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REACHING THE UNREACHED: CHALLENGES FOR THE 21ST CENTURY

High rate sedimentation in waste treatment

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DEPOLLUTION OF URBAN and industrial waste water with organic charges, particularly in developing countries is commonly treated by aerobic biological systems, which need large area of land. Deep anaerobic reactors are most often used on primary treatment for total solid matters removal. Anaerobic reactors working with charge by surface unit of 24m^3/m^2/day can allow elimination rates reaching 100 per cent sedimentable solids matters, 60 per cent suspended solid matters, 35 per cent BOD and 30 per cent COD. With urban population growth it is important to develop new anaerobic alternatives able to increase primary treatment's efficiency and decrease organic charge of aerobic biological systems. High Rate Sedimentation or laminated sedimentation coupled to conventional primary treatment would give good quality effluent without clogging danger for conventional secondary treatment reactors. Up to now, High Rate Sedimentation has been only utilized in drinking water treatment with the goal to increase capacity and efficiency of conventional tank, with charge by surface unit from 20 to 60m^3/m^2/day.

ARBOLEDA (1983) using High Rate Sedimentation for drinking water treatment with Reynolds' Number not greater than 500 and retention time less or equal to 15 minutes reached 90 per cent turbidity removal. Despite High Rate Sedimentation efficiency, many authors do not recommend its utilization in waste water treatment because of clean-up difficulties.

Materials and methods

The system studied here combined together an Upflow Anaerobic Sludge Blanket (UASB) with laminated sedimentation in its sedimentation area. In this specific case the Upflow Anaerobic Sludge Blanket, placed in very steep slope area, is the product of the transformation of an IMHOFF tank. High Rate Sedimentation consists of series of lamellas between which flows water under laminated regimen. Sedimentation speed and speed flow are determined by geometrical relation formulas between triangles BFC and IHG (see Diagram 1). Here High Rate Sedimentation is formed of 10 asbestos-cement sheets of 0.61m x 1.22m, 8mm of thickness, spaced of 6 cm, 60°C angle with horizontal and charge by surface unit of 185m3/m2/day. Diagram 2 shows sheets' disposal of the laminated sedimentation.

Waste water from unitary sewage system was considered to compare:

- Efficiency of Upflow Anaerobic Sludge Blanket (UASB) with High Rate Sedimentation (HRS) in its sedimentation area and without HRS.
- Efficiency of High Rate Sedimentation under high hydraulic and organic charges.

Because UASB's biomasslayer reached 85 per cent BOD removal and 80 per cent COD removal, efficiency considered as higher score of anaerobic reactors, and because of

Diagram 1. Geometrical relations in laminated sedimentation

Diagram 2. Sheets disposal of high rate sedimentation studied

Diagram 3. Level of mud in reactor sedimentation area

Table 1. Effuent quality versus waste waste composition

the absence of pre-coagulation, clean up was not considered as the main weakness of this process. 32 days have been taken to evaluate the system. Two measures linked to critical conditions of UASB's efficiency have been considered during the evaluation:

- Keeping of 25 cm of sediment in sedimentation area of the reactor (see Diagram 3).
- Extraction of mud by hydrostatic charge and application of UASB's maximum hydraulic charge.

These measures affect UASB's efficiency and allow high turbidity and increase suspended solid matters in UASB's effluent, which is the input of High Rate Sedimentation.

Environmental waste water composition

Inflow from 1.22 L/S to 2.82 L/S pH from 6.4 to 7.1 Temperature from 21.1 to 23°C.

Parameters have been determined by calorimetry (HACH Spectrophotometer).

Measure of grease volatile acids, despite its importance in anaerobic processes, were not determined, because of the plainly physical characteristics of laminated sedimentation.

Diagram 4. BOD removal efficiency

Diagram 5. COD removal efficiency

Table 2. UASB efficiency with high rate sedimentation versus UASB without HRs

Results and discussion

Table 1 shows efficiency of the system by comparing medium composition of waste water utilized and effluent quality.

- Effluent quality of this system is better than UASB without High Rate Sedimentation (see Table 2). Elimination rates reached 91 per cent BOD (see Diagram 4) and 86 per cent COD (see Diagram 5). The "Upflow Anaerobic Sludge Blanket - High rate sedimentation" system, also permits elimination rates reaching 85 per cent turbidity, 92,68 per cent suspended solid matters and 100 per cent sedimentable solids.
- Under high hydraulic charge the system meets the requirements of High Rate Sedimentation process, i.e. Reynolds number < 500 and hydraulic retention time less or equal to 15 minutes. Table 3 shows basic factors of High Rate Sedimentation under high and low hydraulic charge.
- Experiments made on Upflow Anaerobic Sludge Blanket without High Rate Sedimentation in its sedimentation area showed that reactor does not permit dissolved solid matters removal. The same observation was made with High Rate Sedimentation in sedimentation area of UASB. In this study electrical conductivity and chlorines have been monitored to confirm observation. Our hypothesis made from this observation is that deficiency of Upflow Anaerobic Sludge Blanket or all anaerobic reactors in dissolved solid matters is linked to the presence of organic and mineral salts produced by ion exchange electrochemical processes in the final step of anaerobic stabilization.

Table 3. Basic factors of laminated sedimentation

4. Considering that thickly filter transforms suspended solid matters and dissolved solid matters in sedimentable matters and considering efficiency of the system studied here in turbidity removal, it is possible to conclude that under conditions of high organic charge and low hydraulic charge there does not exist the possibility for thickly filter clogging.

High Rate Sedimentation in waste water treatment is recent and does not require high costs of building and maintenance. However, as it may be interesting for some urban and industrial effluents' treatment, developing countries have interest in promoting research on it to confirm these first results.

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