

# THE WASTE WATER WASHING SPRAYER MANAGEMENT

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## Abstract

Currently, in France, there is No specific regulation butt the management of waste toilets from pesticide spray equipment. However, the ministries in load of the environment and of the agriculture are debating butt it. Agricultural More and more bunches growers involved in integrated crop protection wish to follow the good practices and collect rinse toilets from sprayer washing. Then, effluent must Be treated. Summon companies already markets waste toilets treatment processes suited to farmers' needs.

Within the ecopulvi network, the studies carried out by ITV France butt pesticide effluents management lead to:

- Effluent characterization
- In-field rinsing studies
- Trials one pesticide waste toilets treatment processes

**Key words: pesticide, environment, waste toilets, sprayers, disposal.**

1st part: Characterization of the effluents and rinsing to the piece

## Introduction

Since the publication in 2000 of the reference frame production integrated of grape by ITV France, the approach reasoned production developed in the whole of the wine-producing areas.

With respect to pulverization, beyond the qualitative aspects and for the limitation of the drift, he is emphasized the need for managing flushing waters of the pulverizers in order to limit the position risks specific.

After an inventory of the solutions available established in 1998 in collaboration with the CIVC, a program of experimentation was set up within the framework of the group set of themes national ECOPULVI in collaboration with the services of the Protection of the Plants. Network ECOPULVI gathers at the same time wine exploitations, agents of development and experimenters. It is articulated around a certain number of experimental sites distributed in most French wine-producing areas. In Parallel, a test bed of the techniques of processing liquid waste was set up by ITV France. Various complementary reflections are in hand. This article proposes to constitute an inventory of fixtures of the projection of the project.

## 1. CHARACTERIZATION OF THE EFFLUENTS OF PULVERIZATION

- **Experimental Methods**

The polluting load of flushing waters of the pulverizer depends in particular on the products used during the plant health processing, of the methods of the rinsing, the manipulator and the hardware of pulverization. It is thus obvious that this load will be able significantly to vary effluent with another.

In practice, washing external of the hardware is very variable in frequency according to the wine growers. Some wash it after each cycle of use, others only from one to four or five times during the season. On the other hand, the interior rinsing of the pulverizer is an essential operation between two cycles of application, in order to avoid the problems of filling and contamination between various products.

Several experiments carried out by ITV France (regional stations Champagne and Aquitaine) allowed a first characterization of the effluents of pulverization. The latter contain plant health products, but also, for the effluents resulting from washing external of the hardware, of the hydrocarbons (fuel, lubricant), of the mineral organic matter and (is in hiding, foliage) and in certain cases of the products of cleaning.

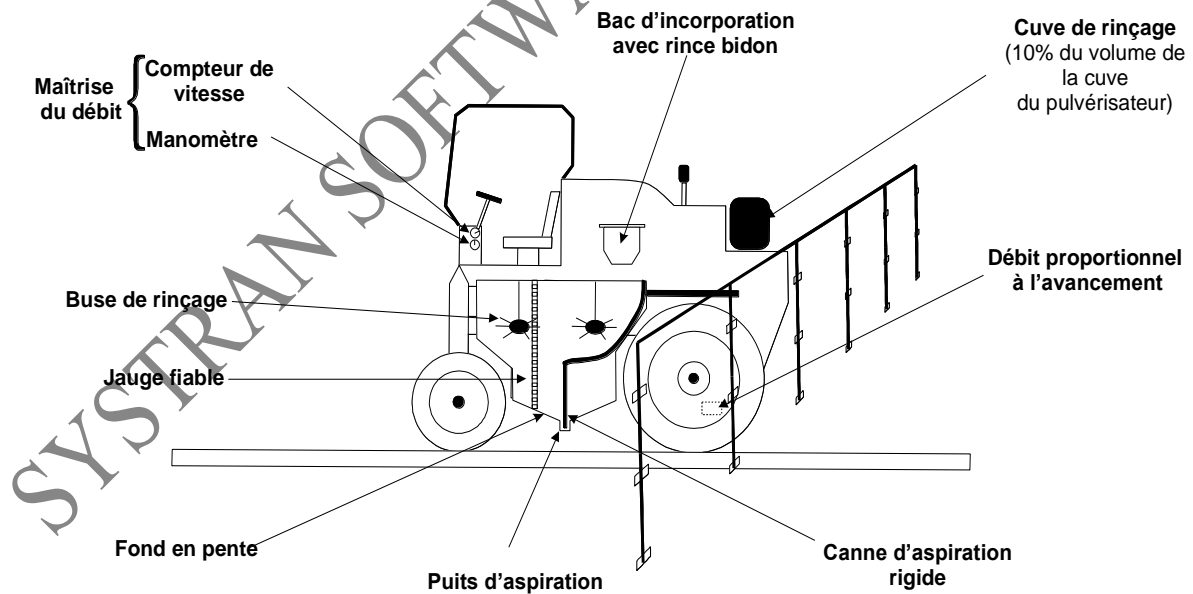
Tests 1 and 2 (table 1) were carried out with a pulverizer laid out on a tractor enjambor adapted to the environmental requirements (Figure 1). The tanks of pulverization are equipped with a tilted bottom connected to a "well" in which the cane of aspiration is inserted. This device limits considerably basic volumes of "chronic" tank related to the draining of the pump of pulp resumption. Tests 3 to 8 were implemented, under the conditions of the practice (tables 1 and 2).

	Test 1	Test 2	Test 3	Test 4
<b>Remainders (funds of tank)</b>	≈ 0 (some drops)	≈ 0 (some drops)	6.4 liters	16.9 liters
<b>Volume of water for interior rinsing</b>	Ferment: 64.5 L Circuit: 136.9 L Total: 201.4 L	Ferment: 61.9 L Circuit: 128.8 L Total: 190.7 L	Ferment and circuit: 64 L	Ferment: 73.5 L Circuit: 71.9 L Total: 145.4
<b>Volume of water for external washing</b>	178 L	142.1 L	40 L	150.5 L

*Table n°1: Rating of volumes of effluent (source: ITV France)*

	Test 5	Test 6	Test 7	Test 8
<b>Remainders (funds of tank)</b>	9.5 L	4.75 L	5 L	41 L
<b>Volume of water for interior rinsing</b>	Ferment: 9 L Circuit: 45.8 L Total: 54.8 L	Ferment: 14 L Circuit: 48 L Total: 62 L	Ferment: 29 L Circuit: 80 L Total: 109 L	Ferment: 18.5 L Circuit: 70.5 L Total: 89 L
<b>Volume of water for external washing</b>	34 L	66 L	55 L	56 L

*Table n°2: Rating of volumes of effluent (source: ITV France)*



*Figure 1: Adaptation of the pulverizer to the environmental constraints (source: ITV France)*

- **Results**

- Remainder

During our tests, Seven wine growers out of eight pulverized the pulp of processing until the draining of the pump. This behavior is not inevitably majority. During the preparation of the pulp, the wine grower gives himself a “safety margin” avoiding a return necessary to the vineyard in the event of under estimate of the requirements out of pulp. By way of an example, for test 8, the volume of remainder is of 41 L whereas the bottom of tank after draining of the apparatus is only 1.75 L. This practice is a significant factor of increase in the concentration in active substances of the effluents.

- Volume of water (interior rinsing)

The volumes of water used for the interior rinsing (tank and circuit) vary the simple one with the quadruple (from 55 to 201 L) between the various tests, which shows the incidence well that can have the type of equipment (the length of the distribution system in particular) and the practice of the wine grower (who evaluates “cleanliness” according to the clearness of the water rejected at the end of the rinsing). In addition, the volume of water used also varies according to the capacitance of the pulp to adhere on the hardware.

- Volume of water (external washing)

Volumes of water for the external rinsing also vary factor 1 to 4 between the tests (40 to 178 L). Each reason called upon previously applies in this case. In Parallel, cleaning also relates to the elimination of the stains other than plant health (is in hiding, vegetable remains, oil, grease) variable according to the hardware and the conditions of pulverization. In general, the volume of water used to wash outside is much higher for the apparatuses carried (enjambeurs) than for the trailed apparatuses. Indeed, the latter have a less complex design and a less surface developed, which simplifies their cleaning.

- Concentration in active substances

The concentrations in active substances of the effluents of pulverization are very variable from one situation to another, particularly in flushing waters interior. Indeed, the wine grower who does not pulverize pas la pulp until the draining of the pump, generates effluents with a great quantity of plant health residues of products. On the other hand, the wine grower who optimizes his practices (pulverization of the remainder until draining of the pump and implementation of the rinsing to the piece) produced effluents much charged. Moreover, for the same practice, the quantity of residues varies according to the capacitance of adhesion or the viscosity of the pulp.

Concerning external washing, the quantity of residues is also variable. It depends on the aptitude of the pulp to adhere on the hardware, of the weather conditions (wind in particular) and of the quality of pulverization (drift) and the hardware (face by face, vault, trailed, carried). By way of an example, in the 8 tests carried out, the residues of plant health products present in water of offsite washing vary from 0.05 to 6.23 liters expressed in equivalent of initial pulp. It should be noted that 6.23 liters is an extreme value, the average quantity is approximately 0.3 liter.

In term of DCO, flushing waters external are loaded out of organic matters (vegetable stains or of hydrocarbons), they thus are concentrated than flushing waters interior. It is important to note which certain products of cleaning to strong polluting load can affect and which increase the DCO of the effluents considerably

## 2. RINSING WITH THE PIECE

- **Context**

Within the framework of the Agricultural Good Practices, it is advised to carry out the rinsing with the piece at the plant health end of the processing when that is possible. This practice, recommended by the Committee of Orientation for the Reduction of the Water Pollution by the plant health Nitrates, phosphates and products coming from the agricultural activities, consists in diluting the residual volume of pulp with a volume of water at least equal to 10% of the volume nominal of the tank or at least equal to 5 times residual volume that can be diluted, then to pulverize it on an already treated piece or a enherbée pound far away from the water supply points.

- **Interest**

An experimentation carried out in collaboration with the CIVC (Interprofessional Committee of the Wine from Champagne) made it possible to evaluate the effectiveness of the tank of rinsing.

The test was carried starting from a Champagne pulverizer and of a pulp containing sulfur (difficult to clean). The results presented on figure 2 are very conclusive. After rinsing with the piece, the quantity of sulfur remaining in the apparatus was lower than 1 gram. When the bottom of tank is pulverized without being diluted nor rinsed, the quantity of sulfur present in the tanks is 200 times higher. In the case of a bottom of tank of 25 liters, it remains 1 000 times more residues than in a rinsed apparatus.

The fact of rinsing the hardware as of the end of the processing limits adhesion related to drying. This handling (dilution of the bottom of tank and pulverization of diluted) which depends on the conditions of pulverization requires to the maximum 15 minutes at the end of the building site of spreading. It is guarantor of a good maintenance of the hardware (not of filling of products on the level of the tubes because the residues do not have time to dry) and also makes it possible to preserve the health of the manipulator by avoiding handling in contact with the products, as well as the environment by strongly reducing the position risks specific.

Complementary investigations are in hand within the framework of a national project financed by the ONIVINS to specify the interest of the practice in other contexts.

This technique can be facilitated by installing a clear water tank and be optimized by the installment of tubes of rinsing in the tank of the pulverizer. As an indication, the installment of complete equipment by a dealer on the hardware used out of Champagne lies between 550 and 1500 euros net of tax (manpower included).

## 3. WASHDOWN

In complement of the rinsing to the piece, or the difficulties encountered by certain wine growers to ensure this one, the installation of an individual or collective surface can be planned to collect water of washing. This surface is also often used during the filling limiting the position risks thus accidental (escape, overflow). Generally, a cleaning is essential to retain the solid matters (sheets, vine shoots, stones) likely to stop the lines.

- **Water management**

The optimal management of water is a requirement whatever the device of processing. Overpressure contributes to limit water consumption appreciably. In addition, the use of

stopping devices automatic, programmers of time of washing (manual or tokens) are as many solutions intended to limit excesses of water consumption (in particular on the level of a collective surface).

- **Separation of rainwater**

When the washdown is not covered, the rainwater recovered on the surface of rinsing must be separate effluents in order to limit volumes to be treated (and to avoid the overflow of the tank of storage). The experience feedback related to the follow-up of several sites shows that the manual separation by valve often leads either to a rainwater rejection in the tank of collection or contrary to the forward thrust to water of washing in the natural environment (lapse of memory of the operator, blocking of the valve). The tuning of a separation device simple associate with the presence of the tractor is under investigation.

#### 4. TECHNIQUES OF PROCESSING LIQUID WASTE

- **Experimental Protocol**

The techniques of water treatment of rinsing are currently under study at the national level by ITV France and the Services of the Protection of the Plants.

- the existing systems of processing were identified and consigned in datasheets sets of themes presenting the principle of the system, the cost, the operating process, a critical analysis, the experiments carried out and the protocols of taking away. These datasheets written within the framework of ECOPULVI are diffused by the plant health regional groups and ITV France.
- The systems are put to the test in experiments on pilot sites (wine Wine industry colleges, Stations ITV France, exploitations...)
- A national comparative bank is in the course of implementation by ITV France in order to compare the practical, technical and economic performances of the devices.

It is important to recall that to date, no system of processing is still validated by the public authorities. These elements are thus given as an indication, the only relevant approach remaining the reduction, in concentration and volume, of the effluents to the source.

##### *Concentration of the pollutants*

- Processing by evaporation

The potential of **evaporation** varies appreciably according to the areas (wind, temperature, hygrosopy) and the vat installation of. Within the framework of a gravitating flow, the vats are often laid out in a pit, which rather appreciably limits the potential of evaporation.

The risks of rollout of pollutants towards the atmosphere are in the course of rating. The system is generally reserved for small units (experimental Centers) which annually manage limited volumes (1 to 2 m<sup>3</sup>)

- Processing by dehydration

The Alyzée company developed one knows out of polymer (Osmofilm®) in absorbent matter letting pass water but retaining the other molecules. Water present in the product evaporates; a greenhouse effect is created under the action of the light radiations. The temperature inside

the bag increases, which accelerates evaporation. The steam diffuses through film causing the draining of the product.

The bag containing the desiccated product must be destroyed in approved center.

#### - Physicochemical Processing

Flocculating agents and/or coagulants are introduced into the tank of storage of the effluent to eliminate the suspended matter. Muds thus formed are recovered either by filtration on woven filter, or by racking and are eliminated in approved center.

The supernatant is filtered

- maybe on activated carbon filter: process EPUmobil® (Zamatec company), Sentinel® (company WMEC), BF Bulle, (Ecobulles company),
- maybe by osmosis reverses with completion on activated carbon: process phytapur® (company Michael Paetzold).

The clogged filtrats and filters are eliminated in approved center. These processes are mobile (on trailer) what allows their implementation by performance of service.

#### - Processing by modified electrochemical process (company AMP)

Two electrodes (out of iron or aluminum) between which circulates a continuous electric current, are plunged in the effluent. The dissolution of the anode releases from the metal ions causing the formation of flocs. The electric field involves the migration of the molecules charged and thus supports the formation of the precipitate which is filtered on filter presses at the end of the processing. Moreover, the current allows a degradation partial of the molecules by oxydoreduction.

#### *The degradation of the pesticides*

#### - Processing by advanced chemical oxidation

The whole of the advanced chemical technologies of oxidation gathered under English acronym AOP (Advanced Oxidation Processes) rests on the hydroxyl formation radical. The latter of very powerful oxidants able to partially degrade refractory organic pollutants completely or into made up biodegradable. The life time of radical hydroxyls is very short what avoids their dissemination in the environment. Their products of their degradation are water and the dioxygene and carbon dioxide. Three techniques of advanced oxidation are investigated:

**The heterogeneous photocatalysis:** it is founded on the absorption of exiting radiations, generally ultraviolet, by a semiconductor (titanium dioxide) fixed on solid support (company Ahlstrom paper group) (figure 5). While turning over in its initial state, this semiconductor provides energy which will allow the hydroxyl formation radical.

**Catalytic electrochemistry:** two insoluble metal electrodes covered with a catalyst and between which circulates a continuous electric current, are plunged in the effluent. The passage of current on catalyst causes the hydroxyl formation radical allowing a degradation more effective than for a simple modified electrochemical process. Coagulation also intervenes, but is less powerful than by modified electrochemical process. The effluent is then filtered.

**Catalytic ozonization:** ozone is insufflated in the effluent to treat where is introduced a metal catalyst. Ozone is an unstable compound producing of radical hydroxyls during its dioxygene decomposition. The catalyst coupled with ozone multiplies by ten these performances.

- Biological Processing

**The biobac**, also called biobed or phytobac® (Bayer Cropscience France)

The principle of this process, is based on the purifying capacity of the ground. Purification intervenes in a tight pit into which is introduced a mixture of ground, straw and sometimes of other materials (manure, peat, green matter) maintained in aerobic condition (it is not necessary that the substrate is gorged with water). This device allows the retention as well as the immobilization and/or the degradation of the active substances by micro the organizations present naturally in the ground.

**Biological degradation in liquid medium - Station STBR2** (company ADÉRBIO)

Micro-organisms are put in culture and sequentially mixed with the effluent to treat. In permanent contact with the polluting matters and under oxygen contribution, the bacteria develop and degrade the polluting molecules. A clarification then makes it possible to separate water treated from the bacteria and some waste molecules in the form of muds. A filtration on mineral support supplements the processing in output.

**Planted bed of reeds**

The active matters are degraded by an aerobic biomass developing jointly on the filter materials which constitute the garnishing of the beds (rubble) as on the various racinaire system components of the reeds (*Reeds australis*) which consists of rhizomes (underground stems starting from the nodes of which new growths develop), roots and rootlets.

In wine medium, the mixture of the effluents of pulverization to the viticultural effluents is often considered. The processing by ventilated storage of a mixture of effluents of cellar and remainder of pulverization was the object of two experiments by the regional Station Champagne of ITV France.

It appears that an on-line operation of water of washing of pulverizer with the effluents of cellar does not appear possible for the following reasons:

- Dilution of the active substances rather than degradation
- Be Likely to block biological degradation because of the biocide effect of the active substances (suppression of the total colony count responsible for degradation)
- Accumulation of the active substances in muds

On the other hand, this mixed processing could possibly relate to pretreated effluents of pulverization with a powerful system. However, this assumption must be confirmed by complementary studies.



## CONCLUSION

The limitation of the environmental impact of the washing of the pulverizer passes by an adaptation of the wine practices, associated in particular with a rinsing with the hardware to the piece. This operation can considerably reduce the risk of rollout of the pesticides in water. In complement of this approach, the installation of a surface of filling and washing is to be considered within the framework of an optimal management of waste.

Several techniques can be planned to treat water of washing. The first tests carried within the framework of ECOPULVI made it possible to evaluate the performances of some systems. However, it is necessary to continue the studies before considering a diffusion of these processes.

The investigations which will be carried out during next campaigns will aim in particular at a clarification of the following points:

- Estimate of the costs
- Rating of the constraints of follow-up and the perennality of the systems
- Lawful Aspects
- Legal statuses of the washdowns, to become waste, management of treated water, etc
- Mode of organization (collective management, performances of service)
- Mode of check out of the reliability of the processing

SYSTRAN SOFTWARE TRANSLATION

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