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MICROSCREENING IN SEWAGE TREATMENT

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Abstract

Microscreening represents an alternative advanced (tertiary) sewage treatment process concerning rapid sandfiltration. Microscreening can be considered as a mechanical process, for it is a filtration through a thin screening cloth. The retained suspended matter creates a contacting film cover that should be removed by flushing. The efficiency of microscreening is influenced by the concentration and material characteristics of suspended solids, the mesh size of the screen and the hydraulic load. The automatic microstrainer can be operated continuously. The process of removal of suspended solids in the microstrainer can be interpreted with the filtrability index (I) by experimental way.

Keywords: advanced wastewater treatment, microstraining, filtrability index.

Introduction

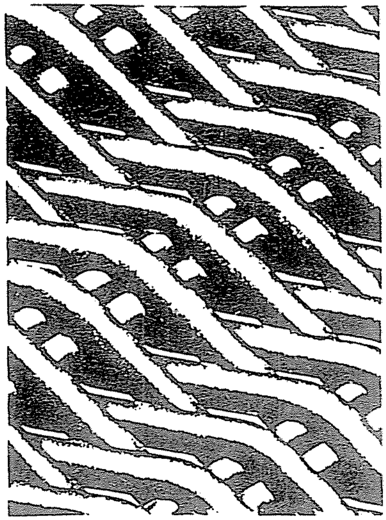
The 50 to 80 per cent of the suspended, flocculent solids in the effluents of the biological treatment plant contains, depending on the oxidation rate of the biological treatment, residual BOD (Biological Oxygen Demand) matters and other floating solids. The protection of the quality of the receiving water recuried further, high-efficient removal of these matters. Through this procedure the BOD of the outlet can be reduced.

Microscreening represents an alternative advanced treatment process concerning rapid sand filtration. The efficiency of the microscreeing is significantly influenced by the oxidation rate of the effluent.

1. Description of the Treatment

Fine screening and its importance in drinking water treatment is discussed in details by Öllős (Water Supply, Chapter 2, 1987).

Also in wastewater treatment, microstraining can be considered as a mechanical process. Microstraining is a filtration through a thin screening



Pic. 1. Screening cloth

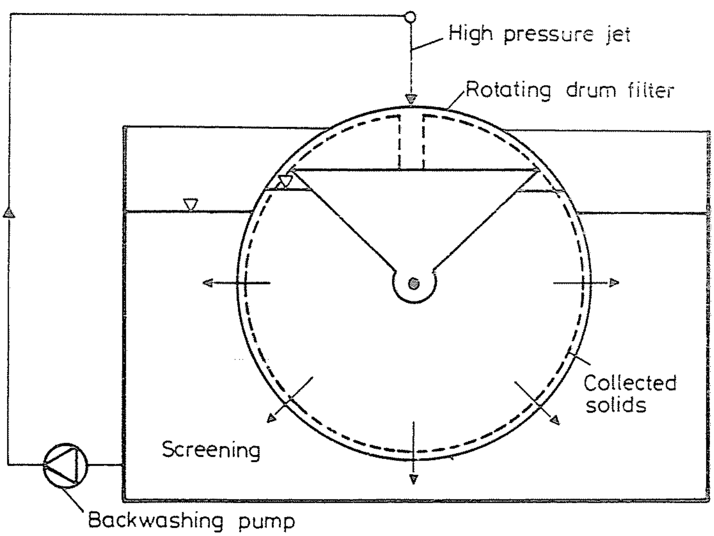


Fig. 1. Operation scheme of microstrainer

cloth *(Picture 1)*. The size of the mesh orifices is less than 40 μ. The cylindrical screen is attached to a horizontally mounted drum *(Fig. 1)*.

The biologically treated wastewater clogs the rotating screening cloth within a short time, therefore the continuous wash (flush) of the screen is required.

The wastewater enters the open end of the drum axially and flows outward through the screening cloth radially. The raw water level inside the drum is fixed by the outlet weir. Approximately 2/3 of the screen surface is immersed in the wastewater.

The screen is made of stainless steal or plastics.

The retained suspended matter creates a contacting film cover on the inside of the immersed drum surface. This film cover promotes the filtration of the suspended solids that are finer than the mesh size.

The material retained on the screen surface is removed by flushing. Filtered water can be used as wash-water. The wash-water jets are situated above the drum. Washed materials are transported through an inside drum pipe system to the secondary settling tank, in general. If the concentration of the washed materials is relatively high, the used wash-water should be transported to the activated sludge tank.

The filtration surface must be submitted to bactericidal treatment in order to protect it against the biological film cover forming easily. This process has got a special importance in wastewater treatment. The oxidation effect can be achieved by UV-radiation *(Picture 2)*.

2. Parameters of Operation

The automatic microstrainers can be operated continuously without any problem.

The most important parameter of the operation and control is the head loss which consists of the joint resistance of the screen and the film cover.

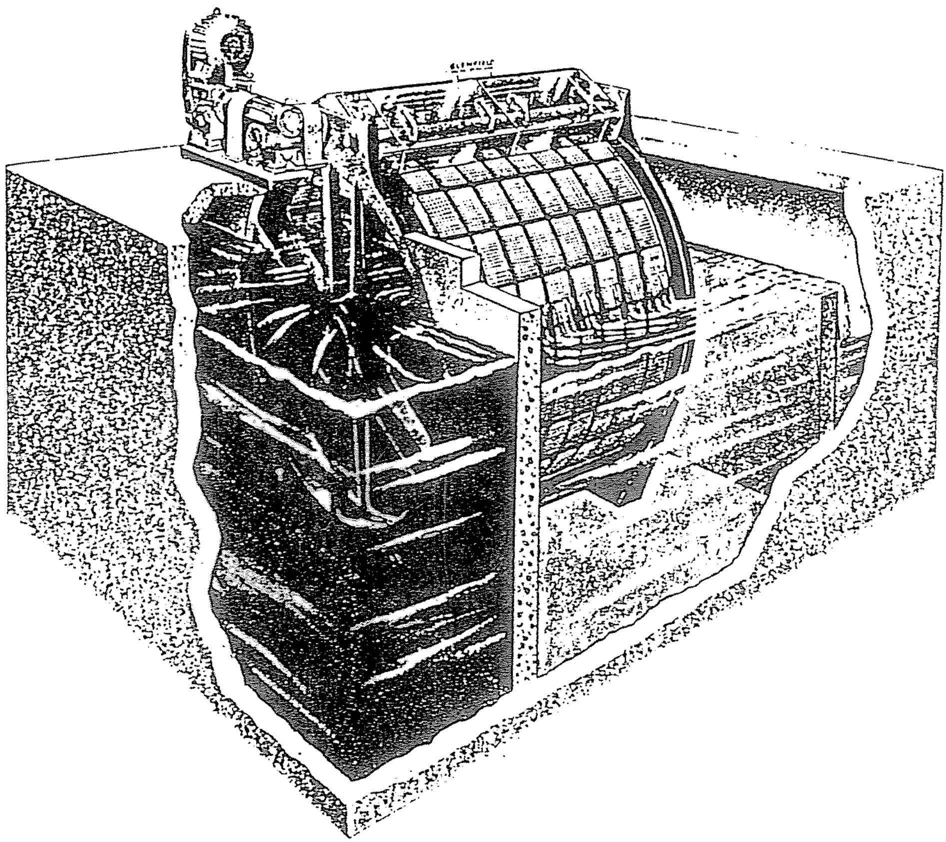
Straining is most efficient in the range of 5 to 15 cm water-gauge head-loss (ROTH, 1976).

The parameters of planning are given in *Table 1.* (METCALF and EDDY Inc., 1985).

The order of the total head loss is usually so low that no pumping is required between the microstrainer and the secondary settling tank.

3. The Efficiency of the Treatment

Figure 2 shows the rate of the BOD removal and the suspended material concentration concerning the time (DIAPER, 1969, 1971). The mesh size is 35 μ, the type of the biological treatment is trickling filter.



Pic. 2. UV-radiation equipment above the rotating drum

In this case, the demand of the advanced (tertiary) treatment is lower, so the mesh size is relatively big. Accordingly, the average efficiency of the removal of suspended materials is 60 %, the BOD decrease is 50 %.

The efficiency of the treatment is considerably higher when using smaller mesh size (23 μ), as it is shown in *Fig 3*. Besides, the concentration and the material characteristics of the suspended solids, the hydraulic load has got main significance. The specific wastewater flow concerns the immersed area $[m^2]$ of the screen. In *Fig 3* the hydraulic loading is given as a function of the concentration of suspended solids in the wastewater and two different mesh orifices.

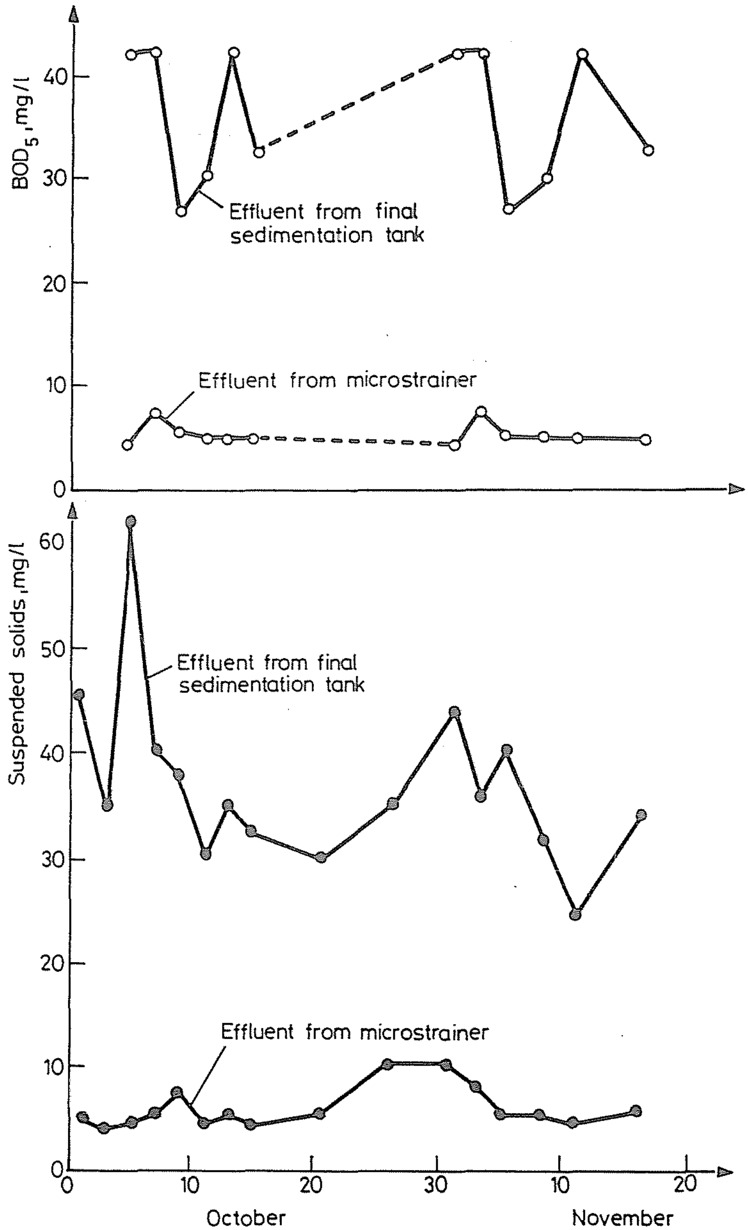


Fig. 2. Rate of the removal of BOD_5 and suspended solids by microscreening. Mesh size: 35 μ (Example)

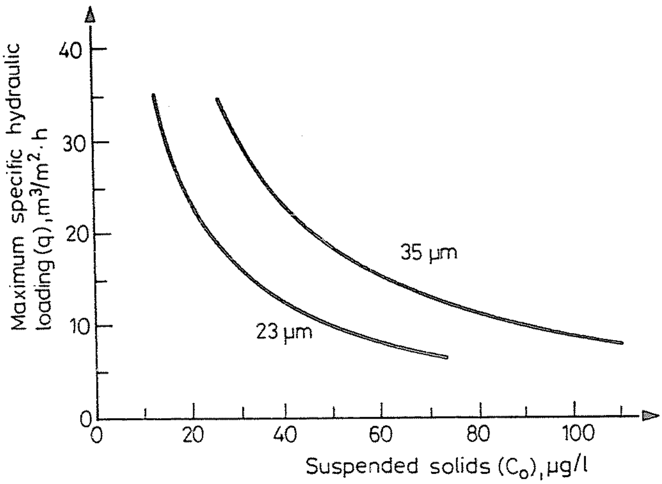


Fig. 3. Maximum specific hydraulic load as a function of the concentration of suspended solids in the wastewater and size of mesh orifices

4. Filtrability Index, Planning of Microscreening

The process of removal of suspended solids in the microstrainer can be interpreted with the filtrability index (I) in experimental way (MIXON, 1970).

The Boucher index, I [1/m] is calculated from the following equation:

$$\frac{\Delta P}{\Delta P_0} = \exp IV, \tag{1}$$

where

V specific wastewater flow on the screen [m^3/min],
ΔP head loss on the operating screen [m],
ΔP_0 head loss on the clean screen [m].

ΔP_0 is calculated from the following equation:

$$\Delta P_0 = C_f \cdot q, \tag{2}$$

where

C_f screen-factor,
q specific wastewater flow.

V is calculated from the following equation:

$$V = q \cdot t, \tag{3}$$

where

t period of filtration.

t is calculated from the following equation:

$$t = \frac{A}{S}, \tag{4}$$

where

A immersed part of the screen surface,
S velocity of rotation.

The specific wastewater flow is calculated from the following equation:

$$q = \frac{Q}{A}, \tag{5}$$

where

Q quantity of wastewater flowing through the screen surface in unit time.

Substituting *Eqs.* (2) and (5) for *Eq.* (1):

$$\Delta P = C_f \cdot \frac{Q}{A} \cdot \exp \frac{I \cdot Q}{S}. \tag{6}$$

'I' can be determined by the joint resistance of the screen and the film cover as a function of the wastewater flow:

$$\frac{\Delta P}{q} = \frac{\Delta P_0}{q_0} \exp IV. \tag{7}$$

If $q = q_o$, *Eq.* (7) can be transformed into *Eq.* (1).

Considering the rotating area of the screen, the *Eq.* (6) is the following:

$$\Delta P = C_f \cdot \frac{\Delta Q}{\Delta A} \cdot \exp \frac{I \cdot Q}{S}. \tag{8}$$

After integration:

$$\frac{\Delta P \cdot A}{C_f \cdot Q} = \frac{\exp \frac{I \cdot Q}{S} - 1}{\frac{I \cdot Q}{S}}. \tag{9}$$

Considering that

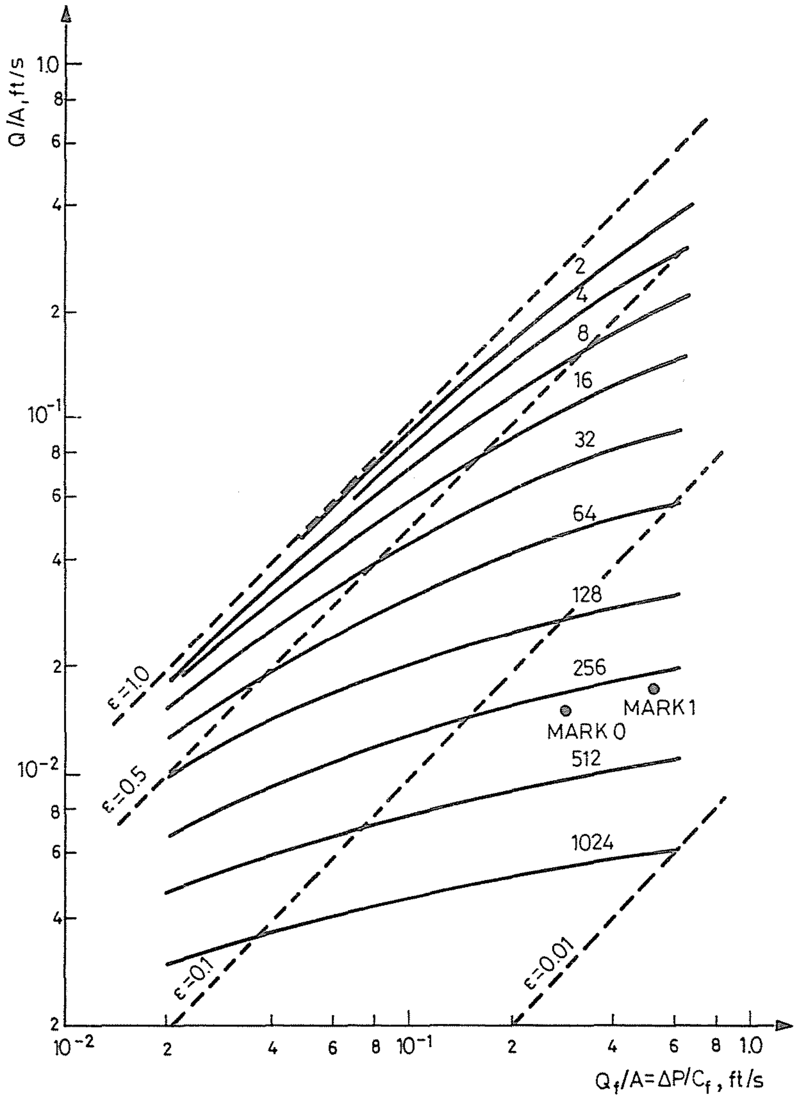


Fig. 4. Planning of the microstrainer with *Eq.* (13).

$$\frac{Q}{A} = \nu \tag{10}$$

and

$$\frac{\Delta P}{C_f} = \nu_f, \tag{11}$$

Eq. (9) is:

$$\frac{C_f \cdot Q}{A \cdot \Delta P} = \frac{\frac{1}{P \cdot A}}{C_f \cdot Q} = \frac{\nu}{\nu_f} = \varepsilon. \tag{12}$$

From *Eq.* (12):

$$\frac{I \cdot Q}{S} = I \cdot \frac{Q \cdot A}{A \cdot S} = I \cdot \frac{Q}{A} \cdot \frac{\Phi}{R} = \frac{\nu}{\nu_o}, \tag{13}$$

where

$$\nu_o = \frac{R}{I \cdot \Phi}, \tag{14}$$

where

R velocity of rotation,
Φ immersed part of the screen surface,
v the average velocity of filtration, concerning the immersed area of the drum,
v_f velocity of filtration, concerning the clean screen.

Microstraining can be planned with *Eq.* (13) and *Fig. 4.* (MIXON, 1970). It must be considered that the parameters of planning significantly depend on the material characteristics of the suspended solids.

Summary

Microstraining can be applied efficiently in advanced (tertiary) treatment of wastewater, specially in reduction of suspended BOD materials.

The operation of the microstrainer depends on several factors (e.g. size of mesh orifices, material characteristics of suspended materials, hydraulic load, etc.), therefore the control of optimal operation is essential.

Chart 1
Characteristicparameters of microstsaining
of biological clarified wastewater

Parameters	Characteristic values	Notation
Size of mesh orifices	20–35 μ	Stainless steal or plastics available in the range of 15–60 μ
Hydraulic load	(3–6) 10^{-3} m^3/m^2min	Concerning the immersed area of drum
Head loss by passing the strainer	75–150 mm	If it is higher than 200 mm, a bypass-channel is required
Immersed part of the strain drum	70–75 % of the diameter, 60–70 % of screen surface	Depends on the planning of the drum
Diameter of the strain drum	2.5–5.0 m	3 m is used in general; in lower diameter ranges the specific wash water demand increases out of proportion
Velocity of rotation	4.5 m/min, supposing 75 mm head loss; 35–45 m/min, supposing 150 mm head loss	The maximum practical velocity: 45 m/min
Requirements of flushing	Required pressure of wash water if its quantity is 2 % of raw water: 350 kPa 5 % of raw water: 100 kPa	

References

BÖHNKE, B. – MEYER, H. (1980): Literaturstudie zur weitergehenden Abwasserreinigung-Einleitung (Review of Tertiary Treatment of Wastewater – Introduction) GWA. H. 43. Aachen, 1980. (in German).

DIAPER, E. W. J. (1969): Tertiary Treatment by Microstraining. Water and Sewage Works. June, 1969.

DIAPER, E. W. J. – GLOVER, G. E. (1971): Microstraining of Combined Sewer Overflows. *Journal WPCF.* October, 1971.

GLENFIELD, and KENNEDY Ltd (1961): Microstraining, Prospect. Glenfield and Kennedy Limited, 41/6/5000/3/61.

METCALF and EDDY, Inc. (1985): Wastewater Engineering: Treatment, Disposal, Reuse. TATA McGraw - Hill Publ. Company Ltd. New Delhi, 1985.

MEYER, H. (1980): Mikrosiebung (Microstraining). In GWA, A.43. Aachen, 1980. (in German).

MIXON, F. O. (1970): Filtrability Index and Microscreener Design. *Journal WPCF.* November, 1970.

ÖLLŐS, G. (1987): Vízellátás (Water Supply). AQUA Kiadó, Budapest, 1987. (in Hungarian)

ROTH, M. (1976): Erfahrungen mit der Mikrosiebung von Abwasser (Experiences on Microscreening in Wastewatre Treatment). Korrespondenz Abwasser. 12/1976. (in German).

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