Environmental aspects of wine filtration

Vinciane Couvent, Jean-Michel Desseigne, Sébastien Kerner (IFV) – January 2011

Wine industry, as any other sector, may try hard to limit environmental impact of its activities. Filtration, used for clarifying and/or microbiological stabilization in wines, consists in separating particles from the liquid phase under the action of a pressure gradient through a porous medium. This operation needs an energy use (pumps), cold and hot water use (filters functioning, cleaning) and generates effluents more or less polluted which need to be treated. Eliminated particles end up, depending on the filtration method, either in the form of "solid" waste, rich in organic matter, eventually mixed with filtering products; either in the liquid form (retentate) and make by-products potentially polluting; or in the rinsing-restoration-cleaning water, which constitute effluents of high pollution charge.

To choose a filter, environmental criteria have better to be taking into account. The objective will be to reduce these consumptions and these wastes, which in addition to their environmental impacts, can also have a direct impact upon the production costs.

So as to throw light on this aspect of filtration, different filters types will be studied here. The data are coming from experimentations carried out by IFV in different vineyard region and by the Chambre d'Agriculture de Gironde.

The data are about one filtration cycle. To obtain the same result in clarification term, sometimes two cycles are needed, as for example in the case of earth filtration compared with cross-flow filtration. The means presented in following graphs are indicatives, the difference between minimum and maximum often are important. This is due to:

- Tested wine variability because chemistry physical conditions affect their filterability
- Duration of tested filtration cycles, which affect cleaning frequency and generated impacts by hL of filtered wine
- Equipment variability
- Way of use variability

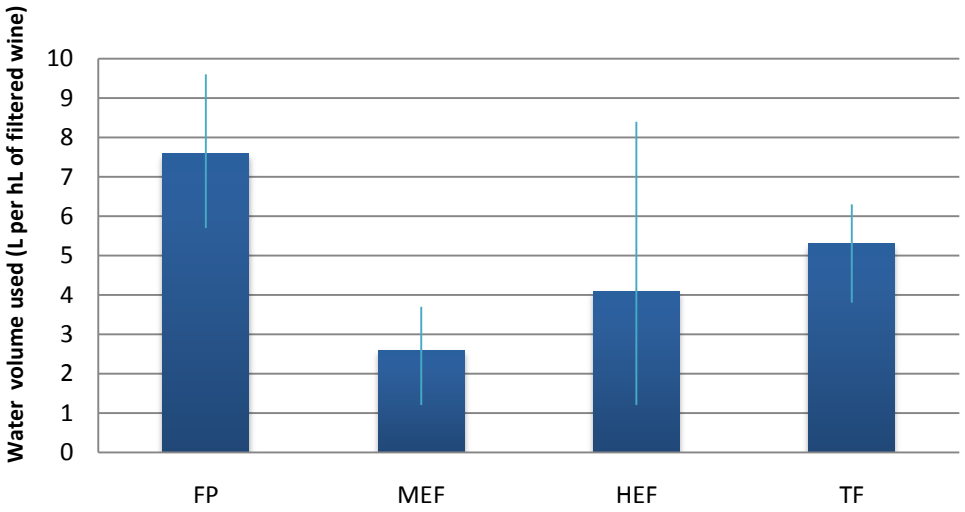
Water consomption

Water is more and more identified as a precious element which use deserves best management. Water volume consumption also has a direct impact upon characteristics and effluents volumes generated and treated before to discharge it in natural environment.

Water can be used in different steps during filtration depending on the filtration type chosen and use conditions:

- Possible water precoat realization in the case of earth filtration
- Filtering media rinsing before filtration, as for example the sheets
- Unclogging or restoration during filtration

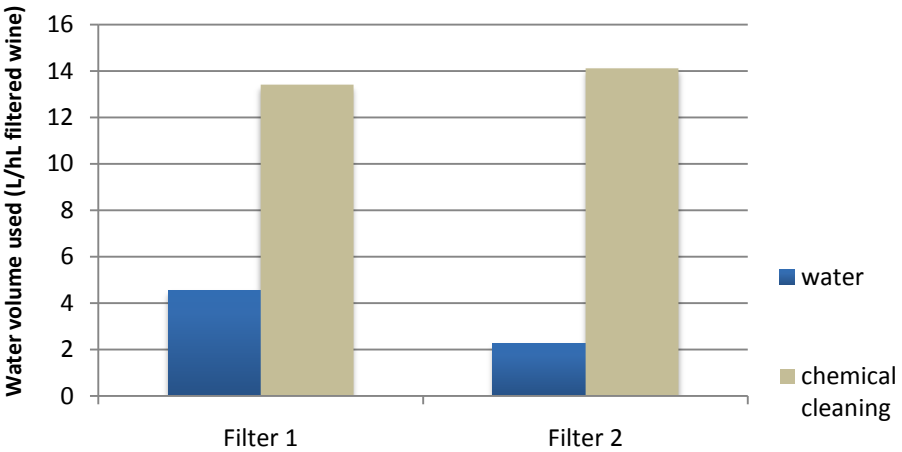
- Rinsing and cleaning/disinfection/sterilization; the role of rinsing and cleaning operation is to insure hygiene conditions. They can also permit to restore initial performances in flow terms.
- Water necessary for vacuum pump functioning during rotating filter use…



Graph No. 1: Water volume used depending on filtration method, IFV, 2003-2005

PF : Press filter, MEF : Mechanical earth filter, HEF : Hydraulic earth filter, TF : Tangential filter

The press filter can require important water consumption for low volumes batches. Depending on conception, it can be difficult to clean. The important water consumption needed for washing and regeneration of membranes is often considered as a weak point of tangential filtration. These water consumptions are in practice, very variable depending on equipments and use conditions, in particular the chemical cleaning frequency (for the mean below, it has been considered one chemical cleaning once a week).



Graph No. 2: Water volume used depending on the tangential filter type IFV, 2003-2005

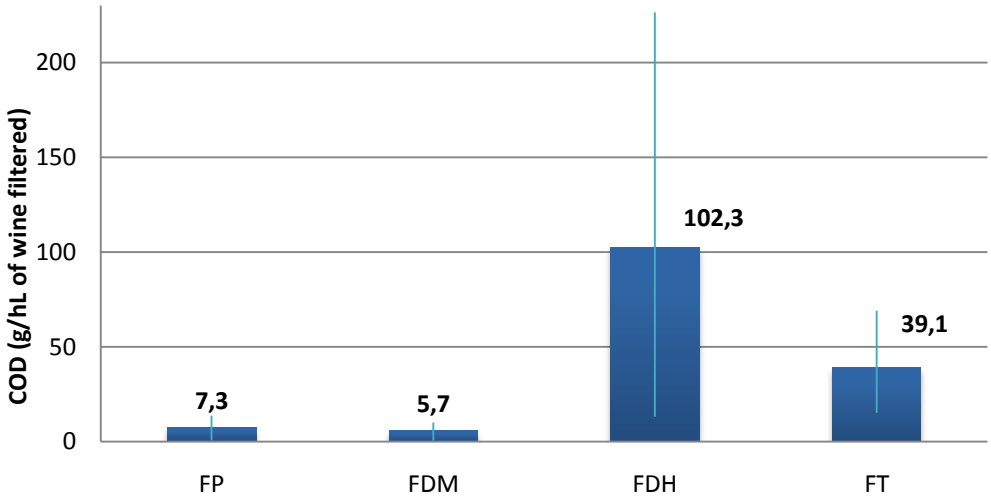
Indeed, biggest consumptions are measured during chemical cleaning whereas water rinsing consumes quantities close to mechanical earth filter. A chemical cleaning cycle can include several stages: pre-rinsing with cold water, rinsing with hot water, one or several chemical cleaning, two or three water rinsing until neutrality. Management of chemical cleaning frequency depending on production constraints can lead to reduce very significantly necessary water quantities.

Thanks to technical improvements brought to conception (reduction of dead volumes, reduction of retentate volume) and about the process management (management of intermediate rinsing, transmembrane pressure,…), water use is strongly reduced for few years.

Pollution charge of generated effluents

The other aspect about water is the pollution charge which it contains after use. This charge generates energy use for effluent treatment plant for most of the cases or pollution of the natural environment if it is directly discharged (non authorized practice). The pollution charge and the volumes generated have a direct impact upon the design and the functioning cost of the treatment plant.

Water used during cleaning carries solid and soluble matters away. These ones will confer to effluent its pollutant character. The objective of filtration being separating the solid phase of the wine, this one can be in effluent or in the filtering medium. The wine lost during filtration cycle, additives or chemical products necessary to cleaning operation vary depending on the filter type and make vary the COD (Chemical Oxygen Demand) and the pH of effluents.

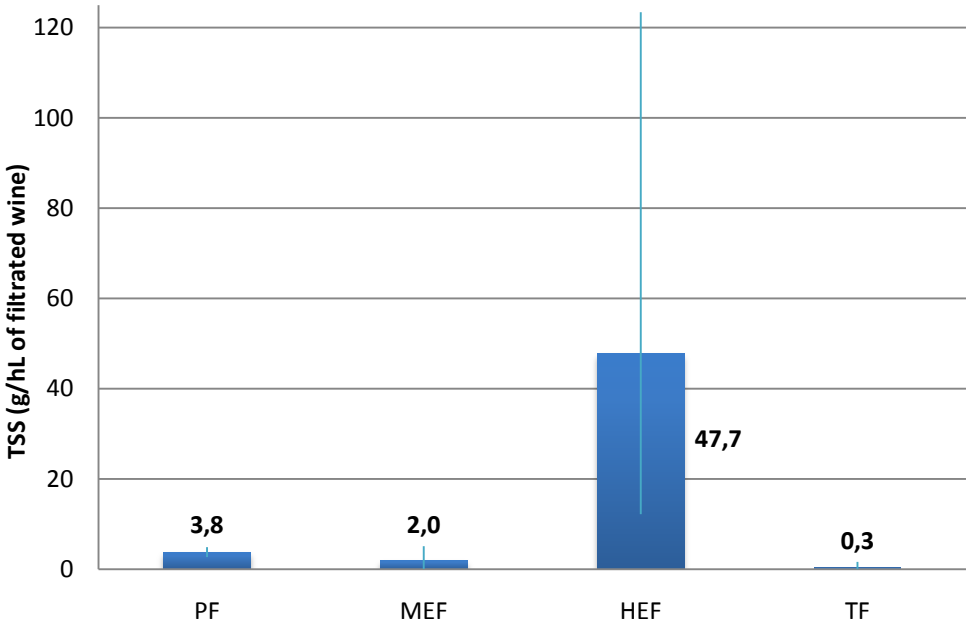


Graph No. 3: COD of effluents discharged depending on filtration type, IFV, 2003-2005

The older hydraulic earth filters generate the most pollutant effluents. The totality of used earth, mixed to eliminated particles, is evacuated by rinsing water. The discharge of these effluents very loaded in filtration earth presents important risks for network and treatment plant. It is strongly recommended not to use this type of material anymore.
Press filter and mechanical earth filter generate effluents few pollutants because particle eliminated from wine are kept into the filtering media, which is evacuated under a more or less pasty form.

This rotating filter used to filter sediments, lees and some of press wine, can lead to very important pollution flow, according to the tests carried out by the Chambre d'agriculture of Gironde. At the end of a filtration, a coat of filtration earth remains around the drum. All or a part of this one can be left in cleaning water.

The TSS measure, Total Suspended Solids, also is a good indicator of the pollutant charge of effluents.



Graph No. 4: TSS of discharged effluents depending on filtration type, IFV, 2003-2005

For reasons explained previously, the hydraulic earth filter discharge the most loaded effluent in TSS.

In earth filtration with additive collection, a part of these ones is found in effluents, which give effluent very loaded in TSS compared to a tangential filtration for example.

Waste production and recovery way

In an environment safeguard approach, that is important to question about the possible reduction of waste “at the source” and about their recovery process.

Obviously, « used » filtration earth is the waste that is the most produced in the cellars having chosen earth filtration.

– Filtration earth

To put them in landfill site after use is not the best solution because of the quantity of matter recoverable. Indeed, it contains mineral matter (alumina and silica) and organic matter (alcohols, acids, and polyphenols).

Currently, UFE is eliminated either by direct land spreading or by landfill disposal. Land spreading is limited by technical constraints and the low agricultural value of UFE. Landfill disposal is both economically and environmentally unsuitable.

The sustainable treatment way of this waste of by-composting with green waste has been studied. Chemistry physical analysis have been carried out on used filtration (agronomic value, organic compound traces, metallic elements traces, microbiological innocuity,…), then on the obtained compost. The results show earth nature does not disturb composting process. Composts obtained are in accordance with French norm NF U 44-051 about organic amendment.

- Cartridge and filtration sheets

Once saturated, sheets and cartridges became waste to discharge. Cartridges are made of membranes assembled on a solid support and protected on the outside by a cloth or by a frame. Membranes are made from different material, as glass fibers, polypropylene, cellulose esters, nylon, polysulfones. Sheets can contain cellulose, kieslguhr, perlite, resin, fibers, and especially organic matter. Some of the sheets are biodegradable and compostable. It is possible to regenerate membranes and sheets/lenticular modules to reuse them after a time.

No specified treatment has been developed for their discharge. For small quantities, it is adviced to discharge them with household waste collect, if it is accepted by municipality or, to call a collection company.

Other wastes are generated by filtration step: these are paper or plastic packaging containing filtration products, which can be collected separately to be recycled. Their volume can be optimized by supplier involvement.

Conclusion

If filtration operation must be thought depending on objectives such as wine quality obtained and filtration efficiency, environmental aspects really have to be taking into account. Environmental impacts of filtration can be different depending on technologies used, with however big variability depending on material conception. These impacts can be reduced easily with good practices of equipment use. We shall recall hydraulic earth filtration is not advised due to high pollution of effluents produced.

Imperatives of environmental impacts are getting better integrated by constructive and supplier. This is how "eco-innovating" technologies based on new concepts or improving existing process were proposed. The study of these technologies is a part of the objectives of Eco-innovation Winenvironment project led by IFV.

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Glossary :

COD: Chemical Oxygen Demand: corresponds to the total quantity of oxygen required for complete oxidisation of organic and mineral matters; expressed in mg O_2 / L of effluent

TSS: Total Suspended Solids: corresponds to the quantity of non soluble matters (berries, leaves, skins, stems, earth, ...) contained in the effluent; expressed in mg / L