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Model Análisis Ofthesoilpermeability And Filtraationusingthedifferential And Integral Calculus

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Summary

The need to choose an adequate clean technology for the treatment of wastewater, implies knowing very well both the available technological options and the quality of the water to be treated, the existing resources in the region and the socioeconomic conditions of the environment.

For the test and the analysis, compliance activities were carried out sequentially, thus guiding the development of the study itself, namely:

- Observationsweremade in situ, and documents related to the operation and design of the filters were compiled, and about the differential and integral calculation, texts of interest were studied and analyzed for this purpose, consulting bibliography and internet, opinion study was conducted and needs expressed in the environment by professionals in the field.
- All the aforementioned activities addressed the characterization of differential and integral methods to deduce equations in order to establish the parameters and / or design criteria for the filters, based on the behavior and operation of the soils and the materials that act as filter medium when these are subjected to hydraulic load differentials, or well known as hydraulic gradient.

I. INTRODUCTION

The importance of establishing a model and / or mathematician that allows the optimal design of hydraulic filters, suitable with appropriate technology depending on the environment, has encumbered an interest in immediately solving one of the problems such as water resource contamination, a pollution imposed by the activities of man on the planet and especially in the countries of the central region of America.

In this sense, the theoretical-practical study of the operation of filters with any material as a filter medium, leads to the deduction of appropriate equations and considerations for the design of these technological equipment, where it is allowed to study theparameters as supernatant load, filterbody, filterdiameter, filtrationflow, retention time and outflow and outlet pipes.

Therefore, the purpose of this work is to analyze the differential and integral calculation with the Taylor variant for the deduction of an integral equation that allows studying the behavior of the soil and other volcanic materials as a filter medium; as well as the deduction of equations that allow the proper design of the filters according to their application, and finally establish analysis methods for the design of filters according to their application.

II. METHODOLOGY

1.1. Designflowdetermination

[1]According to the technical guide for thedesignofsanitarysewage and wastewatertreatmentsystems, itestablishes the following flows for determination:

- Infiltration flowrate (Q_{inf}): This expense is justified by the presence of rainwater that may occur in the stages of visitor wells, as well as in illegal connection pipes. [1] According to the technical standards of INAA for the design of the network with PVC pipe, an expense of 2 l/hrs/100m of pipe isassigned.
- Averageexpenditure (Q_m): Forthecalculation of the average expenditure of domestic wastewater, 80% of the water consumption endowment is estimated.
- Minimumwastewaterexpenditure (Q_{min}): The following relationship applies to the verificationoftheminimumexpenditure in sewers:

$$Q_{min} = \frac{1}{5} Q_m \; equation\ 1$$

- Maximum wastewaterexpenditure (Q_{max}): Domesticwastewaterexpenditure is terminated using the [2] ratio factor proposedby Victor Tirado:

$$Q_{max} = K Q_m \; equation\ 2$$

Where:

$K = \frac{2.888}{Q_m^{0.120}} \; equation\ 3$

Q_{max} = maximumhousehold wastewater expenditure.

Q_m = averagehousehold wastewater expenditure.

The relationship factor must have a value not less than 1.80 or greater than 3.00

For the determination of the design flow, the sum of all the flows will then be the following arithmetic relationship:

$$Q_d = Q_{inf} + Q_{max} + Q_{int} + Q_{com} \; equation\ 4$$

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1.2. Conventional method filter design

[3] Accordingtosanitaryengineeringapplications, itestablishesthefollowingdesignmethodology:

- Forthecalculationofthesurfacearea: $A_s = \frac{Q_d}{T} (m^2) \; equation\ 5$

Length / width ratio L / a equalto2: $\frac{A_s}{2} = Lxa = (2a)xa = 2a^2 \; equation\ 6$

- Filteredwater outlet: side drains and main drain are considered:

For lateral drains: a separation between drains of L / 8 is adopted, where L is the length of the filter.

For main drain:

- Filterheight: waterheight, filter media, filter media support and free height are considered:

Water height: normally recommended between 0.90m to 1.50m, referring to the initial surface of the filter bed.

Filter medium: it will be a 1m thick layer of sand with soil characteristics suitable for filtering and retaining micron particles.

Support of the filter media: it will be built by 0.50m thick, gravel classified as follows: 20 cm with material from¾” to 2”; 15 cm with material from 3/8 ”to ¾”; and 15 cm with material from 2mm to 3mm.

Free height: it will be the free part of the system will usually be between 0.15cm to 30cm

As observed in the design methodology, there are parameters that are assumed without taking into account the analysis, so it becomes very complex to design and not predict operational effectiveness; on the other hand, the design does not take into account the solid flows produced by the flocs formed by the decomposition of organic matter inside the device.

1.3. Taylor series implementation

Design flow: it will be the total volume that is transported through a filter medium in a certain time, and thiswill be equalto:

$$Q_d = Q_l + Q_s \; equation\ 7$$

Where:

Q_d = designflow in l / s
Q_l = liquidflow in l / s
Q_s = solid flow in l / s

- Theliquidflowis determined using section 2.1.
- Thesolidflow: the flocs are transported by the fluid, rolling on the bottom, jumping or in suspension.

Thick flocs usually roll or slide over others. Those of medium size roll over others when the flow rate is low, but when the speed is high and therefore the turbulence of the runoff, they can also be transported in suspension. Fine flocs are transported in suspension.
To distinguish the form of transport of solid particles and which are taken into account for the design of the filter, it is convenient to divide the transport of flocs into six classes:

Class 1: drag on the bottom layer or bottom drag, is formed by the material that is dragged into a layer adjacent to the bottom, whose thickness is equal to twice the diameter of the floc particle. It is designated with subscript B, either Q_B, depending on the units in which it is expressed.

Class 2: transport of the bottom in suspension, the particles of the bottom are integrated that are transported in suspension, that is to say, above the bottom layer. It is designated with the subscript BS, either Q_{BS}.

Class 3: fundtransport or total fund transport, is the totality of the fund particle that is transported in suspension and within the fund layer. It is designated with the subscript BT, that is, Q_{BT}. Itisstatedthat:

$$Q_{BT} = Q_B + Q_{BS} \; equation\ 8$$

Class 4: washingtransport, is considered for all fine particles transported in suspension, which come from effluent waters and are not represented in the bottom material. It is designated with the subscript L, either as Q_L.

Class 5: suspensiontransport, are all particles that the fluid carries in suspension, whether they come from the bottom or from the wash. It is designated with the subscript S, Q_S. of its definition is fulfilled:

$$Q_S = Q_{BS} + Q_L \; equation\ 9$$

Class 6: total transport, is formed by the totality of particles that pass through a section (in suspension or in bottom layer) and that come from the bottom or wash of the effluent. It is designated with the subscript T, either as Q_T. Therefore, the relationship is fulfilled:

$$Q_T = Q_{BT} + Q_L \; equation\ 10$$

1.4. Meyer-Peter and Müller methodto determine the bottom drag flow

[4] The Meyer-Peter and Müller method is used for materials of any specific weight, such as samples of uniform material or with extended granulometry, and establishes the following equation:

$$Q_B = 8\gamma_s g^{0.5} \Delta^{0.5} D_m^{1.5} \left[\left(\frac{n'}{n} \right)^{1.5} \tau - 0.047 \right]^{1.5} \; equation\ 11$$

Where:

n = total roughness of the material, is obtained from the Manning equation
n'= roughnessduetoparticles, obtained with the equation of Meyer-Peter and Müller, in $s/m^{1/3}$

$$n' = \frac{(D_{90})^{1/6}}{26} \; equation\ 12$$

n equation D_{90} it must be in (m)

1.5. Brooks methodtoquantifysuspension transport

To apply this method it is essential to know the concentration at half the load, that is, for H = d /2. It can be achieved by measuring the concentration at that point or bycalculatingtheconcentration $C_H = C_{d/2}$withthehelpofthefollowingequation:
:

$$C_y = C_a \left[\frac{d-H}{H} x \frac{a}{d-a}\right]^Z \ equation\ 13$$

Where:
d = water height in (m)
a = vertical distance above the bottom at which the concentration C_a is known in (m)
y = vertical distance over the bottom at which you want to know the concentration C_y in (m)
Z = exponent that takes into account the turbulence of the flow and is worth:

$$Z = \frac{2.5\omega}{U_*} \ equation\ 14$$

In the last equation, ω is the rate of fall of the particles with diameter D. D can be the average diameter of the suspended material, although it is recommended to calculate for different fractions of the granulometric curve.

[5] According to Brooks, the cost of solid material in suspension is equal to:

$$Q_S = qC_{d/2}\left[f\left(Z, \frac{kU}{U_*}\right)\right] \ equation\ 15$$

Where:
Q_S = unittransport in suspension in kg-f/s-m
q = liquidunitexpenditure in m^3/s-m
Z = parameter defined by equation 14
$C_{d/2}$ = concentration at halfofthe load expressed in weightkgf/m^3

Thefuntion$\left[f\left(Z, \frac{kU}{U_*}\right)\right]$, it is in graph, in which k is the constant of Von Karman and is taken equal to 0.4

III. RESULT AND DISCUSSION

You want to design a slow filter with the following characteristics:

- Designflow: Q_d = 2 l/s = 172 m^3/day
- Filtrationrate: 4 to 7 m^3/m^2/day

Forthedesignflow, a filtrationrateequalto 5.5 m^3/m^2/dayisconsidered, intermediatevaluebetweentherecommendedwork extremes, a surfaceareawill be necessary

$$A_S = \frac{Q_d}{T} = \frac{172.8m^3/day}{5.5\frac{m^3}{m^2-day}} = 31.42m^2$$

For a long / wide ratio L / a equal to 2, you have the following parameters:

$$\frac{A_S}{2} = L * a = (2a) * a = 2a^2$$
$$\frac{31.42m^2}{2} = 15.71m^2 = 2a^2$$
$$a = 2.80m$$
$$\frac{L}{a} = 2 = 2a = 2 * 2.80 = 5.60m \approx 6m$$

a = 2.80m
L = 6m

The total area with these dimensions for a rectangular filter will be equal to:

$$A_S = 2.80m * 6m = 33.6m^2$$

For this area, with a minimum and maximum infiltration rateof 4 to 7 m^3/m^2/day, respectively, therewill be a working range for the following filter:

Top Rank:	Q = 33.6m^2*7m^3/m^2/día Q = 235 m^3/día = 2.72 l/s
Dow rank:	Q = 33.6m^2*4m^3/m^2/día Q = 134.4 m^3/día = 1.55 l/s

The recommended working range is chosenwill be between 1.55 l/s and 2.72 l/s

- **Slowfilterdesing**

For an averageliquidflowequalto 2,135 l/s = 184.46 m^3/day

For the solid flow the following data are required:
- Water temperature TºC = 25
- Specific weight of water at the indicated temperature, γ = 0.9974 gr/cm^3
- Specific weight of the floc particle, γ = 1,250 gr/cm^3
- Diameter of the calculation in mm, 0.005mm
- n 'roughness due to the particle of the calculation
- n roughness due to filtration material, in the case of sand 0.001
- Kinematic viscosity at indicated temperature, $\nu_{25ºC}$ = 0.896x10-6 m^2/s

Drag in the background layer or background drag:

$$n' = \frac{(D_{90})^{1/6}}{26} = \frac{(5x10^{-6})^{1/6}}{26} = 0.00503$$
$$\tau = 0.047(\gamma_S - \gamma)D_i = 0.047(1250 - 997.4) * 5x10^{-6} = 5.94x10^{-5}kgf/m^2$$
$$\Delta = \frac{\gamma_S - \gamma}{\gamma} = \frac{1.25 - 0.9974}{0.9974} = 0.25$$
$$Q_B = 8(1250)(9.81^{0.5})(0.25^{0.5})(5x10^{-6})^{1.5}\left[\left(\frac{0.00503}{0.00001}\right)^{1.5}(5.94x10^{-5}) - (0.047)\right]^{1.5}$$
$$Q_B = 8.611x10^{-5}m^3/s$$
$$Q_B = 7.43m^3/dìa$$

Suspension Transportation

$$Q_S = qC_{d/2}\left[f\left(Z, \frac{kU}{U_*}\right)\right] = \left(\frac{2x10^{-3}}{2000}\right)\left(\frac{1250}{2}\right)\left[f\left(Z, \frac{kU}{U_*}\right)\right]$$

Froude number calculation:

$$F_1 = \sqrt{\frac{2}{3} + \frac{36\vartheta^2}{g\Delta D^3}} - \sqrt{\frac{36\vartheta^2}{g\Delta D^3}}$$
$$F_1 = \sqrt{\frac{2}{3} + \frac{36(0.896x10^{-6})^2}{9.81(0.25)(5x10^{-6})^3}} - \sqrt{\frac{36(0.896x10^{-6})^2}{9.81(0.25)(5x10^{-6})^3}}$$
$$F_1 = 1.1x10^{-3}$$

Calculation of the rate of fall of the particle:

$$\omega = F_1[g\Delta D]^{0.5} = 1.1x10^{-3}[(9.81)(0.25)(5x10^{-4}]^{0.5} = 3.852x10^{-4}cm/s$$

Calculation of the cutting speed:

$$U_* = \sqrt{gR_H S} = \sqrt{(9.81)(\frac{5x10^{-4}}{4})(1)} = 0.35cm/s$$

Z factor calculation:

$$Z = \frac{2.5\omega}{U_*} = \frac{(2.5)(3.852x10^{-4})}{0.35} = 0.003$$

Calculation of the average speed according to Manning:

$$U = \frac{1}{n} R_H^{0.60} S^{0.5} = \frac{1}{0.001}\left(\frac{5x10^{-4}}{4}\right)^{0.60} (1)^{0.5} = 11.6cm/s$$

RelationshipCalculation$\frac{U}{2.5(U_*)}$:

$$\frac{U}{2.5(U_*)} = \frac{11.6}{2.5(0.35)} = 13.26$$

[6] This value is searched in the transport chart in suspension according to Brooks, as it is not expressed in the curve with the value 13.26, it approaches the closest, in this case itwill be curve 10.

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FunctionCalculation: $\left[f\left(Z, \frac{kU}{U_*}\right)\right]$

For Z = 0.003 itapproximates0.2, and $\frac{U}{2.5(U_*)} = 13.26$, curve 10 is intercepted and projected to the left finding the value of$\left[f\left(Z, \frac{kU}{U_*}\right)\right]$, for the case it gave an approximate value equal to 1, dimensionless.

Therefore, the suspended flow will be equal to:

$$Q_S = \left(\frac{2x10^{-3}}{2000}\right)\left(\frac{1250}{2}\right)(1) = 6.25x10^{-4} m^3/s = 54 m^3/dìa$$

Then the solid flow will be equal to:

$$Q_{SO} = Q_B + Q_S = 7.43 + 54 = 61.43 m^3/dìa$$

The design flow will be equal to:

$$Q_d = Q_{SO} + Q_L = 184.46 + 61.43 = 245.89 m^3/dìa$$

- **Filterdimensionswiththe Taylor series**

[7] Fromtheequationofcontinuity Q=VcAthefollowingrelationisobtainedforpermeable places:$Q = \frac{36}{1+0.0337T+0.00022T^2}\frac{1}{\emptyset}A$clearing A, you have the following equality, and studying a circular section, you work with the area of a circle:
$\frac{Q}{A} = \frac{36}{1+0.0337T+0.00022T^2}\frac{1}{\emptyset}$, the respective substitutions are made and the relations are simplified, the following is had:

$$\frac{4Q}{\pi\emptyset^2} = \frac{36}{1+0.0337T+0.00022T^2}\frac{1}{\emptyset}$$

$$\frac{4Q}{36\pi\emptyset} = \frac{1}{1+0.0337T+0.00022T^2}$$

Implementingthe integral bysubstitution, wehavethefollowingrelationship:

$$\frac{4dQ}{36\pi\emptyset dT} = \frac{1}{1+0.0337T+0.00022T^2}$$

$$\int \frac{4dQ}{36\pi\emptyset} = \int \frac{dT}{1+0.0337T+0.00022T^2}$$

a = 0.00022
b = 0.0337
T = x

dT= dx

$$\int \frac{4dQ}{36\pi\emptyset} = \int \frac{dx}{ax^2 + bx + c}$$

$$\frac{4Q}{36\pi\emptyset} = -29.86\ln(xa + b) + \frac{1.01}{a}\ln(x + 1)$$

$$\frac{4Q}{36\pi\emptyset} = -29.86\ln(0.00022T + 0.0337) + \frac{1.01}{0.00022}\ln(T + 1)$$

$$B = -29.86\ln(0.00022T + 0.0337) + \frac{1.01}{0.00022}\ln(T + 1)$$

$$\frac{4Q}{36\pi\emptyset} = B\ equation\ 16$$

As factor B is a function of temperature, a table of factor B is designed at different temperatures that will be given in m2 / day, for this case this procedure is suppressed, since what you want to achieve is the sizing of the filter.

Clearing the diameter of the previous expression, you have:

$$\emptyset = \frac{4Q}{36\pi B}\ equation\ 17$$

Where:
Ø = is the filter design diameter in (m)
Q = is the design flow to be treated in (m^3/day)
B = factor depending on the temperature, which for this case is 1.51 m^2/day

$$\emptyset = \frac{4(245.89)}{36\pi(1.51)} = 5.47m$$

- Calculation of critical speed:

$$Q = V_c A$$

$$V_c = \frac{Q}{A} = \frac{4Q}{\pi\emptyset^2} = \frac{4(2.4589x10^{-3})}{\pi(5.47^2)} = 1.1497x10^{-4}\ m/s = 0.011497cm/s$$

- Calculation of the discharge or filtration speed:

$$V_1 = \frac{1 + e}{e}V_c\ equation\ 18$$

$$Q = \frac{1 + e}{e}V_c A\ equation\ 19$$

The critical velocity and area that are known values are cleared and left according to the vacuum ratio (e):

$$\frac{4Q}{\pi\emptyset^2 V_c} = \frac{1 + e}{e}$$

$$to\ do\ C = \frac{4}{\pi\emptyset^2 V_c}$$

The expression is reduced, and then derived:

$$CQ = \frac{1 + e}{e}$$

$$C\frac{dQ}{de} = \frac{1 + e}{e} = \frac{(1 + e)'e - (1 + e)e'}{e^2}$$

$$C\frac{dQ}{de} = \frac{1 + e}{e} = \frac{(1)e - (1 + e)1}{e^2} = \frac{e - 1 - e}{e^2} = -\frac{1}{e^2}$$

$$C\frac{d^2Q}{de} = -\frac{1}{e^2}$$

$$C\frac{d^2Q}{de} = \frac{-(1)'e - (-1)(e^2)}{e^4} = \frac{2e}{e^4} = \frac{2}{e^3}$$

$$CQ = \frac{2}{e^3}$$

The vacuum ratio is cleared, and it is left based on the flow rate and the constant C:

$$e = \left(\frac{2}{CQ}\right)^{0.3}$$

Incorporating values to the variables, it is determined:

$$e = \left(\frac{2}{0.99}\right)^{0.3} = 1.26$$

Therefore, it is concluded that the material must have a vacuum ratio equal to 1.26, [8] According to Barbery, Sánchez, R. (1988), this ratio can theoretically vary from 0 (VV = 0) to ∞ (value corresponding to an empty space), in practice, values less than 0.25 (very compact and fine sand) are usually not found, and the highest value can reach up to 3 (macroporous soils).

$$V_1 = \frac{1+e}{e}V_c = \frac{1+1.26}{1.26}(1.1497x10^{-4}) = 2.0622x10^{-4}\,m/s\ = 0.02062cm/s$$

- Calculation of real speed with known L:

Consideringtheheightof the filter medium L, the actual length of the flow in the filtration layer is determined from the following expression:

$$V_2 = V_1\frac{1+e}{e}V_c\frac{L_m}{L}\ equation\ 20$$

From the expression of continuity:

$$Q = V_1 A \therefore A = \frac{Q}{V_1}$$
$$A = \frac{2.4589x10^{-3}}{2.0622x10^{-4}} = 13.10m^2$$

For the actual speed:

$$Q = V_2 A$$
$$\frac{Q}{A} = V_1\frac{1+e}{e}V_c\frac{L_m}{L}$$

Where:
V_1 = discharge or filtrationspeed in (m/s)
V_c = criticalspeed in (m/s)
L_m = length of winding and irregular flow path in (m)
L = total length or height of the filter in (m)

Constants$F = \frac{Q}{A}\ y\ G = V_1\frac{1+e}{e}V_c$, the values of Q, A, V_1, V_C and e are known, then the expression is reduced to:

$$F = G\frac{L_m}{L}\ equation\ 21$$

Where:
F = $2.0622x10^{-4}$ m/s
G = $4.2526x10^{-8}$ m/s
Then you get the following relationship:

$$\frac{L_m}{L} = \frac{F}{G} = \frac{2.0622x10^{-4}}{4.2526x10^{-8}} = 4849.27s/m$$

$$V_2 = (2.0622x10^{-4})\left(\frac{1+1.26}{1.26}\right)(1.1497x10^{-4})4849.27$$
$$V_2 = 2.0622x10^{-4}m/s\ = 0.020622cm/s$$

Torelationof$\frac{L_m}{\emptyset} = \frac{v\emptyset}{\vartheta}$, then L_m = 1258.95x5.47 = 6886.48m, and togoofrelationchipsindicated above, develops and determines H.

$$V_2 = V_1\frac{1+e}{e}V_c\frac{L_m}{L} \therefore \frac{V_2}{V_1V_c} = \frac{1+e}{e}\frac{L_m}{L}$$
$$\frac{2.0622x10^{-4}}{(2.0622x10^{-4})(1.1497x10^{-4})} = \left(\frac{1+1.26}{1.26}\right)\left(\frac{6886.48}{L}\right)$$
$$\frac{1}{1.1497x10^{-4}} = \frac{12351.94}{L}$$
$$L = 1.42m$$

It is observed thatthe ratio $L_m/Ø$, is a very high value, this is due to the fact that the ratio of velocities at the left end of the equalization is a value that, when determined, is increased, and to reduce it, it is necessary to havetherelationship $L_m/Ø$ withhighvalue, this means that the flow is transported through the filter medium by means of length Lm equal to 6886.48m in an undulating and sinuous and imaginary way.

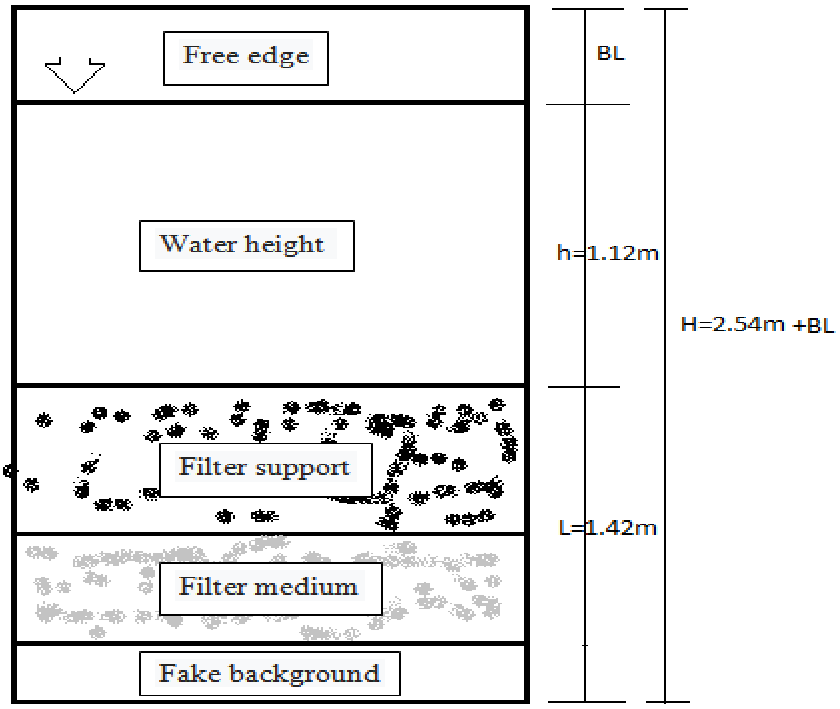
- Determinationofthewater load on the filter body:

By continuity between the critical speed in the transition of the flow through the medium and the speed in the filtration medium, the following relationship is had:

$$V_1A_1 = V_CA_C$$
$$V_1\frac{\forall}{H} = V_C\frac{\forall}{L}$$
$$H = \frac{V_1}{V_C}L = \frac{2.0622x10^{-4}}{1.1497x10^{-4}}x1.42 = 2.54m$$

So the water load on the filter medium will be equal to h = H-L = 2.54-1.42 = 1.12m

The figure with the corresponding dimensionsisshownbelow:



Ilustration 1: Dimensions of a slow down flow filter
Source: self made. (2009)

Filter medium: it will be a 0.5m thick layer of sand with the following characteristics:
Effective particle size: 0.25mm to 0.35mm
Uniformity coefficient: 2 to 3

Support of the filter media: it will be built by 0.50m of gravel thickness classified as follows:
20 cm with material from ¾ ”to 2”
15 cm with material from 3/8 ”to ¾”
15 cm with material from 2mm to 3mm

IV. DISCUSSION

The impact of the case is discussed at the scientific level that involves the effectiveness of the operation of the treatment equipment, which in turn are developed from the equations found, through a procedure for the design of the filters, either east of down flow or up flow.

For example: the implementation of the integral and derivative through the Taylor variant, in the deductions of equations for the design of the upstream or downstream filters, will be appropriate. For this topic, only the integral and derivative were implemented, the Taylor variant being widely developed, implementing a calculation methodology through an example of design, resulting in equations for the determination of diameter, critical speed, filtration speed and speed real, as well as the height of the infiltration zone, the height of water (supernatant height) and the total height of the filter, referring to the height of the filtration zone, at no time does a methodology for determining the diameter of the material, the height calculation that the material layer must have is not performed.

The methodology does not develop another one that helps to design the filter in dimensions, others can be implemented in which an analysis and deep study can be established to incorporate it as a design solution.

What is innovative in this content, is the incorporation of the solid flow for the determination of the design flow, they are made with the objective of evaluating the optimal dimensions that a filter can take, when it is circular or rectangular and / or square.

On the other hand, it is important to mention that the analysis was done theoretically and deductively, a prototype was not used in which parameters can be conjugated to establish a filterdesign.

And finally, regardlessoftheresults, eachofthe variables thatpredominate in thedesignwasanalyzed, which are alldeductionsfromthecontinuityequation in conjunctionwiththe integral and derivedwiththe Taylor variantforthedefinitivedemonstration.

V. CONCLUSION

Istheimplementationof mathematical methods and models, as well as numerical methods for obtaining equations for the design of filters, a new application methodology that guarantees a good outline of the units?

Regarding the question, it is important to state that, to guarantee a good outline of the filtration units, the importance of incorporating the solid flow into the design flow is demonstrated; since in conventional designs itisnotconsidered, developing a case study implementing a methodology where the design of the filtration unit was compared in a conventional way with the modified design.

In the modified design, three definitions are combined for the deduction of the equations; one of them the principle of continuity, followed by the application of the definite integral and the derivative, resulting in demonstrated and deductive equations, valid for implementation in any place or region.

The deductive criteria are: the diameter that the filter section must have; critical speed, filtration speed and actual speed; the total height of the filter without including the free edge, the height of water on the filter media and what the area of the filtration medium should have; The criteria such as permeability and hydraulic gradient were not incorporated, since they are hydraulic parameters that are calculated from speed, Reynolds, flow and heights.

And finally,itispointed out in the topic the importance of creating a calculation methodology for the design of the upstream and downstream filtration units.

2. Gratitude

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