Flottation

Flotation is a method for clarifying white and rosé grape musts, but also red grape musts which have undergone thermal treatment. It is a dynamic must clarification system with a relatively simple principle resembling reversed static settling. Lees (called foam) rise to the surface and are eliminated. Rising gas bubbles fix to the solid particles making them lighter than the liquid and bringing them to the surface.

To cause foam particles to float, the following procedures need to be carried out:
- Foam particles must be coated with a fining agent to form a floc: bentonite, gelatin, silica gel in association or alone.
- Gas bubbles must be inserted into this floc to render it lighter than the must.

Enzymatic depectinisation of musts

Must depectinisation preceding flotation is essential for reducing viscosity and allowing the particles to migrate towards the surface where they are eliminated. In acidic must conditions, positively-charged proteins are surrounded by negatively-charged soluble pectin. These particles in suspension carry an external negative charge, repel one other and stabilize the haze (Figure 1). The addition of an adapted formulation of pectolytic activities allows for a rapid decrease in viscosity. Rapidase® Flotation facilitates particle agglomeration and promotes faster migration of solids in order to increase flotation yields.

Rapidase® Flotation is added after crushing or pressing between 1 and 3 ml per hl of must, depending on pectin quality and content. Pectic polysaccharide content depends on grape maturity, the conditions of the vintage and preliminary stages as well as grape variety. Certain varieties such as Muscat have higher pectin content.

The minimum time required for depectinisation is between 2 and 3 hours, depending on the enzyme dosage and must temperature. A pectin test evaluates the residual presence or absence of pectins (the protocol for carrying out this test is available from our technical service department). In the case of harvest contamination by Botrytis cinerea, the must would be treated prior to flotation with Rapidase® Glucalees (between 2 and 5 g/hl); a pectinase and betaglucanase based enzyme preparation.

Important information: It is vital to leave the enzyme enough time to react prior to adding certain flotation additives, such as bentonite or silica gel. These products adsorb proteins non-selectively and will inactivate the enzymes.

Flotation additives

Additives play an essential role in increasing electrostatic interactions (Figure 1). Fining agents dosage of has a strong
influence on flotation efficiency:

- Flocculation speed.
- Final turbidity.
- Volume of foam.
- Floc size.

If the floc is too small, adhesion does not occur correctly, leading to poor flotation. If the floc is too big, the amalgams cannot float. This is partially due to their weight and partially due to the fact that they block the haze phase (acting like a net), preventing the clear liquid from descending and impeding the upflow of the flocs.

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<th>Flotation additive</th>
<th>Dosage</th>
<th>Role</th>
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| Gelatin            | from 3 to 10 g/hl | - Provides the floc with good adhesion, improved resistance to tearing and improved bubble adhesion.  
- The gelatin flocculates the bentonite, the gelatin-bentonite pair acts on flocculation speed and floc size.  
- The gelatin increases electrostatic interactions. |
| Bentonite          | from 20 to 40 g/hl | - Reduces the protein charge of the musts to be floated  
- Contributes towards floc cohesion. |
| Silica gel         | from 10 to 30 g/hl | - Avoids overlining of the gelatin fractions that have not been flocculated by the bentonite. |

### Flotation gas

The bubble size must be sufficient to allow them to adhere to the floc but not too big to avoid creating overly aerated foam, more difficult to eliminate.

*Remark:* it is important to limit must oxidation.

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<tr>
<th>Gas</th>
<th>Advantages</th>
<th>Remarks</th>
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| Carbon dioxide CO₂   | - Protects the musts against oxidation.        | - Overly large bubbles hinder the passage of the floc to the surface.  
- Creates disturbances in the flotation basin. |
| Oxygen O₂            | - Small-sized bubbles are formed.              | - Risk of must oxidation.                   |
| Nitrogen N₂          | - Low solubility.  
- Bubble size is suitable for solid particle migration.  
- No risk of wine oxidation.  
- Low cost. | - reserved for delicate grape varieties. |
| Compressed air 80 % N₂ + 20 % O₂ | - Most economical gas for this application.  
- The supply of oxygen promotes fermentation start-up following flotation. | - It is advisable to purify the air beforehand using a deoxidisation filter.  
- Trials carried out on whites show that must browning was negligible. |

### Flotation management

#### Pressurisation

This step is between 5 and 7 bars. Above 7 bars the bubbles rise too quickly and do not have enough time to fix the solid particles. In this case fluffy foam forms on the surface instead of a cake of compact must lees. White wines are generally floated at 5 bars. Sweet wines are pressurized at between 6 and 7 bars; flotation time is extended.

#### Must flow rate

Flow rate is determined by the quality of the harvest. The easier the must is to float, the quicker the flow rate.

#### Practical advice

- Turbulence created by suction cannot be stopped when foam thickness is inferior to 10 cm.
- Good clarification by flotation cannot occur when foam thickness is above 15 cm, as the height of the liquid is not sufficient for good floc migration.
- The best way to treat flotation foams is with an earth vacuum filter. Filtered musts can be used despite being of a lower quality.

*Remark:* Any flotation parameter adjustment (additive dosage, flow rate) requires a reaction time. The effects of a modification are not visible before 30 minutes in the flotation tank.

### Flotation apparatus

#### Continuous industrial float

This is made up of:

- a circular flotation tank.
- a flotation system using microbubbles.
- a surface foam suction system.

#### Discontinuous float

The flotation tank is a regular winemaking tank which is linked to:

- a pressurization pump
- a gas supply and regulation device
- a dosage pump for injecting the additive(s)

The clarified juice fraction is racked using the racking valve, foams are eliminated by pumping.
Conclusion
Must flotation helps save time and reduce energy expenditure by limiting cooling requirements during wine clarification. This technique results in a lower more stable turbidity, reduces the volume of lee and decreases tank immobilization (-20 to -30%). When flotation foams are filtered, the volume of filtration earth is reduced by 80% in comparison to total must filtration on rotary filters.
From an aromatic perspective flotation reduces the risks of transmitting off flavours in the case of botrytised harvests (after flotation the wines do not have the ‘rot’ flavour found after pressing).
Sensorial profiles of wines after flotation are comparable to those of wines treated with static must-settling.

Cellar experiments

Trial carried out in Italy
FLB 300-type Velo float on Proseco grape variety.
- Must depectinisation using Rapidase® Flottation (1 g/hl) lasted for 3 hours, at 15-16°C.
- The must was floated for 45 minutes with air, at a pressure of 5 bars.
- The additives used were silica gel (10 g/hl) and bentonite (40 g/hl).
- Flotation flow rate was 200 hl/h.

The use of Rapidase® Flottation reduced the turbidity of the must treated with flotation by 77% (trial 1) and by 81% (trial 2). Turbidity decreased from 122 to 29 NTU. The use of the other enzyme caused an increase in turbidity, probably due to the presence of fining agents.

Trial carried out in Chile
- Rapidase® Flottation was added to the harvest at the crusher (30 g/T), maceration lasted for 6 hours, at 16-18°C.
- Press juices were sent to flotation, under air pressure.
- Additives used were gelatin and bentonite (40 g/hl).

Compared to the pectinase used by the cellar, Rapidase® Flottation yielded a compacted cake of lees, reduced turbidity and improved flotation yield.