PROCESSING OF COMPLETION USE FOR THE PURIFICATION OF THE WINERIES WASTE WATER

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The objective of this document is to present the principles and the bases of dimensioning of the possible stages of completion in the field of viticultural purification.

The concept of completion is completely relating to the position of the installment in the data processing sequence: the activated sludge for example can constitute the heart of a purification or its stage of completion when they are used after an anaerobic processing.

A certain number of processes are well identified as being adapted to the purification of the effluents of cellar (cf § I). For a few years, the manufacturers have proposed various installments of completion. A census of existing was used to direct more theoretical search towards principal the processing of completion usable in our sector.

I. RECALLS ON THE PROCESSES OF PURIFICATION OF THE VITICULTURAL EFFLUENTS []

The pollution contained in the viticultural effluents being very mainly organic, their purification is generally based on the biological processes of degradation. Several sectors can be put in work, some calling on a stage of completion to perfect the purification of waste water. Let Us Note that the processing of muds, purifying micro-organisms developing in the engines, is a process except for whole which is not regarded as a stage of completion.

The most widespread process of purification individual for the liquid waste processing of cellar is probably spreading. By the use of the complex ground-micro-organism-plants, the organic matters are filtered, degraded and for some exported. Purified water continues its infiltration reinstating the natural cycle. By nature, spreading does not need stage of completion. It is the same for the physicochemical process as is evaporation.

Several anaerobic systems of processing to allow to cut down between 80 and 90% of the organic load of the viticultural effluents. They are necessarily supplemented by a processing of completion before rejection in the natural environment, generally an aerobic process of activated sludge type comparable in its principle with the process used like principal processing in domestic or industrial purification. It will thus not be included in this document

Aerobic processes themselves, when they are used as a principal floor of an installment can be supplemented by a stage of completion. That Ci is met of work a filtration (tangential filter) which can be together with biological phenomena (sand filters, planted filters of reeds). The aerobic process ensuring 95 to 98% of the degradation of the organic matters, the stage of completion is primarily used to make safe the rejection, in particular with regard to the contents of suspended matter, even if it makes it possible to lower a little the DCO and the DBO5 [2.].

II. FILTRATION ON MEMBRANES

The membranes appeared in France in the installments of processing of urban waste waters by activated sludge at the beginning of the years 2000.

The technology of the bioréacteurs with membranes borrows the traditional biological processing by activated sludge of the conventional processes, but the separation between activated sludge and treated water is not carried out any more by one clarifier but through a membrane of ultrafiltration. Compared to the decantation filtration by membrane reduced in a very significant way suspended matter and sometimes also content of DBO5 and DCO of the treated effluents. Within this framework this technique can be regarded as a processing of completion.

The arguments in favor of the processes coupling activated sludge and membranes are multiple: compactness, capacitance to treat variable loads, rejection of excellent quality. This technology is well adapted for the stations which generally reject their water in significant mediums (zones of bathe, conchylaceous, etc). It is used more and more for the restoration of old stations when for example the load in effluents increased. Purified water can be re-used under certain conditions **(municipal watering,** industrial **processes**, pretreatment for potabilisation,…).

III. PROCESSING BY BACTERIAL CULTURES FIXEES

Several installments of type ventilated storage and SBR were recently equipped with processing of completion of the type filter sand, filter planted of reeds and even “flowered channel”. These various processes, at the origin, summer developed like principal stage of processing of domestic waste waters. They belong to the general category of the processes of purification by fixed biomass, within which one can distinguish, according to the granulometry of the support and the principle of operation, the beds bacterial (support coarse) and the biofiltres (fine supports) [3.]

BACTERIAL BEDS

PRINCIPLE

They consist of a porous garnishing of standard pozzolana or plastic materials of high specific surface (up to 200 m2/m3) [3.] [5.] being used as support with the purifying micro-organisms [4.]. Water to be treated is sprinkled on the surface of the bed; ventilation is ensured by natural distribution [3.] [4.].

The thickness of the biofilm is stabilized when it reaches values such as it limits the oxygen contribution in the deep layers [4.]. When these cells do not receive either any more from substrate, they are autolysent while releasing from the compounds usable by the close micro-organisms then cause a local detachment of the biofilm thus making the support available for a new colonization [4.].

EXAMPLE

A manufacturer proposes since the grape harvest a 2001 system of processing associating free bacterial cultures and bacterial bed with garnishing pozzolana. The first stage (engine aired with 3 days minimum residence time) allows an abatement close to 60 % of pollution; the second stage (filter pozzolana functioning in recirculation over 24:00) ensures the degradation of the remaining compounds in order to reach, after decantation, the limiting values of rejection in the natural environment [6.]. The lack of retreat with respect to this installment does not enable us to give an opinion as for its behavior in time.

DIMENSIONING

One differentiates the bacterial beds according to their type of filling [4.] and the loads hydraulics (daily output reported to surface from the bed, in m3/m2. J) and organics (flow polluting in kg DBO5/J) which they can support [3.].

A priori and with the sight of the preceding example, the bed likely to constitute a second stage of waste processing of cellar is a bed with traditional filling fed with weak load. The usually allowed loads on these works lie between 0.08 and 0.2 kg DBO5/m3. J for the organic load and 1 to 5 m3/m2. J [3.]. In this configuration, there is not scrubbing of muds which are fixed on the support and are degraded by self-oxidation and action of predatory fauna [3.] [4.]. The abatement obtained can reach 95% but because of their sensitivity to clogging and filling, these installments are less and less used, in urban purification [3.] all at least.

The setting opens some of a recirculation with a high hydraulic head makes it possible to carry out a autocurage of the support which limits the filling but which requires a complementary work to retain and stabilize muds [4.]. This operating process makes it possible to use the beds with traditional filling with strong loads (0.7 to 0.8 kg DBO5/m3. J and 14 to 40 m3/m2. J) [4.] [3.].

The plastic fillings make it possible to reduce the risks of filling and to apply higher loads (up to 5 kg DBO5/m3 .j) [] []. Their use was developed for the biological industrial waste water preprocessing [] but was limited by their high price [].

PROSPECTS

The use of the bacterial beds for the viticultural liquid waste processing could be considered:
- in completion for the bed with traditional filling;
- in biological preprocessing for the plastic beds with filling.

The bibliography insists on the need for rigorously controlling the contributions to control the risks of filling, which can suppose constraints of exploitation (regular analyses) or a dimensioning of security which cause a overcost compared to the extensive process of ventilated storage.

In any event, the bacterial bed not being able to be used only, the economic study must put out of balance the cost of construction reads and the profit which it allows the level of storage.

BIOFILTRES

PRINCIPLE

The biofiltres are part of the processes making it possible to carry out an aerobic biological filtration on a fine granular medium []. This definition can more generally apply to the systems of purification per infiltration in the ground []; for the applications which interest us, we will concentrate primarily on the sealed off and drained installments, allowing a collection of waste water. Certain typical cases - absence of discharge system can lead to the installation of infiltration of treated water; they will be evoked in a specific part (cf 3.2.2.4.).

The capacitance épuratoire of the biofiltres is due to the activity of the bacterial populations which develop on the aggregates [] []. Contrary to the bacterial beds, the smoothness of the support of filling makes it possible to ensure the clarification in the same work and to ensure a rejection not very charged in MY []; on the other hand, it makes them more sensitive to filling so much so that certain versions of the process envisage daily operations of regeneration (détassage with the air and washing of materials to water) [].

Their development particularly assured as an installment completion after a station mud-was activated or a bacterial bed []. A rustic version of the process, based on the use of sands or gravels and not requiring washing of materials is used for on-line operation of small communities: filters sands or sand cushions and filters planted [] []. They are these types of installments which inspired the viticultural designers of processes intended for the exploitation and of which we will study the bases of dimensioning particularly.

SAND FILTERS

Example

In complement of aired storage, several manufacturers now propose a sand filter like stage of completion. The volume of ventilated storage must make it possible to contain the effluents produced during approximately 3 months starting from the grape harvest []. Ventilation is maintained until obtaining an organic load compatible with the feeding of the silica solid mass, i.e. a DCO ranging between 1 G O2/L [] and 2 G O2/L [].

The power supply of the elutriated water filter is sequential, about a few minutes all the 2 to 3 a.m. []. An additional abatement is obtained on MY [] and, according to the design and the mode of feeding, on the DCO, the DBO5, nitrogen and phosphorus []. The filter can be fed a year up to 200 days [].

Dimensioning

The key point of the process is the management of the filling which passes by the choice of the substrate, the check out of the contents of MY of water to be treated and the installation of phases of rest in the plan of power supply of the filters [] [].

Substrate

The composition of our effluents not requiring particular aggregates, the substrate generally used is siliceous sand [2.] [7.] [9.] [10.].

The solid mass must be most homogeneous possible to avoid any preferential advance of the water which would thus reduce its residence time the quality of the processing [7.]. Thus to eliminate fines1, it is preferable to use washed sand; it seems that one can indifferently use round or crushed sands [7.].

Ideal granulometry is difficult to as well specify, of good performances having been obtained as regards processing of water worn servants with dune sands (d50≈0,22 mm; U≈23) that with sands of mason (d50≈0,7 mm and U≈6 with 7) [7.].
However it is necessary to take care to use only sands classified well (U<10) to avoid the segregations involving of the preferential routes, with a d50<2 mm to ensure a sufficient residence time [7.].
The standard concerning the devices of off-line cleansing imposes a grading envelope for which the d50 is understood between 0.8 mm and 3.15 mm [8.] (reproduction of the standards being prohibited, the curves could not be inserted in appendix of this document).

Sealing, drainage

When a check out of waste water before rejection in the surface water network is wished, the solid mass must be sealed off and drained [7.] [5.]. It is the most frequent case in viticultural purification. If the ground in place is permeable, the installation of a géomembrane (or geosynthetic membrane) is essential [7.].

For the domestic facilities of off-line processing requiring a proofing, the imposed impermeable film is out of polyethylene low density, a thickness of 200 µm or equivalent resistance in order to avoid the risks of punching or tearing [8.].

The drainage is ensured by a layer of gravels of size at least equal to 20/40mm [5.] [7.], laid out on a 20 cm thickness [5.] to 40 cm [7.]. The drains can be of the pipes of type individual cleansing with a diameter 100 mm [5.] to 125 mm [7.] according to the size of the solid mass to drain, with slots of 5 mm width directed to the bottom [5.] or distributed on the circumference [12.] and remote between them of 10 cm for the small filters (about a few tens of m2) [12.] to 30 cm (for the filters of several hundred m2) [7.].

Dimensions

Surface is obviously dependant on the organic and hydraulic loads to treat. It can be computed starting from the formula [7.]:

$$\Omega = Q/H^*$$

where Ω = entire surface of the filter, in m2
Q = daily output of the station, in m3/J
H* = average hydraulic head, expressed in m3/J per m2 (in other words in m/J)

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[1] Fines : pourcentage en masse des particules de taille inférieure à 80 µm
[2] Valeurs des coefficients d_{10}, d_{50} et d_{60} = maille des tamis à travers lesquelles passent respectivement 10%, 50% et 60 % de la masse du matériau
[3] U ou CU est le coefficient d'uniformité $U=d_{60}/d_{10}$

The hydraulic head is variable with nature of the effluent to treat and according to the fractionation of the contributions, of the hydrodynamic properties of the solid mass and its possible filling. To give some benchmarks, one can specify that:

- for an effluent whose DTO4 is high, higher than 800 Mg/L, the hydraulic head applied is about 0.1 m/J [7.] [5.];
- for an effluent whose DTO is more reduced, lower than 250 Mg/L, the hydraulic head is understood between 0.6 m/J [5.] and 0.8 m/J |7.].

For the devices of off-line cleansing [], the width of the filters is of 5 m, and the minimal length is of 4 Mr.

The depth of the filtering solid mass varies according to the authors between 0.65 m [], 0.8 m [], 0.9 m [] and 1 m [].

Feeding

To limit filling, it must be carried out by respecting an alternation of phases of feeding and rest which allows:

1) with the deposits of surface to mineralize themselves and dry [7.];
2) to control the organic load brought and consequently the bacterial development interns with the solid mass, without however making disappear completely the flora [7.] [5.].

The respective durations of the phases of rest and feedings can be variable according to the nature of the effluent and the climatic conditions. Generally, a duration of rest equivalent to the duration of feeding is recommended [7.] [5.] on a rate of 2 or 3 days of feeding for 7 days of rest [5.]. In winter, it can be advisable to double this time [5.].

For the effluents charged (processing of completion), examples show the good performance of filters uninterrupted for 6 months of the year then at rest the remainder of time [7.]. It is generally in this configuration that are brought to work the installments of completion used in the viticultural field.

The phenomena of concerned purification being aerobic it is necessary to ensure the renewal of the atmospheric air of the solid mass while respecting, within the phase of feeding, an alternation between the periods of infiltration and drainage, with a majority of time granted to the period when the range of infiltration is pumped out [7.].

Several devices make it possible to distribute with best the effluent on the filtering solid mass:

- a simple pipe or a chute with overflow to carry out a temporary immersion of the solid mass which can be obtained by gravity [7.] [5.];
- a network of sprinklers, a reaction turbine or a mobile slope to ensure sprinkling [7.]. Although making essential a contribution of electrical energy (pumping) these installments are interesting for the flexibility which they bring in the management of the water blade [7.].

It is noted that the buried feeding of the solid mass is possible; in this case, the density of surface charge is reduced of half per security [5.]. The standard concerning the devices of off-

[4] DTO = demande totale en oxygène = DCO $_{dissoute}$ + 4,57 NK = somme des besoins de l'oxydation de la matière organique dissoute et de l'azote organique et ammoniacal [].

line cleansing [8.] usefully specifies the characteristics of the drainage and supply lines in this case of figure.

Perenniality - maintenance

Constraints of exploitations are primarily those of the monitoring: operate valves in the event of alternation between several solid masses, checking of the good flow and the good distribution on the solid mass [5.]. These operations are short times but must be very regular [5.]; it is recommended to pay at least a visit per week [7.].

In processing domesticates the ranges of infiltration must be raked all the 1 to 2 months to gather the dry deposits and to maintain levelling the range of infiltration [7.]. The mowing of the plants which can develop spontaneously must also be regular with complete destruction or maintenance of cover in particular in the case of massive with seasonal operation [7.]. Let Us Notice that in this case, the operations of clearing of weeds must be compatible with the feeding attachment used [7.].

Outlines

The sand filters are already largely used in completion after ventilated storage. The data above should make it possible to make reliable their dimensioning and to specify the necessary operations of maintenance. Their interest in the sector of purification is real since they make it possible to guarantee a low level of rejection in MY and out of organic matters.

If Need Be, the use of filters of great depth (higher than 1 m) with a long residence time makes it possible to consider a microbiological decontamination of the effluents [7.]. This possibility opens up the way for the completion by infiltration-percolation which makes it possible to reject the water treated either in a waterway but, via the ground, in a water table. The lawful constraints must be studied on a case-by-case basis.

- Cellars not subjected to regulation ICPE

They are controls by the law on the water which envisages the classification in authorization of the rejection in water table in heading 1.2.0 of its bill of materials (decree n°93-743 of March 29th, 1993).

- Cellars subjected to the mode of the declaration

Article 5.6 of the standard decree of March 15th, 1999 prohibits the rejection in an underground layer, even after purification.

- Cellars subjected to the mode of the authorization

In the standard decree concerning the cellars subjected to authorization, decree of May 3rd, 2000, nothing does not prohibit the rejection of waste water in an underground layer. The experiment shows that in this case, the limiting values of rejection are often more constraining in order to respect the sensitivity of the medium and the monitoring of the rejections (with the load of the cellar) can require the installation of piezometers upstream and downstream of the outlet with periodic statements.

The whole of the regulations, adapted to the rejections of the cellar and the receiving medium, are detailed in the decree of authorization specific to the exploitation.

Taking into account the constraints in term of performance épuratoire, of monitoring of the rejections and administrative approaches, the rejection in water table is to be held for the situations where the surface water network is completely non-existent.

PLANTED FILTERS

Examples

A growing number of manufacturers proposes installments combining one of the biological processes of purification describes in paragraph I (generally aerobic) and one or more stages of planted filters which can have a different job function:
- stage completion of elutriated water
- system of separation water-muds after in particular a ventilated storage
- process of processing of muds.

Tests are also in hand on the first installments of filters planted in on-line and complete operation of the effluents of the cellars. It is obvious that the design, dimensioning and the exploitation will be different according to the destination from the work, even if a certain number of rules of bases are common.

Basic principles

Classification

The planted filters are biofiltres except for whole, which have the characteristic to present a range of vegetalized infiltration []. Various plants can be used, most widespread are the reeds or macrophytes [].

The phenomena concerned in depollution are complex and utilize a combination of physical, chemical and biological processes such as sedimentation, precipitation, adsorption on the substrate, the assimilation by the plants and the microbial metabolism []. The planted filters are able to cut down the contents of dissolved organic pollution, suspended matter, nitrogenize and cogitate, and to decrease the concentrations in metal elements traces, some organic chemical compounds and pathogenic micro-organisms [] []. Taking into account the composition of the viticultural effluents, we will detail only the performances concerning MY, DCO and DBO5.

The purifying plants using of the plants can be classified in various categories according to nature of the watery plants [] (*cf* illustration next page):
- plants floating or completely submerged in basins of relatively high depth;
- plants having an emerged part: category of the planted filters, which itself can be subdivided according to the system of water run-off within the solid mass [] []:
    - planted beds with cursory horizontal flow;
    - planted horizontal flow filters under surface, hereafter called “horizontal filters”;
    - planted vertical percolation filters, hereafter called “vertical filters”.

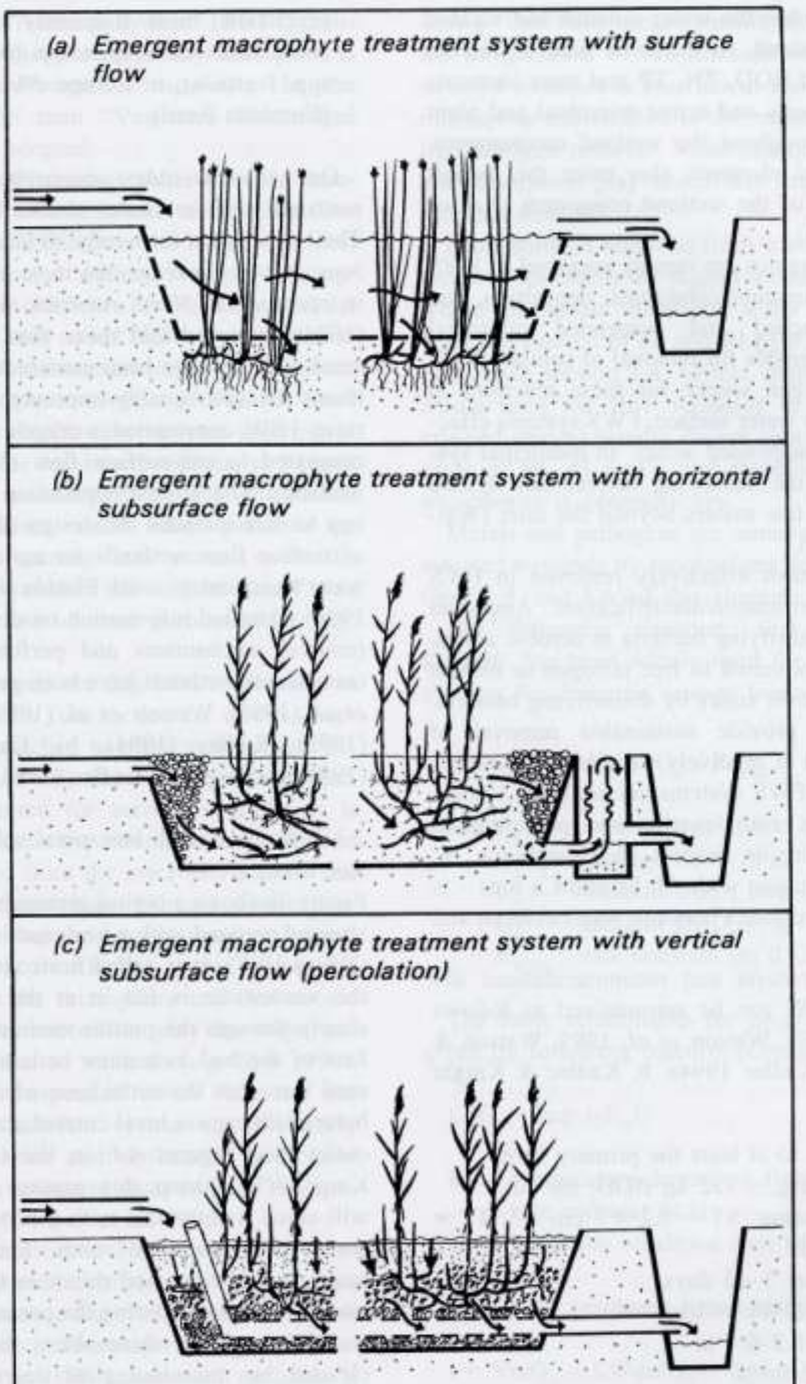

Fig. 3. Schematic representation of emergent macrophyte-based wastewater treatment systems: a) system with surface flow, the species illustrated is *Scirpus lacustris* (Greater Rush); b) system with horizontal subsurface water flow, the species illustrated is *Phragmites australis* (Common Reed); c) system with vertical subsurface water flow (percolation); the species illustrated is *Phragmites australis*. From Brix (1993 a).

source : Vymazal *et al*, 1998

Role of the plants

As in all biofiltre, the substrate of the planted filters plays the double part of filtration and support of the purifying biomass [13.]. The plants are supposed to support purification by a certain number of direct and indirect mechanisms, generally not quantified [13.].

Direct Roles

- For their own growth, the plants assimilate certain substances, in particular the nitrogen and phosphorus [13.]. In term of degradation, this phenomenon seems negligible when the filters are used in principal processing but proportionally more important for the tertiary processing; in this case, clearing of weeds with export of the plants is recommended to avoid saltings out [14.].
- The roots of the reeds secrete toxic products for the pathogenic micro-organisms [21.] [14.]. Interrogations remain as for the compatibility of these phenomena and one supposed effect stimulating with respect to the purifying bacteria [13.].

Indirect Roles

They are more and certainly more significant than the direct roles.

- The presence of the stems, by perforating the surface of the filters and, for the vertical filters, the organic matter crust deposited on the surface, prevents filling [13.].
- The development of the rhizomes and roots ensures an opening of the substrate and facilitates the infiltration of water [13.] [21.]. However, the idea that their presence would make it possible to increase the hydraulic head of the filter beyond the specific conductivity of the substrate does not seem not shown by the follow-ups of installments [14.].
- It seems that the plants support the development of micro-organisms cellulolytic thanks to the shade which they get and with the hygroscopy that they maintain [13.]. The organic matters deposited are thus more easily mineral-bearing [13.].
- The reeds in particular transmit the oxygen of the sheets through the stem until in the rizosphère thus stimulating the degradation of the organic matter and the growth of the nitrifying bacteria [21.]. For the vertical filters, the oxygen contribution by this skew is however very largely lower than that permitted by the feeding by covered [15.]
- The whole of the underground parts intervenes, with the same car as the mineral support, in the development of the microbial biomasses [13.] [21.] and in the filtration of the particulate substances [21.].

The last role of the plants, but not least important, relates to the capacitance of integration of the installments of processing in the landscape; in addition, they confine the odors near the ground and support the acceptability of the devices [].

Floating or immersed plant Basins

They are not strictly speaking filters, although the anglophone bibliography gathers them under the generic term of *constructed wetlands*, and they are studied very little in France. They were not used in the processes of purification of viticultural effluents which we could visit.

The very extensive character of these processes (5 to 30 G/m ² .j for the most important loads) and the sensitivity of the plants generally used to the low-temperatures (the water hyacinths are destroyed by freezing and present a development reduced below 10°C) [] seem to limit their use.

Planted Beds with cursory flow

Description

They permanently presenting a free water blade of about forty centimetres and so are connected more with basins or lagoons that with filters []. A rather slow water run-off allows the sedimentation of the suspended particles containing part of the polluting load [] [], while the dissolved fraction is degraded by the micro-organisms free and fixed in the ground support and on the plants [].

The oxygen contribution is done mainly by gaseous exchange on the surface []; the deep layers and the substrate are thus generally in condition anaerobes [].

Dimensioning

The principal elements of dimensioning are the following []:

- loads organic: < 11.2 G DBO5/m^2 .j
- hydraulic head: between 1.2 and 4.7 cm/J in processing after cleaning, and between 1.9 and 9.4 cm/J in processing of completion
- residence time: 5 to 15 days
- > 10/1
- free water blade: 0.2 to 0.4 m
- basic slope of basin: 0.5 %
- grounds: 30 to 30 cm, without particular hydraulic constraints; the ground in place is generally used
- plants: the species most frequently used are *Scirpus spp* (Scirpes or Snap Rings) and *Typha spp* (Two-handed Hammers) in North America, *Phragmites australis* (common reed) in Europe.

Outlines

These processes have the advantage of being inexpensive under investment and operation, of being of easy maintenance and of recreating a true ecosystem of wetland; on the other hand, they are more extensive than most systems with planted filters and leave possible a contact with the effluent to be treated [].

Their use in the viticultural sector could be under consideration in stage of completion on the water elutriated after a biological processing “traditional” or after one or more stages of planted flow filters under surface.

Horizontal Filters

Description

They are basins filled with homogeneous manner by a aggregate of type gravel or sand supporting the plants []. Mode of feeding distributed the effluent on all the width and the height of the filter to the one of its ends, so that it runs out in a mainly horizontal direction through the substrate [] [].

The evacuation is done by a drain placed at the other end, connected to a tube of overflow modifiable height in order to regulate the height of water in the filter [] []. To avoid the preferential flows and to ensure a homogeneous flow, it is advised to maintain this height of water to approximately 5 cm below surface [].

The suspended matter is retained by sedimentation and filtration through the substrate. The degradation of the organic matters brings into play to bacterial metabolisms anaerobe and aerobe of the biofilm developed in the rhizosphère and on the substrate []. The effluent must at least undergo a primary decantation [] [] and the density of surface charge and/or voluminal must be controlled to obtain a good elimination of the organic matters []. Under these conditions, the outputs obtained with domestic effluents are close to 85% on the organic matters and suspended matter [].

Dimensioning

The principal elements of dimensioning are:

- loads organic: 8 G of DBO5/m^2 .j [] [] on average, 15 G DBO5/m^2 .j to the maximum []
- hydraulic head: < 5 cm/J for effluent elutriated gross [] [], < 20 cm/J in the case of a processing of completion []
- surface: 5 m^2/living out of elutriated raw waters [] [], 1 m^2/living[5] for a processing of completion []
- residence time: 5 days []
- ration length/width: 3/1 []
- materials support |]: washed gravel or crushed stones with a diameter 3-16 mm, porosity 0,3-0,45, hydraulic conductivity 10-3-3.10-3 m/s
- depth: on average 60 cm [] [], which corresponds to the depth reached by the rhizomes and thus to the optimal zone for the processing |]; the depth seems to be able to vary according to fill materials: up to 1 m if it is about planted sand of Reeds, to the maximum 50 cm if it acts of gravel but with the possibility of using various species of macrophytes []
- slope: 1% [], []
- membrane of sealing off: PEHD, PELD, PVC, a thickness ranging between 0.5 and 1 mm [], doubled of geotextile to avoid punchings []
- plants: the species most frequently used are *Scirpus spp* (Scirpes or Snap Rings) and *Typha spp* (Two-handed Hammers) in North America, *Phragmites australis* (common reed) in Europe []; the density of plantation is of approximately 4 seedlings per m^2 [].

Let Us Specify that these data were largely validated for purification of the domestic effluents and that they are not inevitably adapted to the conditions of the effluents of the industrial type.

Application to the viticultural liquid waste processing

The first experiments on the use of filters planted to treat the viticultural effluents were led in 1994-1995 to the university of Davis, in California []. The pilot of 6 m length and 2.42 m broad was filled with 95 cm of peastones of diameter ranging between 50 and 200 mm, planted of *Scirpus acutus* and *Typha dominica* []. A sand filter with ascending flow (1m X 6m, filled with 50 cm with coarse sand 1-2 mm) was used as preprocessing before the horizontal filter []. The feeding of the pilot was carried out at a rate of 500 liters per day, for a residence time of approximately 10 days [].

[5] 1 habitant correspond à 60 g DBO5 / j

Several loads and organic matter concentrations were applied. In the most unfavourable case, the concentration in input of the horizontal filter reached 4 723 Mg DCO/L with a load of 164 G DCO/m ² .j; the median values obtained in output were: 60 Mg DCO/L and 32 Mg MY/L [] [Over the 66 days which the tests with this very high load lasted, 4 results appeared higher than 125 Mg DCO/L, without however exceeding 170 Mg DCO/L [].

Vertical Filters

Description

They are basins filled with layers of different gravels of granulometry superimposed [] [] being able to be covered with a layer of sand on the surface if the effluent to be treated is not very charged []. The feeding system of the filter is conceived to disperse the effluent on the totality of surface [], generally by envisaging several mouths or lines distributed in a homogeneous way [].

Contrary to the horizontal filters, the power supply of the vertical filters must be sequential to allow a good rollout of oxygen inside the filter [] []. It is generally carried out by covered, either by pumping or by auto--starting siphon, in order to facilitate the distribution of the water blade and to support the piston effect which allows the renewal of the interstitial air []. The principle of feeding is very similar to that implemented for the filters at sands (cf § 3.2.2.2. d)

Most authors [] [] [] recommend, for the domestic liquid waste processing, of the installments with several beds in parallel in order to spare an alternation between the periods of power supply and rest of the filters.

A French characteristic on the domestic stations is the development of the feeding of the 1st stage of filters by raw waters, having undergone a simple cleaning []. The accumulation of the suspended matter creates a deposit which facilitates the good distribution of the effluent on the filter []. Filling is avoided thanks to the openings bored by the stems of the rhizomes and with the mineralization which occurs for the periods of rest of the filter [] [].

The sealing off and the supply lines are similar to those used for the sand filters []. However, to support the ventilation of the solid masses, the drains comprise intakes air external [] [] [].

Dimensioning

Surface and depth

These essential components of dimensioning are often based on examples of installment more than on rules of calculations [**Erreur! Signet non défini.**]. Indeed, those utilize a constant determined on the ground and being able to vary the simple one with the double [].

For the domestic liquid waste processing, the average surfaces put in work to ensure the degradation of DBO are about 1 m2/living for the first stage and 0.5 m2/living for the second, with a depth ranging between 0.5 and 0.8 m [].

If nitrification is one of the objectives of the processing, surfaces necessary are closer to 5 m2/living with a depth from at least 1 m [].

In processing of completion, entire surfaces of filters of about 1 to 2 m2/inhabitant seem sufficient [].

Media
Sands or gravels usually used have the following characteristics: diameter: 0 to 12 mm, d10 > 0.3 mm, d60/d10 < 4, permeability ranging between 10-3 and 10-4 m/s []. All the materials are washed and rolled [].

Several layers are generally superimposed, the largest diameters being placed at the bottom with the need for the rollers around the drains and often for sand on the surface []. The material sizes used and the respective thicknesses of the layers vary according to the countries [].

Hydraulic head
It lies between 20 to 80 mm/J, the contributions being split into 4 to 6 covered [].

In France, the key figures used for dimensionings of the domestic sectors are 2.5 m2/inhabitant, 20 G DBO5/m2.jour, 10 cm/J (filters ensuring nitrification, in two stages, with at least two filters per stage to ensure an alternation) [].

Feeding System
It is generally placed surfaces some to facilitate maintenance of it, with the need a protection system against freezing [14.]. It can be completely comparable with the system describes for the sand filters (cf § 3.2.2.2. d).

For a point supply distributed on surface, the pipes with a diameter 100 mm are recommended, with the openings directed downwards; each “mouth” allows a good distribution on 5 to 15 m2 [14.].

System of drainage
Cf § 3.2.2.2. B

Outlines

In the actual position of knowledge, several fields of application were defined for the planted filters:

Stage of completion for elutriated water

With the image of the sand filters, the filters of reeds can constitute a stage of completion of the water treatment after separation of muds. They then make it possible to guarantee the conformity of organic matter and the suspended matter concentrations before rejection in the natural environment. Their performances épuratoires are comparable with those obtained with the planted filters used in domestic processing: concentration in input of about 1 g/l of DCO and obtaining values of output lower than 125 mg/l.

stage of separation of the water-muds mixture

After a storage aired in particular, the dimensioned planted filters in an adequate way can filter the water-muds mixture, thus avoiding the taking into account of the stage of decantation in the dimensioning of storage and the annual management of muds. Those, retained and mineralized on the filters, will be developed by spreading at 5 years estimated intervals. A follow-up of the first existing sites will be necessary over several years to check the reliability of the installments in the course of time and the constraints of their exploitation.

c) process of processing of muds

A third type of planted filter can be intended exclusively for the processing of the sewage sludge. Besides the dehydration (which could be obtained with a bed of sand drying), the plants allow a degradation and a stabilization of muds which reduces the final volume of product and its smell pollutions. This phenomenon is probably accentuated by the presence of the vegetable cover which limits displacement lots of air and the dispersion of the odors.

Criteria of design such as surface, the depth, the granulometry of the substrate or the rate of feed, are specific to each manufacturer. They must be rigorously given to ensure an optimal operation. Once these fixed data, construction can be realized by an entrepreneur or possibly, for the smallest installments, by the vine grower himself.

In the actual position of knowledge, on-line operation of the viticultural effluents (without preliminary biological degradation) cannot be completely carried out by a planted system. Taking into account the unequal distribution of the effluents during the year (point of the grape harvest) the tests in progress generally integrate a storage allowing an operation by recirculation.

Reflections are also committed on the possibilities of water treatment of streaming of wine slopes or on flushing waters of the pulverizers. The problems being completely different in measurement or the compounds to be degraded have a certain toxicity with respect to the purifying micro-organisms, the studies are for the moment futurologies and do not allow yet to consider realization.

The diversity of the planted systems makes it possible to consider several uses in the field of purification of the effluents of cellar. Although today, they are reserved for the stages of completion, work of adaptation of the processes to carry out the complete processing of viticultural waste waters continue. The small number of installments does not make it possible any to provide investment costs or of operation representative. More than financial, their interest is esthetic since it allows the landscape integration of the installments of processing, even their valorization in the communication of the cellars towards their customers increasingly sensitive to environmental protection.

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