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DETERMINATION OF THE DEPOSITION OF PARTICLES CONTAINED IN THE WATER PASSING THROUGH THE SUMP WELL.

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Abstract *- This article shows the deposition of suspended particles in water passing through an sump well. The size of the sludge and particles contained in the water directly depends on the weighing speed of the substances that are sown in the sump well.*

Keywords: *water velocity, size, density, degree of roughness of their surface*.

INTRODUCTION

To improve the flow spreading in the advance chamber and the volume of sediment deposition, .[1,2] it is recommended to provide for special measures of the advance chamber with a reverse slope of the bottom or with curved slopes (in plan), [3,4] the installation of longitudinal or transverse wall guides, .[5] etc The selection of measures is carried out on the basis of technical and economic calculations with, [6] if necessary, for large and unique pumping stations model hydraulic research. .[7] The deposition rate of particles suspended in water depends on their size, shape, density and degree of roughness of their surface.[8,9]

If small particles or particles of low density are subjected to settling, then a linear law applies, in other words, the resistance of particles to precipitation is proportional to the deposition rate in the first degree. .[10] The settling of large particles occurs according to the quadratic law, i.e. the resistance experienced by the particles becomes proportional to the second degree of the deposition rate. For medium-sized particles, the resistance is proportional to the deposition rate to a degree whose values are greater than 1 and less than 2. .[11]

Consequently, at any point of the flow and at any time, velocities may appear that are not constant in magnitude and direction. .[12] The actual velocity of the particles moving into the sump well undergoes the same changes. .[13] This excludes the practical possibility of an unambiguous solution to the problem of determining the point of precipitation of a suspended particle to the bottom of the sump well. [14]

THEORETICAL ANALYSIS OF EXPERIMENTAL RESULTS

It follows from the above that at present the theoretical determination of the calculated deposition rate of the coagulated suspension is not feasible. Therefore, in order to calculate the advance chamber, the deposition rate of the suspension should be determined using an experimental curve of the percentage precipitation of the suspension. On the abscissa axis, numerical values of the settling duration in minutes are postponed, and on the ordinate axis — the amount of suspended matter dropped as a percentage of the initial content of suspended substances in the water of this source.

Another parameter necessary for calculating the advance chamber is the average value of the vertical component of the flow velocity. Studies have shown that this value linearly depends on the average flow velocity. Therefore, the average speed of water movement in the horizontal sump well should be assigned depending on the calculated rate of precipitation of the suspension, which, in turn, depends on the turbidity of the water in this source. The Building codes and regulations shows the approximate values of the rate of precipitation of the io suspension in *mm/sec*, delayed in the sump well.

To determine the coefficient a, which takes into account the weighing effect of the vertical flow velocity, the formula is

$$\alpha = \frac{u_0}{\frac{v_{cp}}{30}} \qquad (1)$$

Where

u_0 - is the rate of precipitation of the suspension retained in the ante—chamber, in mm/sec;

v_{cp} - is the average horizontal velocity of water movement in the ante—chamber in *mm/sec*, which is assumed to be equal to:

$$v_{cp} = K u_0 \qquad (2)$$

It follows that

$$\alpha = \frac{1}{\frac{K}{30}} \qquad (3)$$

that is, the value of a depends only on the coefficient K.

The values of the coefficients K and a are determined depending on the ratio of the length of the horizontal advance chamber L to its depth H and can be taken according to Table 1.

Table 1

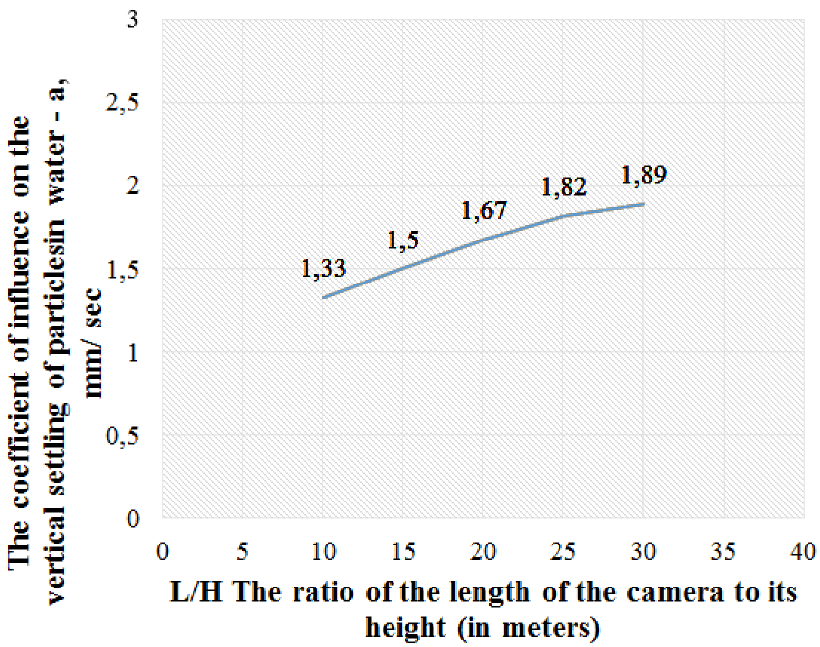
Values of coefficients K and a

L/H	10	15	20	25
K	7,5	10	12	13,5
a	1,33	1,5	1,67	1,82

THEORETICAL ANALYSIS OF EXPERIMENTAL RESULTS

To determine the rate of precipitation of the suspension, io uses data from technological analysis or practical data from the operation of an advance chamber operating under similar conditions. At the same time, it should be borne in mind that the content of suspended substances in the water that has passed the pre-chamber should not exceed 8-12 g / m3.

Figure 1



Calculation of the advance camera **Figure 2**

In the sump well (Fig. 1,2), two zones are distinguished: the zone of suspension deposition and the zone of accumulation and compaction of sediment. The average depth of the deposition zone is taken in the range of 2.5—3.5 m, depending on the altitude scheme of the water treatment plant; the depth of the zone (accumulation and compaction of sediment depends on the average concentration of suspended solids and on the duration of the pre-chamber operation between two regular cleanings (see Table 1).

The advance chambers have a rectangular shape in plan and can be either one-story or two-story, but with common devices for entering and exiting water. Turns of the flow into the sump well are not allowed either vertically or horizontally.

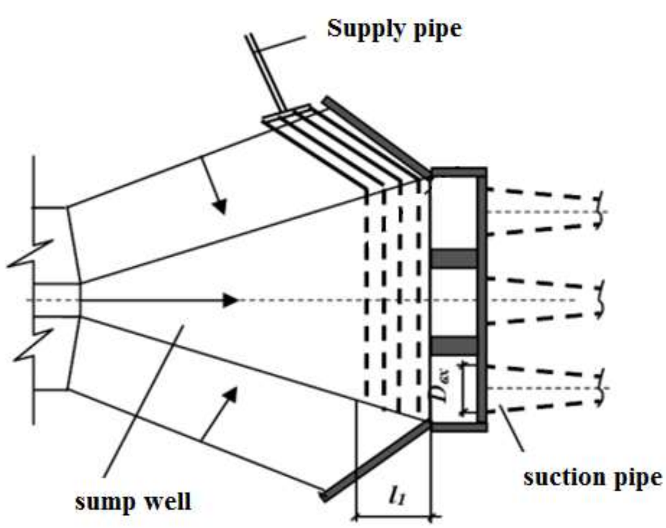


Fig. 3. Layout of pipes in the pump station's sump well

With the periodic removal of sediment, the advance chamber is turned off from operation with its complete emptying. Continuous removal of sediment can also be organized without turning off the advance chamber, if devices for mechanized or hydraulic removal of sediment are provided. The total (total) area of the sump well in the plan

$$F_{tot} = \frac{\alpha Q_{heat}}{3,6u_0} \quad (4)$$

where

$Q_{час}$— the estimated flow rate of water falling on the entire sump well, in m^3/h*;*

u_o — the rate of precipitation of the suspension delayed by the sump well, in mm/sec*;*

a — a coefficient that takes into account the weighing effect of the vertical component of the flow velocity

Width of one sump well

$$B = \frac{Q_{час}}{3,6v_{ср}HN} \quad (5)$$

where

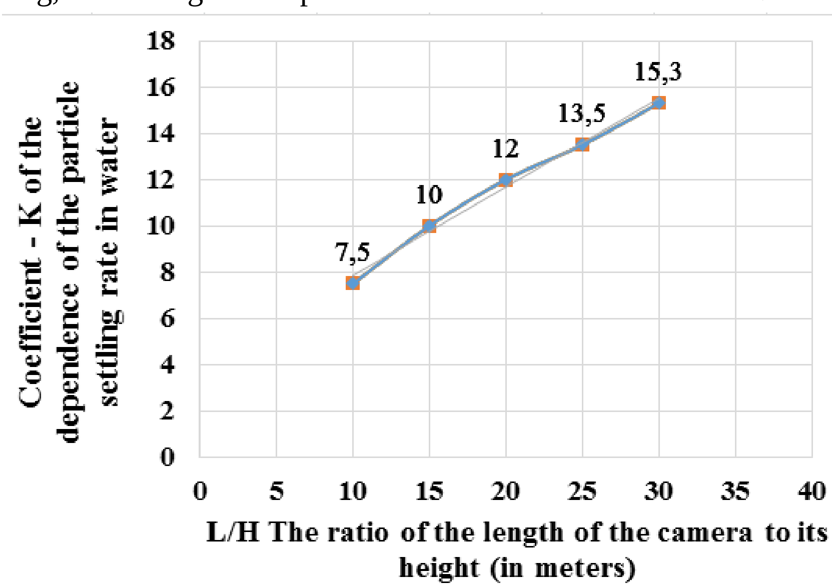
H — average depth of the deposition zone;

υ_{av} — average horizontal velocity of water movement in the sump well, in mm/sec

N — estimated number of advance cameras.

THE DISCUSSION OF THE RESULTS

If the number of advance chambers is less than six, one reserve should be provided for the possibility of their repair and cleaning, if the coagulation period lasts more than three months.



1 According to the research of stanzas by P. I. Piskunov, at speeds of water movement in the sump well of more than 6 mm / sec, large vortex formations occur at the turn.

With a considerable width of the anteroom, each of them should be divided by guide partitions into longitudinal corridors, the width of which depends on the pitch of the columns (but not more than 9 m).

Sump well length

$L=F_{tot}:BN,$ (6)

где F_{tot} — the total area of all the advance chambers in plan b $м^2$.

In this case, the condition L/H = 10-25 must be met

To ensure uniform distribution of water over the living section of the sump well, transverse perforated partitions are installed at the beginning and at the end of it at a distance of 1.5 m from the end walls. The lower part of the perforated partitions, located at a distance of 0.3 m above the sediment accumulation and compaction zone, has no holes.

The coupling of the water intake structure (head) with the slopes of the sump well should be performed with retaining walls located at an angle of no more than 70 ° to the axis of the sump well (the optimal angle is 45 °).

The bottom and slopes of the sump well should not have depressions that contribute to the formation of dead zones and counter currents. The most effective use of water intakes with a curved intake front is when the direction of water movement to each intake opening is perpendicular

CONCLUSION

The slopes of the anteroom and the end part of the channel (at a length of 3-5h, where h is the filling of the channel) should be fixed with a stone blind or reinforced concrete slabs. The bottom of the sump well adjacent to the water intake openings, as well as to the walls of the divider, must be fixed to a length of at least five diameters (height) of the inlet. With a special justification, a critical section of the bottom can be lined (the ridge is the place of transition from the reverse slope of the bottom to the straight one). The remaining sections of the bottom of the sump well should not be fixed, so as not to create difficulties in mechanized cleaning of the channel bottom from sediment.

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