *quantitative*, the source must provide the amount of water required by users throughout the year, *qualitative*, source must be within specific quality standards for water supply, *technical*, referring to the source capture mode, recommendations on treatment technology, equipment used and method of exploitation, *economical*, referring to the costs of designing, manufacturing and exploitation [1,2,3,4, 5,7,9].

Treatment technologies issues of water treatment plants in drinking purposes are extremely complex because of many factors involved in treatment processes. Treatment plants should be made so as to provide: water movement from one installation to another; correcting all the indicators of water quality; minimum exploitation costs in terms of safely in water delivered potabilization; a flexible exploitation, allowing installations adapting to water quality changing from source; the possibility of further development of the treatment plant according to the increasing demand for water; treatment plant classification whole water supply system, in terms of increased reliability and of some opportunities for automation and dispatching appropriate level of time and perspective [2,3,5,7,9].

Currently operators operating water supply systems face many difficulties in practical work of exploitation, development of investments and economic and financial management system.

To this way a lever action to improve technical performance and quality of service provided, is to optimize installations exploitation from a treatment plant by automating and monitoring water supply system which is even more justified if large cities, where supply system is developed by large distances and is characterized by a large amount of information necessary for optimal and operational exploitation. Automation is ultimately the highest level of leadership that can ensure high performance for driven process [3,8,10].

2. EXPERIMENTAL MEASUREMENTS

Experimental measurements were made at plant no. 4 of Timisoara (in regards sedimentation in longitudinal horizontal settling tank and its efficiency - with chemical reagents coagulation) and the Water Treatment Laboratory at the Hydraulic Engineering Faculty (in terms of suspension mass dependence according to the turbidity of the water) during spring and summer of 2006 (at various flows and turbidity) [3].

Mass suspension of existing in different water samples was determined using two methods of working. The first method consisted of filtering a volume of 1 litter of water on a filter paper (HF) and then HF with suspensions remaining on HF were dried in the oven until complete evaporation of water (3 hours at 105ºC). The second approach, considered safer, with less errors and faster is that to measure water volume (1 litter) and placing it in a special dish in the oven for complete evaporation of water. Following this procedure, the vessel will remain total waste. To determine the fixed residue proceed to drying in oven of a volume of water equal to that before, but filtered. To the measured difference at

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analytical balance of the two dry samples, resulting total suspensions mass from water.

Mass suspension was considered rather small and thus it was agreed that the unit is mg for mass suspension contained in a litter (dm^3) of the sample is mg/l.

Water turbidity at No.4 plant was measured by laboratory turbidity meter Nephla –Lange existing at No.4 plant. Scale that was used to measure turbidity at turbidity meter is the degree N.T.U., turbidity meter being calibrated to this scale. Were taken sampled from the settling tank VI extension plant no. 4 with the following data: L = 32 m (L_{pool} = 30); B = 4 m; H=3.5 m; Q_{d1}= 32.26 l/s; v_1=2.31 mm/s; t_1 =16.2°C; D_{SA1}=31 mg/l SA. pH=7.0, turbidity of treated water with reagent after mixture room in supply room 80 NTU (C = 110 mg/l), turbidity output from settling tank 5 NTU (C = 11.8 mg/l). Samples were taken from studied settling tank length *input*- 5m-10m - 15m - 20m - 25m - 30m - *output* and depth of water level 0, -0.5m, -1.0m, -1.5m, -2.0m, -2.5m, -3,0m.[3].

For sedimentary process modelling is considered a multi-phase fluid motion through a horizontal longitudinal settling tank placed in a system of triortogonal, Euclidean axis, as shown in Figure 1.1. in settling tank enter the flow Qi with the concentration Ci and goes out the flow Q_{ef} of effluent with concentration C_e. Through the bottom go out mud flow out Q_n with concentration C_n in solids suspensions [7].

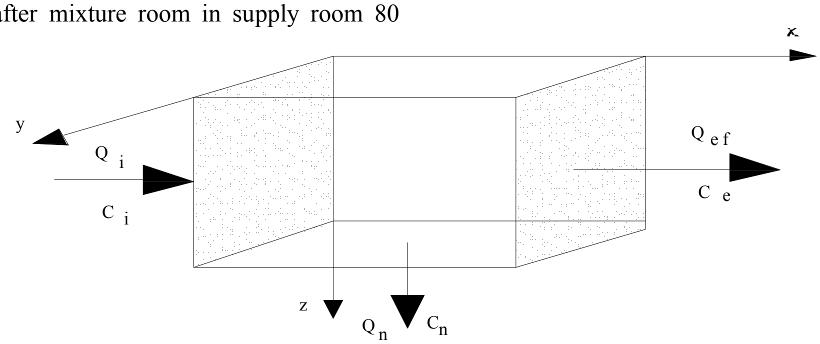

Figure 1.1. Scheme location coordinate axes

For modelling was considered settling tank studied from No.4 Plant Timisoara with volume V = 300 m^3 in which enter a flow of Q = 0.032 m^3/s with a concentration in suspensions of 110 mg/l for a 80 NTU turbidity, with density p_s = 1100 kg/ m^3. On settling tank slab foundation, marked in Figure 1.2. with AB, solids suspensions are deposited as mud. In AD area of the settling tank enter the flow Q = 0.032 m^3/s at a concentration of 110 mg/l in raw water. In the CD area raw water from the settling tank is in contact with the atmosphere - the line CD represents the free surface of water from settling tank.

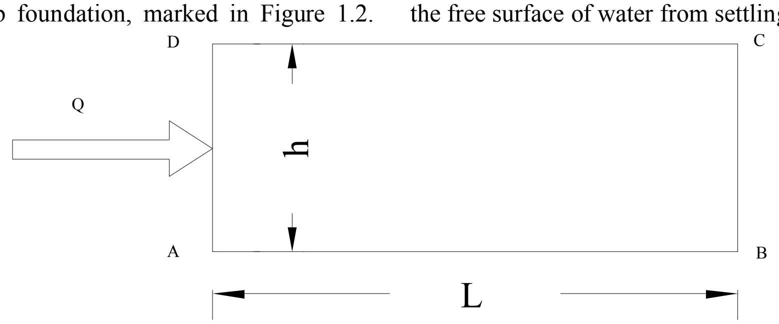

Figure 1.2. Sedimentary basin – settling tank - vertical section

Numerical integration by finite element method of partial differential equations are formulated following boundary conditions: on the side AD - the concentration of suspensions of raw water is 110 mg/l - Dirichlet type condition, the DC side - concentration in suspensions of free area is C = 110 mg/l hypothesis which ensures the value required by the terms of purity of treated water - Dirichlet type condition, the side BA - bottom surface of the settling tank should be provided to achieve maximum concentration in the mud suspension - Dirichlet type condition, the side BC - vertical side of the settling tank to the aqueous environment which is bordered by concrete side of the sedimentary basin, provided that there should not be exchange of suspension with construction material $\partial C / \partial z = 0$ Neumann type condition. [3,6,7]

For initial condition we value the concentration at time t=0. It is considered that at baseline, when applying flow injection loaded with suspensions concentration is $C_{It=0}$=0. This condition is justified by the situation in which primed settling tank exploitation, because the continuous flow regime is a concentration any time. To identify the distributions of concentration on the length of the pool concentrations were measured throughout the length and depth of the basin.

3. RESULTS AND DISCUSSION

Table 1 centralized data from experimental measurements in terms of concentration (C_1-C_5) in mg/l on settling tank length (L) in m and depth of the settling tank (H) in m.

Table 1.

L / H	5	10	15	20	25	30
	C_1	C_2	C_3	C_4	C_5	C_6
0	*2,38*	*2,09*	*2,1*	*1,57*	*1,99*	*2*
-0,5	*3,8*	*5*	*4,5*	*4,3*	*4,9*	*5*
-1	*36*	*58*	*40*	*25*	*31*	*33,2*
-1,5	*80,5*	*105*	*74,3*	*34*	*40,3*	*41*
-2	*130*	*166*	*126*	*79*	*83,2*	*93*
-2,5	*200*	*272*	*259,6*	*213*	*215*	*228*
-3	*260*	*340*				

Using *polifit* function of Matlab program that approximates a data set with a polynomial of degree n, were plotted distribution curves of concentration at different depths (H) on basin length (L). It was developed a program under Matlab that resolves this problem, called *prog. rc. m* [3,7,9].

After running the program have obtained curves of the graph in Figure 1.3.

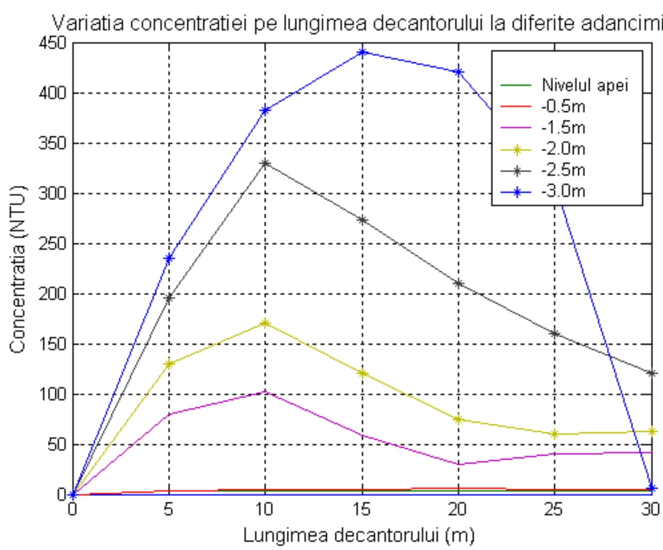

Figure 1.3. Changes in concentration depending on the length of the settling tank to different depths

To calculate the settling tank efficiency have done a program *eficient.m* in Matlab in that are defined the following: geometric parameters of the settling tank, H_n and C_n, ,T - time constant of the process, Kr-amplification factor of regulator, T_i - time constant integration of the regulator for PI (PID) case is taken 0.1, the period in which we study EF [%], set EF [%] before settling tank to work, introduce input concentrations C1 = [80 60 40], EF(k) = 70% - is required C1 = [80 60 40], EF(k) = 50% is required. The result of running the program is shown in Figure 1.4. [3,6,7,9].

From graphic analysis of concentration distribution (Figure 1.3.) we can finding the conclusion that in the first half of the settling tank is an intensification of sedimentation processes of floaters influenced by the water distribution system in the settling tank. So we can say that the thickness of the deposits of mud in studied settling tank it's in the first half of this, which is visually checked at the clearing and washing of the settling tank.

To optimize exploitation of the settling tank is proposing three options work, namely:

- can *change constructive the supply and distribution system of raw water* pre-treated with coagulants, which implicitly leads to more efficient use of space sedimentation of suspensions (floaters or other elements in suspension) [5];
- *introduction of automation and monitoring systems* of the sedimentation process which requires two control systems namely one control system of concentration and control system of level [3,8];

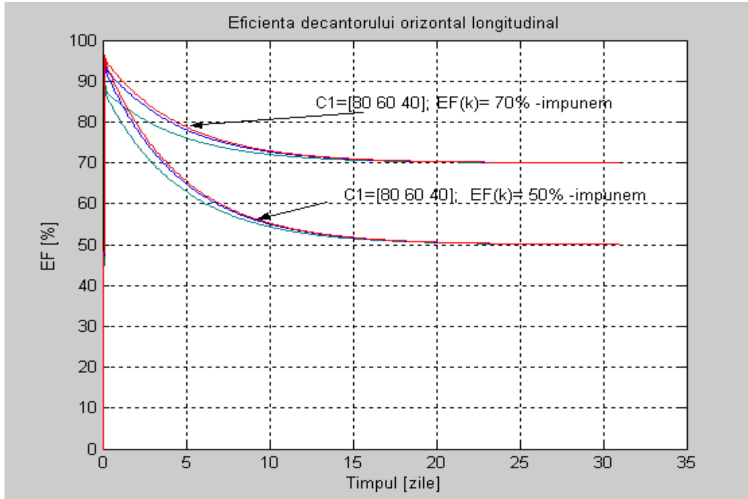

Figure 1.4. Efficiency variation in time of the settling tank

- *settling tank washing efficiency by automating the process,* which will provide an installation for washing and a water recovery installation from settling tank, in conjunction with process management system to your computer using effective program *m* and *prog. rc. m*.

4. RECOMMENDATIONS ON THE SETTLING TANKS EXPLOITATION

Settling tanks exploitation will include the following operations [3]:

- hourly monitoring and regulating water flow coming into each battery compartment decanters;
- removal of floating bodies and the foam;
- visual inspection of the efficiency of reaction chambers, by examining the process of formation of flakes, of their size etc;
- visual inspection of the effectiveness of decantation, by observing the hourly water transparency at the overflow collection of decanted water;
- daily measurement of height and volume of mud deposited in the area of sedimentation;
- discharge of mud collected at the intervals prescribed in the project;
- maintenance of cleaning the area around settling tanks;
- keeping regarding mud cleanup operations, operating reaction chamber devices and bridges - playpen.

GENERAL CONCLUSIONS

In the current context to optimize exploitation of existing longitudinal horizontal settling tanks in a drinking surface water station following strategies are proposed namely:

- automation longitudinal horizontal settling tanks through management, monitoring and control using computer, without major intervention in the existing technology;
- automation longitudinal horizontal settling tanks through management, control and monitoring using computer, with intervention in existing technology;
- refurbishment longitudinal horizontal settling tanks;
- for settling tanks washing will provide an installation for washing and an installation of water recovery from settling tanks through a pumping station equipped with submersible electro pumps.

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