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DOMESTIC WASTEWATER TREATMENT IN TANKS WITH EMERGENT HYDROPHYTES: LATEST RESULTS OF A RECENT PLANT IN FRANCE

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KEYWORDS

Wastewater treatment; domestic wastewater; rooted macrophytes; emergent hydrophytes.

INTRODUCTION

Since 1979, CEMAGREF has been studying the potential purifying action of aquatic vegetation in two small wastewater treatment units (Boutin, 1986) built under the direct supervision of Dr. K. SEIDEL to ensure that they are identical to "MPIP Process or Krefeld system" plants.

In 1985, based on these results, CEMAGREF designed a similar pilot plant for the Village of Pont Remy (Somme), 500 inhab. eq. capacity.

OBJECTIVES OF THE PILOT PLANT

The Saint Bohaire EHTS* plants (Boutin, 1986) are of a small size (approximately 30 inhab. eq.) and, irrespective of the high quality of their construction, they are nonetheless man-made, which makes it difficult to estimate their real construction cost. Interesting treatment results have already been obtained. Nevertheless, these promising results still remain to be confirmed by advanced investigations on a larger plant receiving polluting loads of domestic origin such as a permanently resident population would produce.

PLANT DESCRIPTION

The operating principle is identical to the one used at Saint Bohaire. The useful surface area of the plant (1250 m^2) was calculated on the basis of the Saint Bohaire results, according to which a specific surface area of 2.5 m^2/inh. eq. should be sufficient. The treatment is carried out in 5 stages :

1st and 2nd stages (percolation flow).
The first stage consists of 8 parallel tanks with a surface area of 80 m^2 each (length 16m, breadth 5m). Only four of them are presently operated so as to rapidly collect information at a significant load rate, based on users' sewerage connections.

In order to observe the relative treatment performance of each hydrophyte species represented, the retained configurations are as follows :
- 1 tank planted with Phragmites communis,
- 2 tanks planted with Glyceria aquatica,

*EHTS: Emergent Hydrophyte Treatment Systems.

- 1 tank without plants.

The second stage is composed of 4 tanks, 2 of which are now operational. They have been planted with Phragmites only, and covered on the surface with a 2.5cm sand layer of 0 to 5mm grain size. After completion, when the whole area is put in operation, this type of tank will represent almost 77 % of the total surface area.

3rd, 4th and 5th stages. These tanks, which are planted with Scirpus (3rd and 4th) and Iris (5th) are arranged in series. In the initial design, the water level is kept constant by a sill, thus providing a mainly horizontal component path, known as translation flow. The surface area of each tank is $96m^2$ (17.5m X 5.5m).

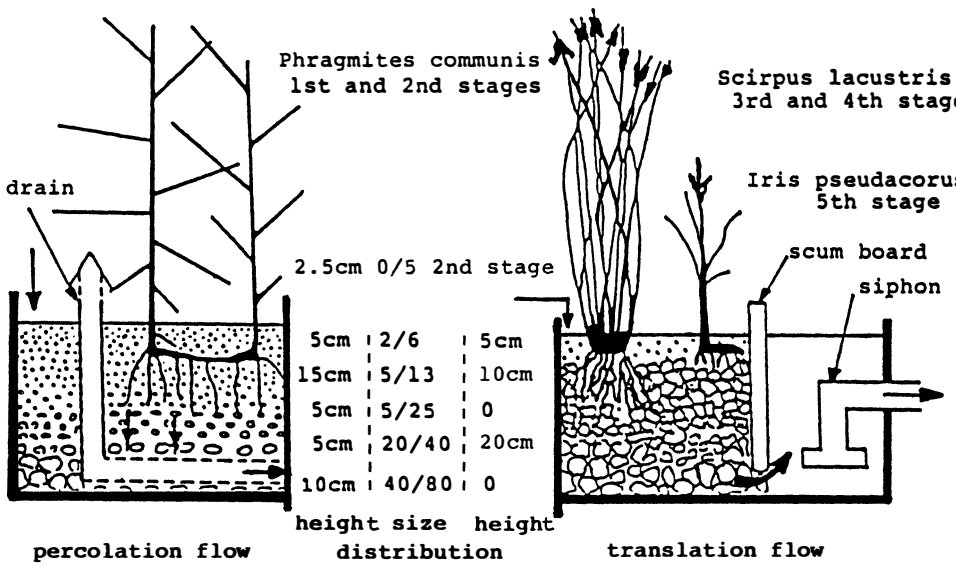

Fig.1. Longitudinal section of the tanks

Auxiliary works. The plant is fed from a recently built separate sewerage system, by means of a two-pump prefabricated unit. The inlet pipework is connected to a static grease trap which also operates as a distributor at the top of the 1st stage tanks.
A measuring channel with a triangular adjustable weir is placed at the outlet before discharge into the River Somme.

CONSTRUCTION TECHNIQUE USED

Concrete was immediately selected as construction material. However, because of local problems of loadbearing capacity of the ground, it was necessary to substantially reinforce it. For the same reason, the outer walls are made of "STEPOC" reinforced hollow construction blocks, then lined with a water repellent coating, for increased water-tightness. As a result, this strong construction was found to be expensive. The minimum cost (end of 1986 value) was estimated to be 1650 F.F/inh.eq.

OBSERVATIONS ON THE TRANSPLANTATION AND SECOND GROWTH OF VARIOUS PLANT SPECIES

General condition. All the young shoots were bought and planted by a specialized horticulturist. The purpose of this was to identify the quality of the market available plants and to evaluate the cost of the total service, including one-year growth guarantee and maintenance.

The 2 year old seedlings had grown in a tight pool filled with earth and watered with river water. The offshoots were picked the day before their transplantation and stored

in water-saturated atmosphere inside tight containers during their transfer. Prior to the actual transplantation, the tanks were filled with clear water up to a level slightly above the gravel surface. This immersion was constantly maintained for 4 weeks, followed by the normal introduction of wastewater with periodic dilution using water from the Somme River.

The planting was done in 2 stages :
- September 1985 - Phragmites, Scirpus and Iris
- End of June 1986 - new planting of Phragmites and Glyceria

The planting density was always maintained at 5 units per m^2.

Phragmites. This species was characterized by a very low second growth rate on two attempts (10 % and 15 % respectively). This may be due to a number of reasons (heterogeneity and size of the mineral substrate - lack of fertilizer); the short size of the picked rhizomes may also have been a determining factor.

Glyceria, Scirpus and Iris. Scirpus and Iris have remarkably taken root again (100 %) right from the first planting. A similar result was achieved with the Glyceria used to replace part of the Phragmites in the second planting attempt.

REMARKS CONCERNING THE FUNCTIONING OF TRANSLATION FLOW TANKS

The experience acquired in Saint Bohaire shows that the design of these tanks needs perfecting. The medium is insufficiently aerated; the low mineralization of the organic matter is responsible for an excessively rapid clogging and an insufficient nitrification prior to denitrification. The oxidoreduction potentials observed never exceeded +150 mV EHN.

At Pont Rémy, in spite of the low quantity of treated load, signs of septicity in the medium (substrate and water) appeared shortly after the plant was put into operation (unpleasant odours, whitish bacterial colonies). This condition shows that species presumably capable of transfering oxygen to their roots such as Scirpus, in actual fact only disperse a small quantity of that oxygen in their immediate root environment which is just sufficient for their growth but not sufficient to achieve satisfactory treatment. CEMAGREF is presently studying the installation of additional devices which might remedy this situation, such as an auto-starting siphon. A syphon prototype with a mobile arm has been tested at the outlet of the 5th stage at the Pont-Rémy plant since October 1986. Two similar devices are being installed at the outlet of the 3rd and 4th stages.

Numerous tests still remain to be made on these devices to ascertain their efficiency and to determine the optimum operational frequency and amplitude of level variations.

IMPROVING THE EFFLUENT DISTRIBUTION

Presently, the infiltration of wastewaters to the tanks of the first two stages takes place through one inlet only. This deliberate choice was made for the sake of simplicity and to follow the Saint Bohaire example. However, it appears insufficient for tanks with a large surface area. A simple distribution system using overflow gutters is also being tested.

CONCLUSION

An important effort in applied research still remains to be made on the Pont-Rémy site which is representative of many small communities in Europe, particularly in respect of its operating cost and constraints compared with natural lagooning. This is essential in order to determine if the specific surface area could be reduced by 4 as it is hoped.

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