TECHNICAL BOOKLET

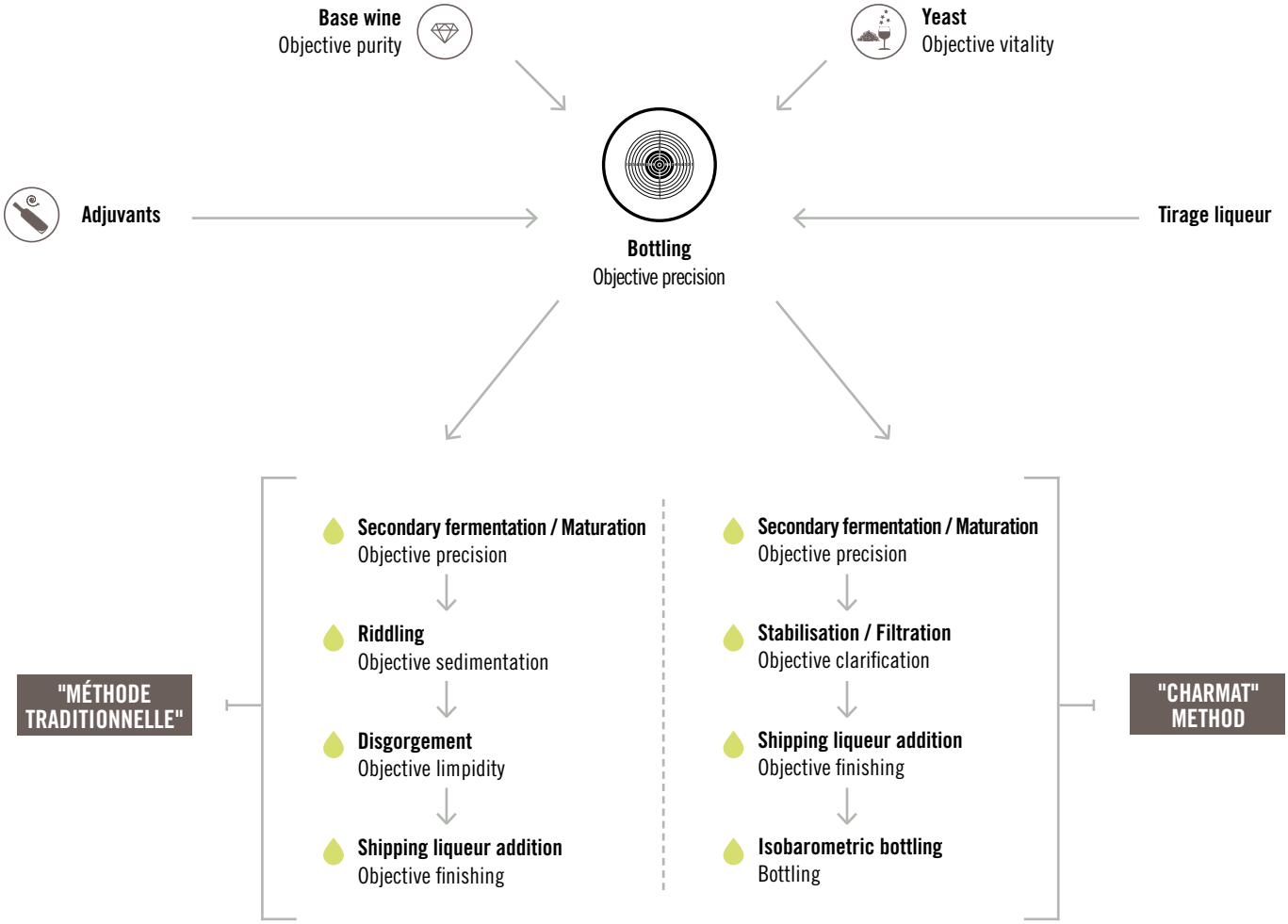
THE BIRTH OF BUBBLES

Demand for sparkling wines has been increasing over the past decade, and they are now produced in all of the world's wine regions. However, a great deal of rigour and technicity is required to produce good quality sparkling wines.

Lamothe-Abiet's E2F® range has been specially developed in response to winemakers' technical and enological requirements for sparkling wine production.

This booklet offers guidance in the creation of your wines, through each step of the process in both "méthode traditionnelle" and the "Charmat" method. With a focus on reaching a defined objective, Lamothe-Abiet gives you all the tools you need to succeed in your sparkling wine production and to guarantee the stability of your wines.

BASIS FOR THE PRODUCTION OF SPARKLING WINES



BASE WINE PRODUCTION

The quality of the base wine is crucial for the production of a good sparkling wine. This base wine must be made with precision and have clean aromas. It is also important to guarantee tartaric and microbiological stability. These factors together ensure a good secondary fermentation and an optimal maturation.

1. Pressing: a key step for successful base wines

The first juices (at the bottom of the hopper and first press) usually contain phytosanitary products and/or copper residues. Grape skin fatty acids are also found in higher concentrations. **It is therefore important to separate these juices and to treat them separately.**

The free run juices are of better quality for the production of the base wine and should be separated from the press juices, and treated differently.

Using precise indicators, such as the **conductivity**, the **pH** or the **modified colour index**, help to optimise the partitioning of the juices. Tasting can be used to refine and adjust the selection.

2. Extraction and clarification

The use of fining and enzymes helps to optimise this step in the vinification. Purified enzymes (FCE) should be used in order to ensure the cleanness of the wines' aromatic profiles.

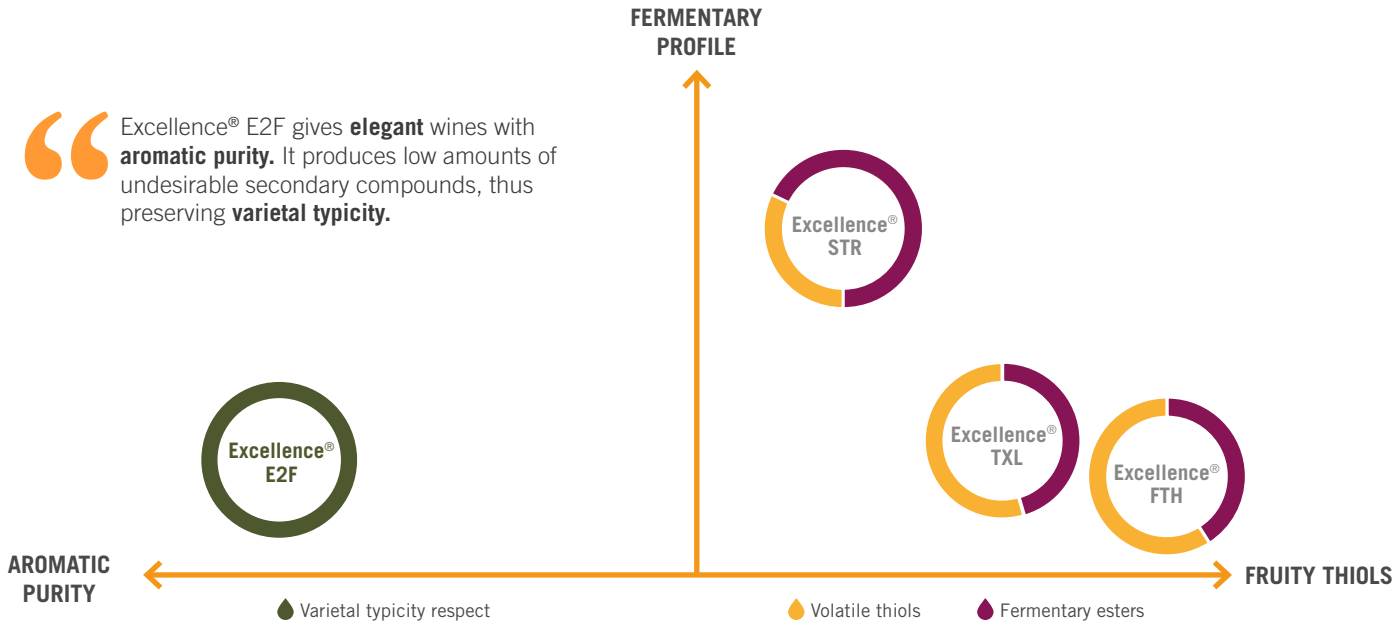
- **Enzymes:** Novoclair® Speed (or Vinoclear® Classic).
- **Fining solutions:** products from the GreenFine®, Polymix® Natur' (mixture of PVPP, calcium bentonite and yeast hulls).

GOOD TO KNOW

The use of gallic tannins extracted with alcohol helps to protect musts against oxidation. These are the most effective tannins against oxidases, the enzymes responsible for must oxidation (laccases and tyrosinases).

3. Adjusting the wine's profile using yeast

Excellence® E2F gives **elegant** wines with **aromatic purity.** It produces low amounts of undesirable secondary compounds, thus preserving **varietal typicity.**



4. Nutrition management

Nutrition is an essential factor to secure fermentation. It should be considered in advance in order **to optimize yeast performance and to make the highest quality base wines.**

- **Yeast preparation:** Oenostim®
- **Activators:** Vitaferment®/ Vitaferment PH®
- **Organic nutrition:** Optiflore® O

FOR MLF AND AF MANAGEMENT:
see the "Alcoholic fermentation management" practical booklet

STABILISATION AND PROTECTION

1.Oak addition: sucrosity and complexity

Using oak during fermentation or maturation allows the winemaker to modulate the **wine's desired structure** and **aromas**. Lamothe-Abiet offers different oak solutions with its Œnobois® range: Granules, Chips, Sticks and Staves.

2. Malolactic fermentation: roundness and microbiological stability

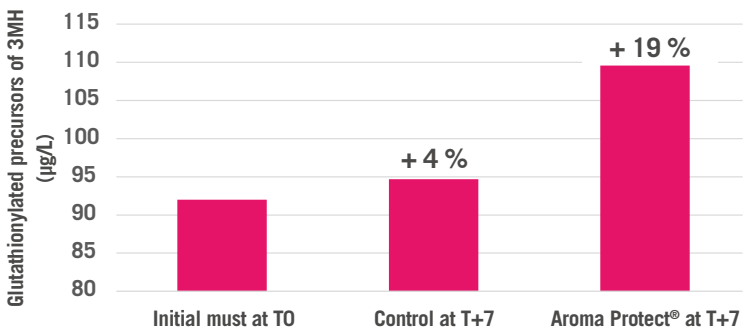
MLF may be desired in order to **deacidify and/or obtain microbiological stability, thus facilitating riddling and wine stabilisation**. It can also bring roundness to the wine. If it is not desired, it is necessary to ensure that a spontaneous malolactic fermentation does not occur during the secondary fermentation.

Adding sulfites or a biocontrol solution such as Killbact® (formulation of lysozyme and chitosan) inhibits MLF and ensures precise microbiological management.

3. Protecting aromas: ensure that the aromatic potential is conserved over time

It is important to implement solutions to **avoid the oxidation of aromatic compounds**, which would decrease the wine's quality. Aroma Protect®, a formulation of inactivated yeasts rich in glutathione, is effective at slowing oxidative mechanisms.

Impact of Aroma Protect® added before fermentation of thiols potential

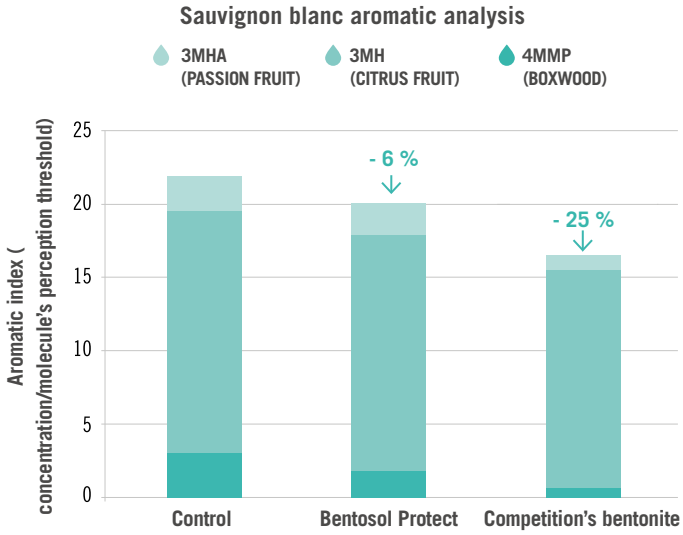


4. Protein stabilisation: improve mousse formation and longevity of mousse

Proteins and mannoproteins have a **positive role on the mousse formation of sparkling wines**. However must proteins, as opposed to proteins from yeast, are unstable. Furthermore, fatty acids from the grape skins can be found in the must. These lead to the formation of cloudiness in the bottle and inhibit the longevity of bubbles.

Unstable fatty acids and proteins are a **spoilage risk for wines**. It is important to **treat them early using bentonite on the must to remove them**. A bentonite should be chosen that respects the aromatic potential in order to conserve the quality of the base wine. To allow good mousse durability, it is recommended to work with a slight protein instability..

- **Bentosol Protect® :** sodium bentonite, allows for good deproteinization. The loss in aromatic potential is minimal.
- **Bentosol FT® :** deproteinizing and compacting sodium calcium bentonite, suited for cross flow filtration.



The use of Bentosol Protect **limits loss of aromas** compared to classical bentonites.

TO KNOW

Manno'Sense® is a new formulation of pure mannoproteins. It gives fresh aromas and volume whilst increasing the quality and persistence of the bubbles!

5. Tartaric stabilisation: avoiding floculation

The method used for tartaric stabilisation should take into account the initial instability. A prior laboratory test is important to be sure of which solution to use.

TESTS CLASSIQUES	LA. SOLUTIONS
- Cold test -	**- Nucleation inhibition -** Stab K (mannoproteins), 5-20 cL/hL
- Mini-contact test -	**- Block growth of microcrystals -** Antitartre 36 and Antitartre 40, 10 g/hL
- Saturation temperature (TSat) -	**- Encourage crystallization -** Tartaric cream + froid, 4 g/L
- Degree of tartartic instabiliy -	

TIRAGE

The tirage process is the foundation for the effervescence to come and requires the highest level of precision. It involves adding to the bottle (for "méthode traditionnelle") or the tank ("charmat" method) completely evenly five essential ingredients for the secondary fermentation: the blended wine, the tirage liqueur, yeast, riddling adjuvants and secondary fermentation activators.

1. The blended wine: adopt good practices

The success of the secondary fermentation is built on numerous points that should be considered beforehand.

High alcohol content causes slow yeast development. The ABV should be considered from the moment the grapes are harvested, taking into consideration the fact that the secondary fermentation increases it by 1.3% vol on average.

If the ABV is too high, the AF may become stuck when it reaches 11% (filtration, cold…). The secondary fermentation will in this case occur with residual sugars, which consist mainly of fructose. Fructose is harder for the yeast to assimilate than glucose, **thus a "fructophilic" yeast (Excellence® E2F) is recommended for a complete secondary fermentation.**

SO_2 can greatly perturb the secondary fermentation. The concentration in active SO_2 must be less than 1.5 mg/L. Sulfite must not be added less than 15 days before tirage.

Calculate at any time your active SO_2 and optimize the secondary fermentation using our mobile app ŒnoSolutions available on AppStore and Google Play Store.

A low pH is often a limiting factor for the production of the base wine or in the secondary fermentation since it can strongly inhibit yeast multiplication and viability.

Due to this, the conditions must be favourable for the yeasts' growth and development. **The use of rehydration products that are rich in ergosterols helps the yeast to maintain a fluid and functional cell wall, thus improving their viability and effectiveness.**

A small dissolved oxygen addition (1 to 2 mg/L) also helps to synthesise membrane ergosterols and to avoid the medium becoming reductive during the secondary fermentation, which may be prejudicial to the aromatic quality.

Nutrition is extremely important. During the secondary fermentation, the aim is to favour the yeasts' viability, rather than the development of biomass. Therefore, an addition in the form of organic nitrogen should be favoured, **for example using Optiflore O® whose formulation helps to improve yeasts' viability and resistance to stress**.

2. The tirage liqueur

The liqueur de tirage's sugar concentration is correlated with the amount of pressure obtained in the bottle. 4 g/L of sugar will give 1 bar of pressure at 10°C. Therefore, the base wine before secondary fermentation must contain approximately 24 g/L of sugar in order to reach 6 bars of pressure.

ABV OF BASE WINE (% Vol.)	QUANTITY OF SACCHAROSE NECESSARY (G/L) TO HAVE A PRESSURE OF :		
	5 BARS	5,5 BARS	6 BARS
9	19	21	23
10	20	22	24
11	21	23	25
12	22	24	26

Source: Ribéreau-Gayon, Traité d'œnologie, Tome I

This value depends on the ABV of the base wine. It is theoretically valid for an ABV of 10% vol. For higher ABVs, the alcohol has a solvent effect on the CO_2, which must be taken into account.

The tirage liqueur can be made from sugar cane, beet sugar or RCM (rectified concentrated must), which has a concentration in the range of 500 g/L.

The addition of tannins during tirage is optional but has several benefits. Lamothe-Abiet offers **Tanin E2F®**, a selection of gallic and ellagic tannins. Through its **natural anti-oxidant effect, it inhibits polyphenol-oxidases and improves the effectiveness of SO_2**. As well as bringing elegance and structure to white wines, **Tanin E2F® stabilises unstable proteins, improving the aromatic potential as well as the longevity of the mousse.**

3. Yeast: the motor of the secondary fermentation

During the secondary fermentation, the medium is particularly hostile for the yeast: alcohol, SO_2, CO_2, low pH, low temperature, unmixed confined medium. It is therefore essential to **have a high quality yeast preparation**. Lamothe-Abiet offers you an example protocol for yeast preparation.

PROTOCOL FOR PREPARING YEAST FOR TIRAGE - *FOR 100 HL OF BASE WINE*

STEP 1

YEAST REHYDRATION

In **10L** of water at **37°C +/- 3°C** :

- Dilute 1 kg of **Œnostim®**
- Add 1 kg of **Excellence® E2F**
- Add 500 g of sugar (or 1L of liqueur)

Allow it to swell for **20 MIN**

STEP 2

ACCLIMATISATION TO ALCOHOL

To the "**rehydration**" medium add:

- **12 L** of wine
- **10 L** of water
- **3 kg** of sugar (or **6 L of liqueur**)
- **150 g** of **Vitaferment® PH**

> Aerated pump over 3 times per day.
> Follow the density until 1015.
> Keep the temperature at **20°C**.

12 HOURS

STEP 3

FINAL STEP

To the "**acclimatisation**" medium, add:

- **300 L** of wine
- **100 L** of water
- **45 Kg** of sugar (or **90 L of liqueur**)
- **100 g** of **Vitaferment® PH**

> Aerated pump over 3 times per day.
> Follow the density until 1000.
> Keep the temperature at **20°C**.

The temperature can be modulated (**until 13-15°C**) to stay around a density of 1000 until the tirage day.

2-4 DAYS

WHAT ARE THE ELEMENTS NECESSARY FOR THE PRODUCTION OF A QUALITY YEAST STARTER?

- **A robust yeast:** Excellence E2F®, fructophilic, resistant to alcohol, pressure, hostile environments, and produces a high quality mousse.
- **Perfect rehydration:** Œnostim® adds growth factors (vitamins, minerals) and survival factors (sterols, unsaturated fatty acids). Greatly increases cell viability.
- **Yeast starter management:** 5 to 6 days of preparation are necessary in order to follow all of the above steps. Once ready, the yeast should be used as quickly as possible. Too long a preparation (>15 to 20 days) can lead to risks of microbiological spoilage (bacterial contaminations) or a loss of yeast viability due to having too many generations.

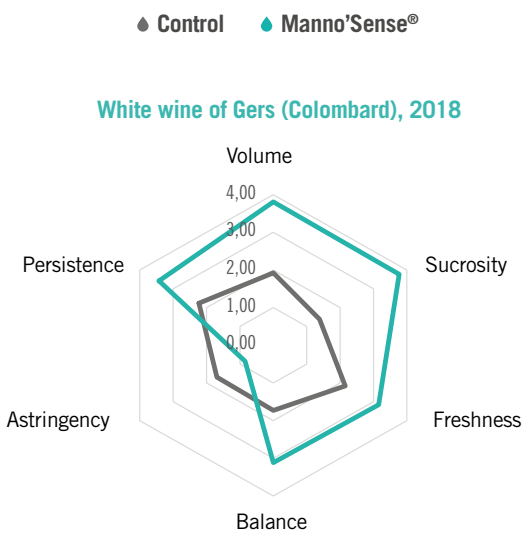
  The amount of proteins in the yeast cell walls can also increase, leading to "sticky" deposits on the glass during riddling.
- **Dosage:** the yeast starter should constitute about 3 to 5% of the wine volume at tirage.

4. Riddling adjuvants

The riddling adjuvants **help a compact deposit to form in the bottle, which can easily be removed at disgorgement**. These adjuvants take different forms:

- **Purely bentonite** based adjuvants (Bentosol Protect®, Bentosol E2F®) that help to **compact the deposit**. Easily neutralised by the unstable proteins, the base wine should not be too rich in proteins. If it is, it is sometimes advised to increase the adjuvant dosage by 1 to 2 cL/hL.
- **Bentonite-alginate** associations promote **coagulation** and **flocculation** of elements in suspension in the wine. Thanks to their low deproteinizing capacity, they also **preserve the finesse and longevity of the mousse**.
- **Gum arabics** (Vinogom®, Subli'Sense®) or **mannoproteins** (Manno'Sense®) can be used to add **roundness** and **sucrosity**.

Tasting results of wines after Manno'Sense® treatment at 10 cL/hL before bottling:



CORRECT PREPARATION AND INCORPORATION OF ADJUVANTS:

- These mixtures of adjuvants can gelify when they come directly into contact with the wine on their own. It is therefore highly recommended to incorporate them to the yeast starter or at exactly the same time as the starter.
- It is not advised to leave an adjuvant preparation for use the following day. They are solutions with high pH, thus microbiologically unstable. The daily needs should be calculated as accurately as possible.

5. Secondary fermentation: objective pressure

Good practices are required in order to obtain an optimal pressure and a secondary fermentation without hitches.

During the tirage, the mixture of base wine, yeast starter, tirage liqueur and adjuvants should be **perfectly mixed**. Good mixing helps to avoid certain problems in riddling, or a sluggish fermentation.

The tirage equipment should be **perfectly sterilised** to avoid any microbial contamination.

The **temperature should be controlled** to avoid thermal shocks during tirage, to keep the yeasts at optimal viability. During the tirage, the room should ideally be at a temperature between 15 and 18°C to ensure a good secondary fermentation. The temperature should be managed throughout all the steps of blending, yeast starter preparation and the tirage. Below 12°C the fermentation kinetics can be negatively affected.

Finally, **controlled inoculation of the yeast starter** during tirage helps to ensure the precision of the secondary fermentation. Ideally, an initial population in bottle of between 1.5 and 2.6cells/mL should be aimed for. Below this, the secondary fermentation can be slower or become stuck. Above this, the fermentation is fast, but there is a risk of yeast or reductive tastes and/or a lack of freshness on the nose.

SUCCESS YOUR SPARKLING WINES IS NOT AN OPTION ANYMORE

Lamothe-Abiet offers enological solutions adapted to all the stages in the production of your sparkling wines. You can therefore modulate the aromatic profile and ensure perfect stabilisation of your base wines. With these technical tools, you can then guarantee perfect control of the secondary fermentation.

Lamothe-Abiet's technical service is at your service to solve your problems and accompany you, with tailored protocols, in the production of your sparkling wines.

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