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MANAGEMENT OF CAP IN RED FERMENTATION: DEFECTS OF THE MOST COMMON TECHNIQUES

Avoiding specific pros and cons of the various vinificators and techniques, we can generally affirm that all of them lose effectiveness and quality up to the point of getting not effective when the tank grows in size (in terms of capacity) and/or has an elevated height/diameter ratio.

Considering that most red wine produced around the world is fermented in tall narrow tanks with a capacity ranging from 200 to 3000 hl and a height/diameter ratio from a minimum of 2:1 to 4:1 and beyond, a qualitative criticality can easily be identified.

In fact, those conditions where the grape cap reaches a significant thickness (from 2 to 5 metres and even greater under certain conditions).

We know that the natural production of CO₂ released by the yeasts during alcoholic fermentation leads to the formation of gassy microbubbles that rise up to the surface. These are partly detained within and around the fruits, causing them to rise up also.

All this forms the grape marc cap, a compact floating layer that tends to solidify at the top of the vat. Around 30% of the marc cap's thickness tends to rise up out of the liquid and thus dry out.

It is intuitive that under such conditions, classic punch-down techniques cannot be used whilst even pumping-over, despite being the most widely used technique, is not entirely effective since the liquid—even in ideal conditions with the perfect wetting of the entire surface—remains solid. What's more, the cap does not break up, with the liquid thus passing exclusively along the pathways that form within the cap itself.

This means that much of the marc is excluded from the wetting operations, limiting the release and thus greatly reducing the effectiveness and quality of the MACERATION. All this favours the creation of **marked thermal gradients** that lead to an overheating of the mass of the cap, especially the dry part, creating an excessive extraction of unwanted substances.

A cap that is compact and dry in part facilitates and **contributes to the development of acetic bacteria** that generate entirely unpleasant compounds in the wine.

In these conditions, proper maceration is reduced to just a small section of the skins forming the bottom layer of the cap, whilst the liquid in contact with the marc quickly becomes saturated with extracted compounds. Another primary problem arising from a compact cap that is dry in certain areas is the complexity of drawing off. At the end of fermentation, removing the grape marc from the tank when it is compact and hardened is an extensive, complex and dangerous process.

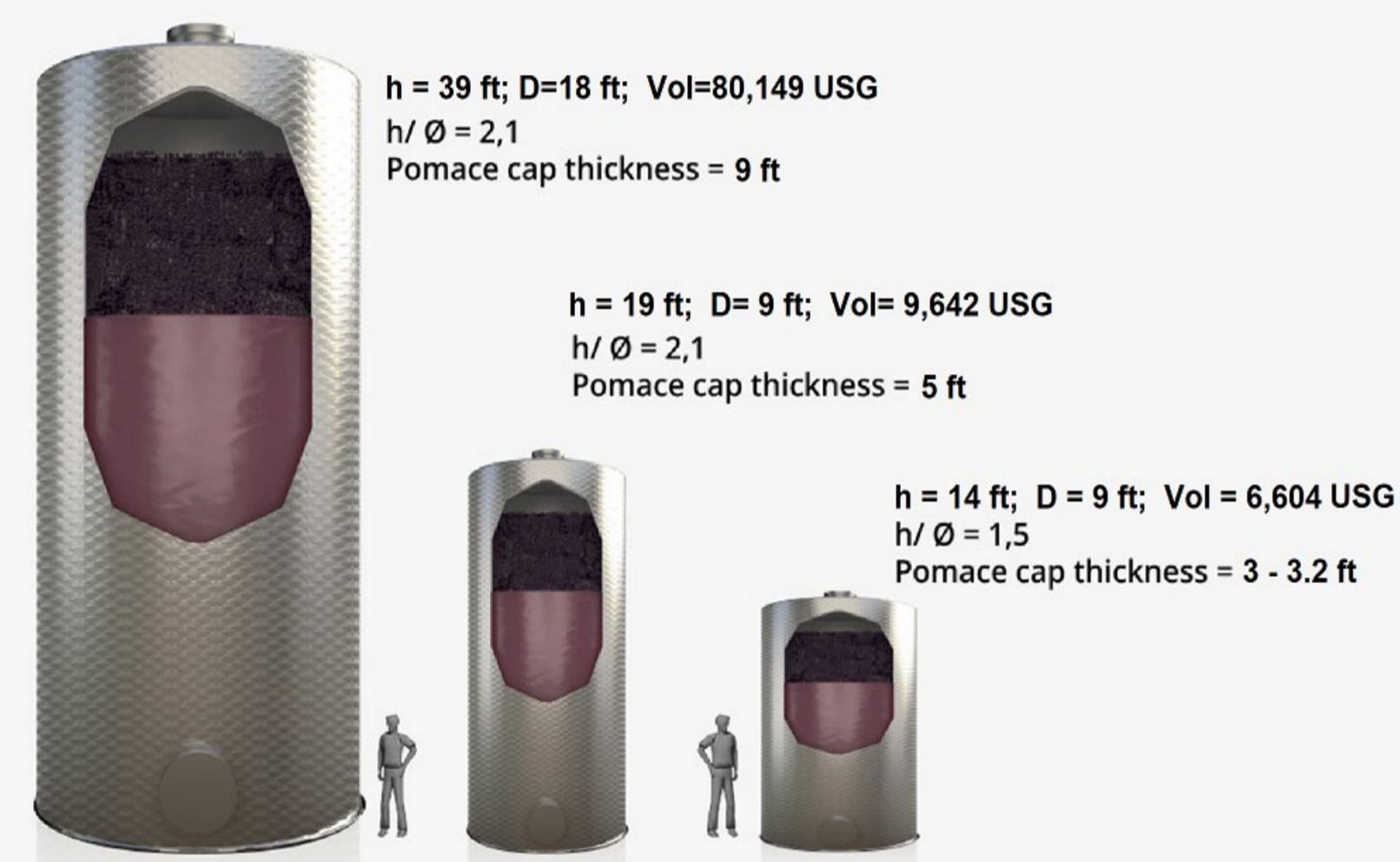


Fig. 1: The image shows tanks of various sizes compared to a man of regular stature. You can see the proportion between the liquid and the grape marc cap.

Then extraction of colour and maceration of the skins in tanks of very large volume or with adverse forms presents problems that are not solvable with traditional leaching techniques

MATERIALS AND METHODS:

All **AIRMIXING M.I.**TM trials is managed by the **SAEn5000 platform**. Advanced multifunction system that **allows you to oversee and monitor the entire vinification process**.

The SAEn5000 platform allows the centralised supervision of all tanks along with the most suitable maceration cycles and protocols for each grape and oenological objective to be stored and customised.

Effective and high-performance solutions and functions for controlling and overseeing the fermentation and maturation process are within it.

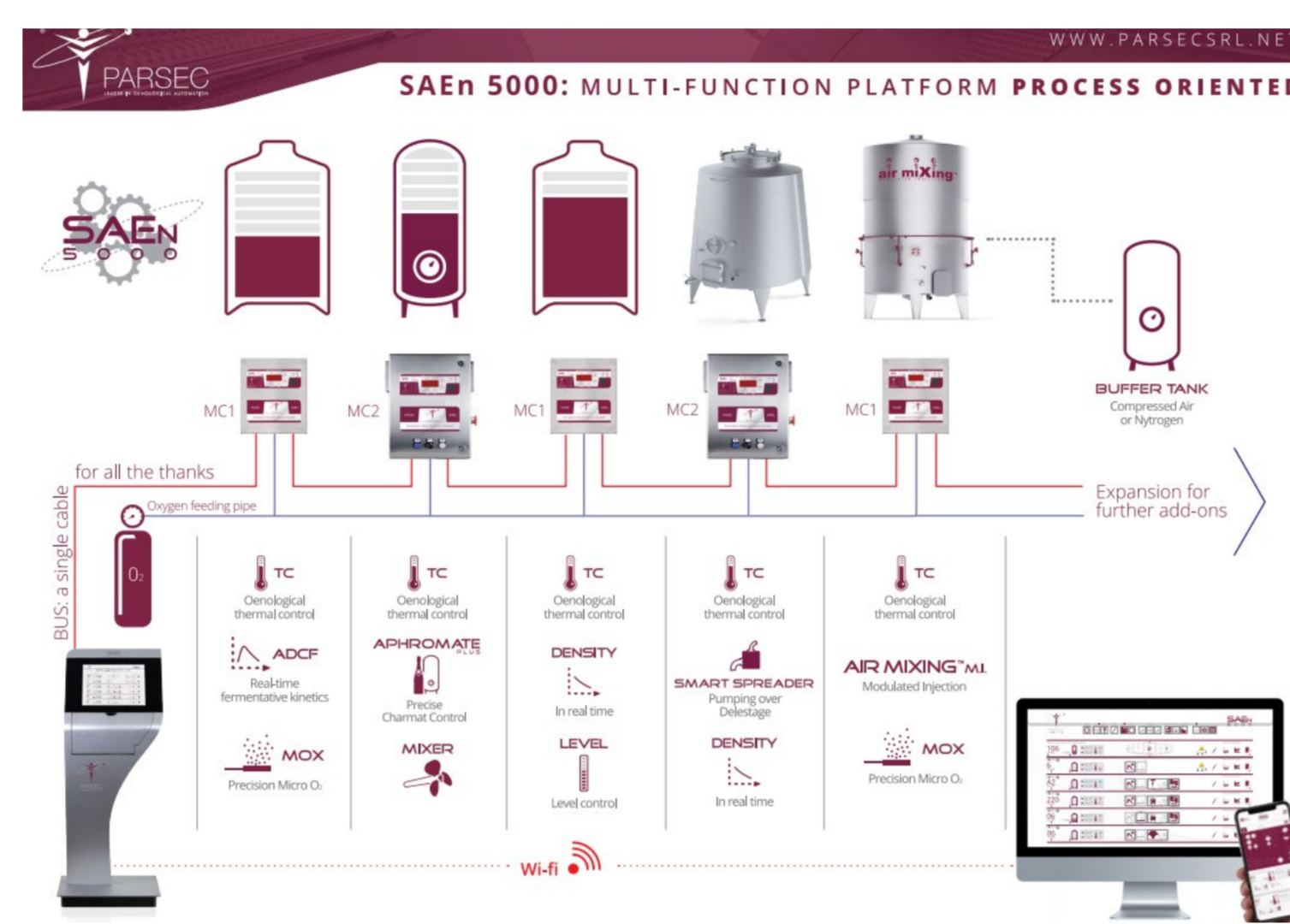
Great importance is the **oenological temperature control** (much more than a standard temperature check), **precision PARSEC micro-oxygenation**, the real-time **control of the density and/or fermentation kinetics**.

The system is able to **control all of these parameters in order to manage their interactions** and in accordance with the actual needs of the fermentation process.

In all the trial, in addition to **AIRMIXING M.I.**TM, also monitored in the tank are:

- Temperature;
- Micro- and macro-oxygenation;
- Density/Sugar residue/Fermentation Kinetics;
- The analyses imported from the laboratory or from any other analysis system in the cellar.

On the basis of our experience, we considered the measurement of redox potential, dissolved oxygen and conductivity to be useless in this research. But the SAEn5000 system allows to control all the sensors present on the market (REDOX potential, conductivity, capacity, and so on) that the oenologist considers to be of use or if it is considered important for research.



CONCLUSION:

Vinification by AirMixing M.I.TM means a cap no longer compact or hard. Fermentation cap is kept soaked and soft thanks to periodically submersions in the liquid phase. **THIS IS A FUNDAMENTAL ACHIEVEMENT THAT BRINGS THE FOLLOWING ADVANTAGES:**

Oenological results:

- Elimination of stratification (temperature and density)
- Yeasts dispersed throughout the entire mass
- The entire cap is involved in the extraction
- Absence of dry and smelly components in the cap
- Possibility to switch between Air compressed to Nitrogen for entire reductive fermentation
- Drastic reduction of vegetable residue production thanks due to not mechanical contact with the skin
- Proper management of the lees, especially for cultivars with high presence of polysaccharides (Pinot Noir, Merlot)
- The fermentative trend is optimised and typical fermentation issue is avoided
- Reductive issues are eliminated and there is no need AIR PUMPING-OVER intervention

Analytical and organoleptic results:

- Up to 30% more Colour Intensity
- Softer tannins and a drastic reduction of the "vegetal" notes
- Wine without olfactory defects that is ready in no time at all
- A stable wine, resistant to oxidation
- Quick and easy drawing off and quality pressed wine.
- Wines made by AIRMIXING M.I.TM have generally higher volume, fruitiness according to test panels.

Practical results:

- **Time & Safety:**
 - Quick and easy drawing off and quality pressed wine (up to 80% of time saved)
 - Tank racking without anyone having to go inside
- **Money saving & Quality**
 - Reducing personnel working in the winery during harvest time
 - The AIRMIXING M.I.TM does not uses pumps, electric motors, sprayer, funnels, etc
 - Significant reduction of maintenance
- **Environmental sustainability**
 - Significant reduction (Up to 75%) of Energy consumption: less cooling power needed

All the trials have always produced better results than the other technique (pumping over, bubbles solutions, rotovinifiers, etc) especially with larger tanks and the more unfavourable the geometry

COMPARATIVE TRIALS FROM 2015 TO 2020 IN DIFFERENT PARTS OF THE WORLD WITH AIRMIXING M.I.TM

A new method for selective extraction from grapes that doesn't require, pigeage, délestage, pump-overs or other bulk inside the tank.

The **simplification** and **optimisation** of the **racking and cleaning** operations is combined with **significant energy savings overall**. Thanks to the ability avoids hard cap formation, this new technique is changing the traditional management of the red winemaking process through an **optimized handling of the thermal-densimetric stratification, temperature, oxygenation, nutrition and fermentative kinetics**. The advantages are both practical and qualitative, even in tanks with large-scale or complex geometries.

In the 5 years since the introduction of this new technique, comparative tests have been performed out on many red grape varieties in various parts of the world. Following typical examples of the many done all over the years:

SPAIN—2015

On 2015 harvest First trial was performed in Spain on Tempranillo grapes in tanks with a capacity of 1500 hl, comparing the extraction results obtained with the new AirMixing M.I.TM system and those achieved with the technique commonly adopted in the cellar, with pumping over and délestage.

The results highlighted how the use of AirMixing M.I.TM allows for greater extraction from the earliest stages (an important aspect if there is the need to reduce the maceration time due to space constraints) along with an increase in colour intensity of between 17% and 21%

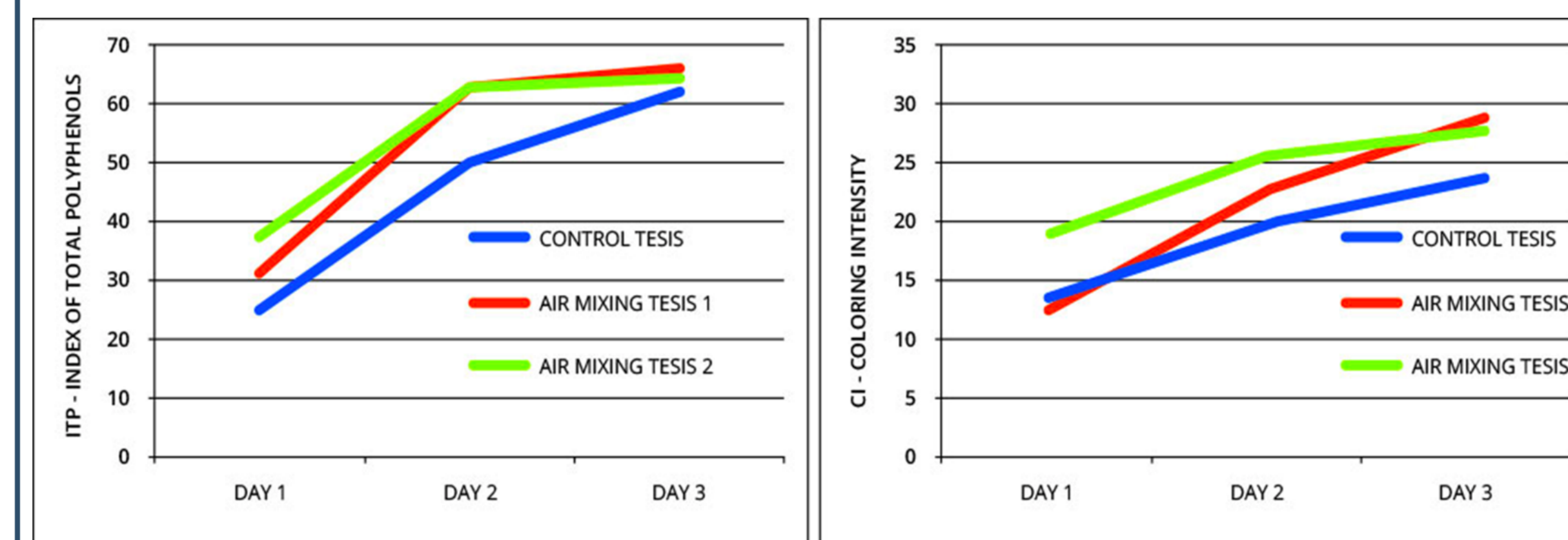


Image 1: Extraction of phenolic compounds (on the Total Polyphenol Index) on the left and evolution of the colouration intensity on the right during the extraction on Tempranillo subjected to various maceration techniques in 1500-hl tanks, with the new AirMixing M.I.TM technique or with pumping over and délestage.

ARGENTINA—2018

In Argentina has been performed trial on grapes as: Carmenere, Cabernet Sauvignon and Malbec.

The result are showed in the following graphics below.

TANQUE	MALBEC AIRMIXING M.I.				MALBEC TRADICIONAL			
	MACERACION DIAS	COLOR (Air-Mixing M.I.) INTENSIDAD OPTICA 420nm - 520nm	MATIZ		MACERACION DIAS	COLOR (TRADICIONAL) INTENSIDAD OPTICA 420nm - 520nm	MATIZ	
285	16	1681	0,5		244	18	1908	0,39
303	16	1637	0,49		245	16	2039	0,44
291	16	1644	0,44		235	16	1551	0,45
303	16	1637	0,49		242	15	1752	0,43
287	15	1436	0,48		203	14	1452	0,47
301	13	1667	0,43		243	12	1143	0,41
300	13	1822	0,38		254	12	1534	0,38
296	13	2454	0,44		257	12	1415	0,46
283	13	2246	0,44		233	12	1472	0,45
280	12	2390	0,42		219	11	1556	0,42
284	11	1507	0,43		236	10	1506	0,41
286	11	1299	0,46		246	10	1085	0,45
AVG	13,8	1785	0,45		13,2	1534	0,43	
								+16,33%

In 2018 a comparison trial by Argentinian Malbec has brought out how using AIRMIXING M.I.TM instead traditional pump-over and de-lestage improved the colour Intensity as well as the time for completing the fermentation on the left (Table 1)

TABLE 1: Colour Intensity in Mendoza Malbec in AIRMIXING M.I.TM – traditional method (8 pump-over + 1delestage) comparison. AIRMIXING M.I.TM provided wine fermentation shorter (13.8 days) and higher CI (+16.33%)

Additionally, to those, we have found that the high colour extraction in the AIRMIXING M.I.TM technic is not longer connected with time of contact between grape skin and must/wine (Image 2). In the AIRMIXING M.I.TM trial we can notice how the highest CI are around 12 days of fermentation, instead the trials with longer fermentation don't bring unexpectedly a lower CI.

In the traditional method the CI continues to be tightly connected with time of contact

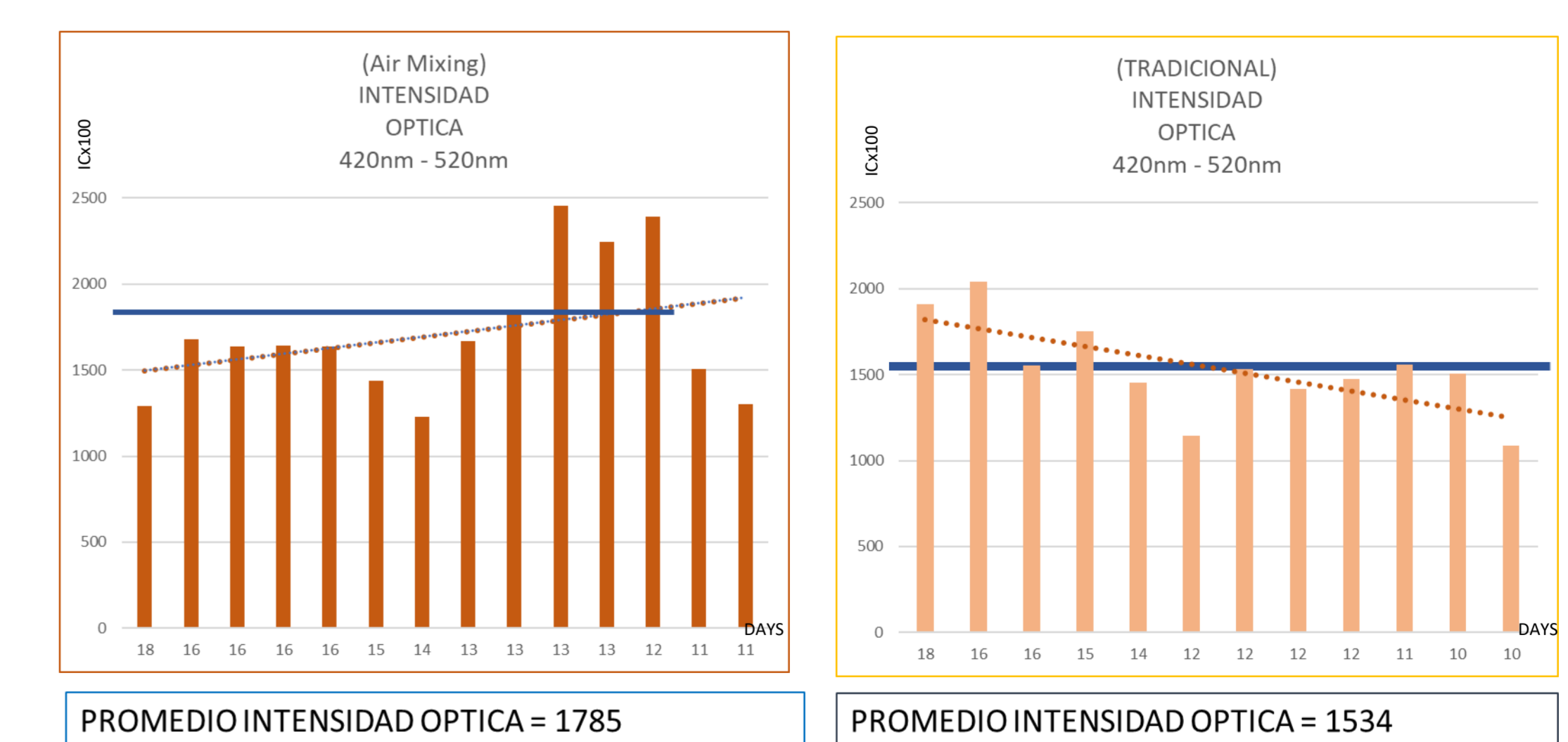


Image 2: correlation between colour intensity and skin/wine contact time.

BREAKING UP THE CAP WITH AIR OR COMPRESSED GAS

TODAY AIRMIXING M.I.TM IS PATENTED BY PARSEC SRL

The new solution **AirMixing M.I.** (Modulated Injection) use an original and innovative air injection method without bubbles: **a gas injection that creates DISINTEGRATING WAVES OF LIQUID that effectively break down and sink the cap, completely inundating it with must.**

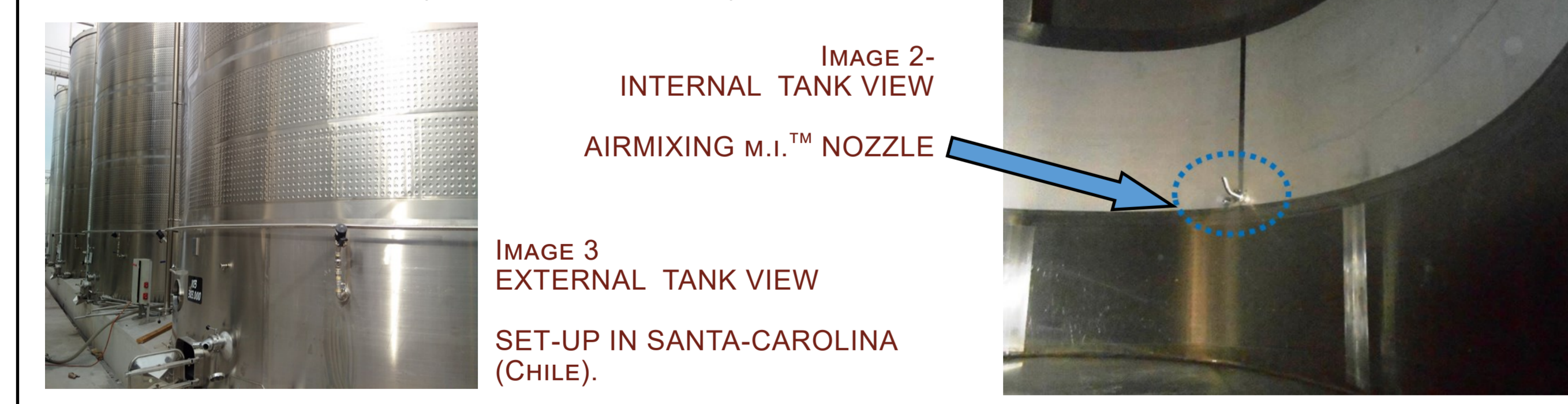
To achieve this result, PARSEC has developed a **SPECIAL AIR-INJECTION TECHNIQUE** CONSISTING OF THE SYNERGISTIC ACTION OF A **SYSTEM OF NOZZLES MOUNTED ON THE SIDE OF THE TANK** (such as on the plating), EACH INDIVIDUALLY OPERATED BY A PRE-SET COMBINATION.

In other words: The Parsec-patented solution works thanks to a SYNERGISTIC combination of **repeated short jets of air coordinated between the various nozzles**. These small jets of compressed air or gas **transmit the necessary mechanical energy to the liquid** to create a suitable amount of movement in the liquid itself (**DISRUPTING WAVES OF LIQUID**).

EACH INDIVIDUAL INJECTION OF GAS FROM EVERY NOZZLE IS A PARTICULAR SYNERGISTIC COMBINATION OF PAUSES AND SPURTS, WITH ALL NOZZLES OPERATED IN A SUITABLE SEQUENCE IN COORDINATION WITH THE OTHERS. THIS COMBINED AND SEQUENTIAL ACTION OF JETS CREATES MOVEMENT IN THE LIQUID WITHIN THE TANK COMPARABLE TO WAVES.

It is precisely these WAVES OF LIQUID that cause the grape marc cap to break up and submerge.

This new technique, in addition to being AN ABSOLUTE INNOVATION, allows you to "DOSE" the intensity of the energy transmitted to the LIQUID and to then MEASURE OUT THE INTENSITY OF THE DISINTEGRATIVE OPERATION ON THE CAP AND THE MIXING OF THE MUST/WINE ON THE BASIS OF THE SIZE OF THE TANK, THE DESIRED EXTRACTION ACTION, THE TYPE OF GRAPE, AND SO ON.



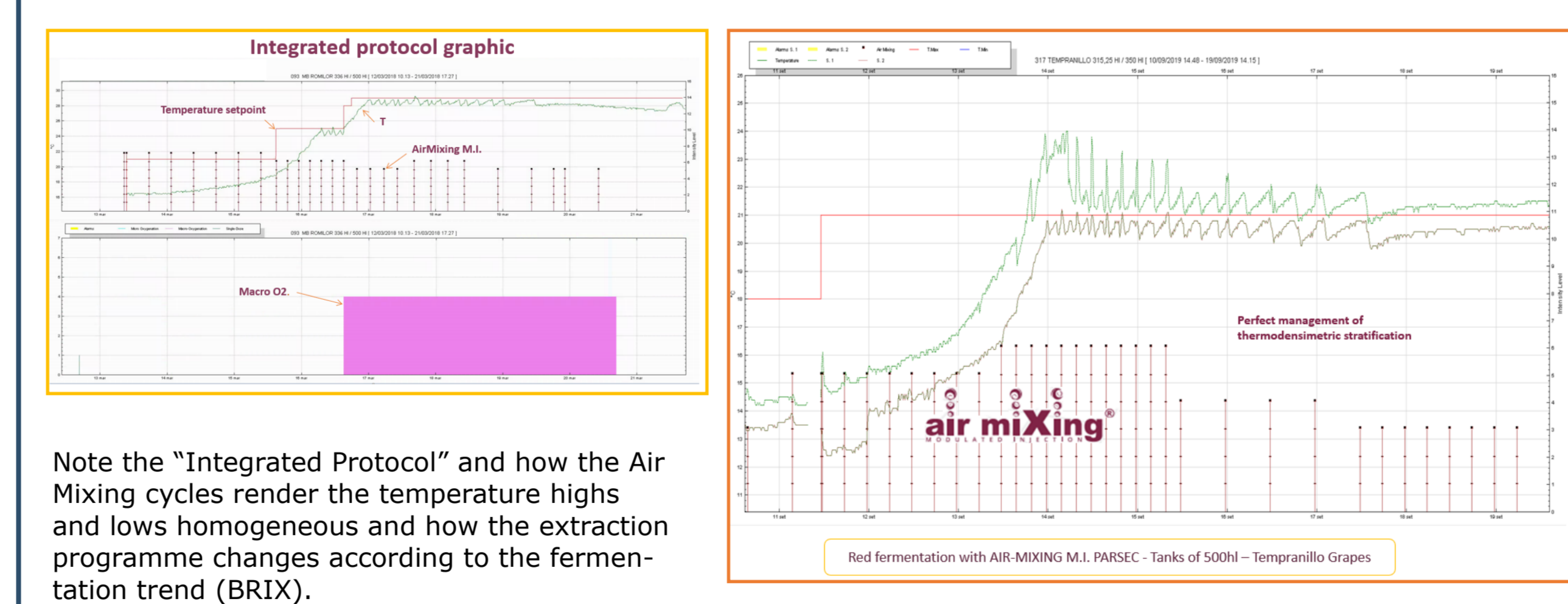
IN THE PAST The origins and evolution

The technique of **breaking up the marc cap with air** has been around for several decades.

Historically, the oldest technical solution consists of a tubular rod equipped with a manual tap. Once the rod has been inserted into the tank—either from the top through the grape marc cap or from below through a valve—the tap is manually turned on and off. Another solution utilises several of special nozzles (from 3 to 10, produced in such a way as to create air bubbles) to be positioned in concentric circles on the base of the container before being operated or contemporaneously alternating the centre and odd and equal circles. This movement of the bubbles in turn generates movement in the liquid.

With all of the old aforementioned techniques for breaking up the marc cap, it is important to keep in mind:

- 1) the cap does not break down and the liquid does not immerse it completely
- 2) it can only be used in small-sized tanks
- 3) the issue of stripping aromas and alcohol
- 4) normally must it used in conjunction with common pumping-over and punch-down methods



Note the "Integrated Protocol" and how the Air Mixing cycles render the temperature highs and lows homogeneous and how the extraction programme changes according to the fermentation trend (BRIX).

ITALY 2020

Sangiovese from Tuscany trial on 2020 has proven how AIRMIXING M.I.TM can effect positively the color structure of wine, especially in that grapes harvested with no perfect phenolic maturation. In fact, this kind of condition AIRMIXING M.I.TM has proven more color substance extraction and less astringency from green seed than traditional vinification by pump-over. (Image 1-2-3) That was confirmed not only by analysis but thanks to a following panel test (Image 4)

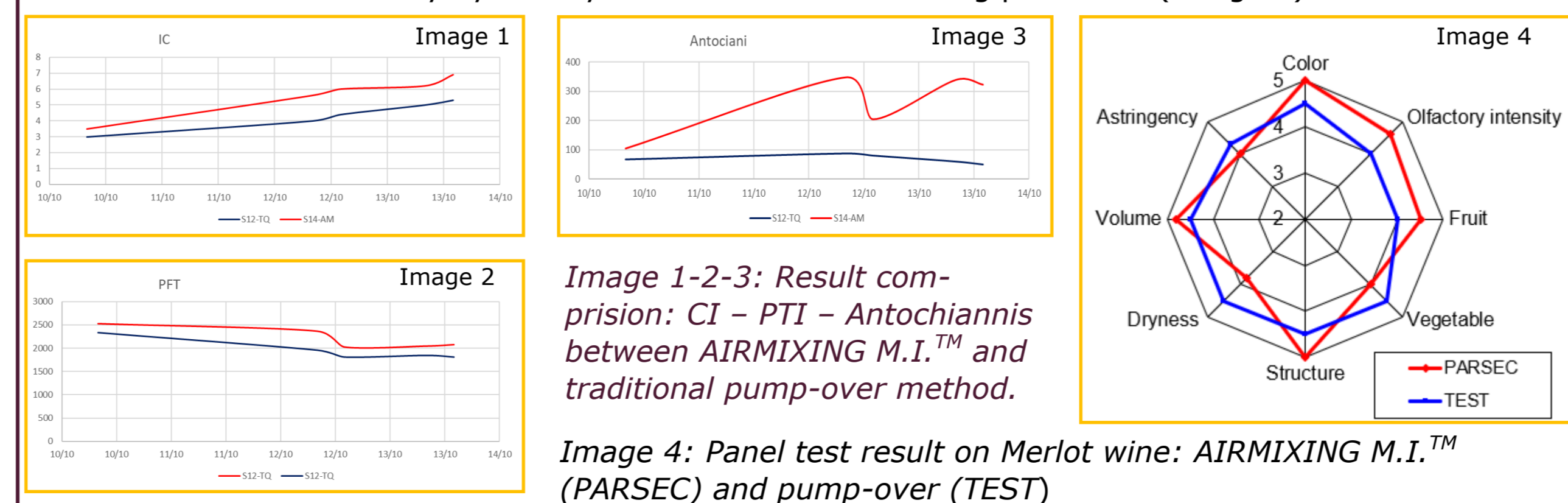


Image 4: Panel test result on Merlot wine: AIRMIXING M.I.TM (PARSEC) and pump-over (TEST)

CHILE-2020

A trial carried out in 2020 with Carmenere (Chile) produced similar results, with an improvement in colour and a reduction in fermentation and polyphenol extraction times (table 2).

Harvest 2020 Carmenere Chile AIR MIXING			Harvest 2020 Carmenere Chile PUMP-OVER		
CUBAS	TIPO VINO	COLOR int.	CUBAS	TIPO VINO	COLOR int.
92	CARMENERE BL. C.	19,20	91	CARMENERE BL. C.	17,79
101	CARMENERE BL. C.	18,59	102	CARMENERE BL. C.	14,12

table 2: Colour Intensity Carmenere (Chile) in AIRMIXING M.I.TM and traditional method of pump-over