OENODIA

INRA

STARS®
pH

KEEP IT NATURAL !

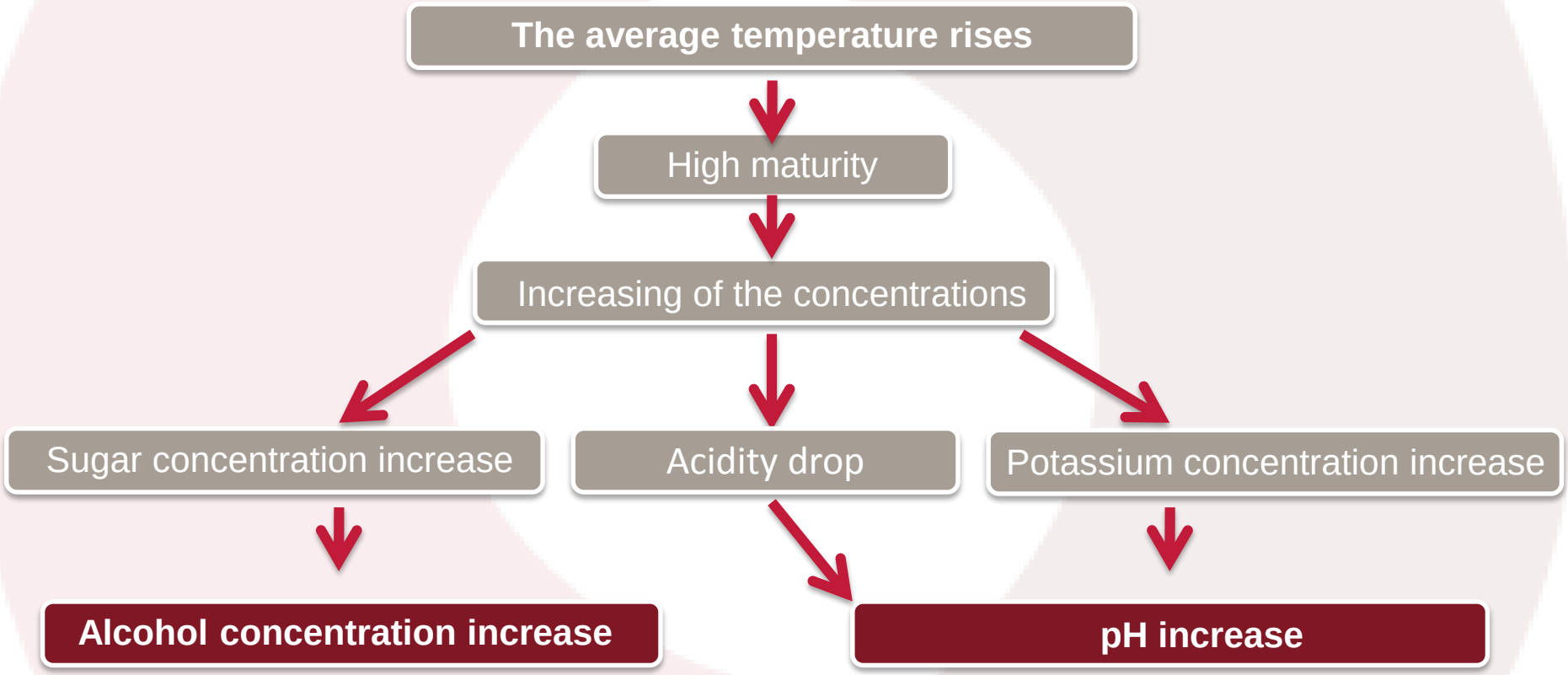
Adjusting the pH of wine without chemical additives thanks to

STARS® pH

STARS® pH

In order to provide the most effective response to the challenge of wine acidity, OENODIA has developed an innovative membrane-based technology which enables the pH of wine and musts to be adjusted naturally and with precision. The work carried out by OENODIA and the National Institute for Agronomic Research (Institut National de la Recherche Agronomique - INRA) has shown that **pH values** which could be considered too high are most commonly associated with **excess** cationic concentrations, in particular **potassium** (strong base salts) and for too low pH are associated with excess acid concentration, in particular **tartaric acid**.

Therefore, **membrane-based acidification / deacidification** attempts to **remove** some of this **potassium** or **tartaric acid** from must or wine **in order to lower or increase pH** and **optimize natural acidity**.



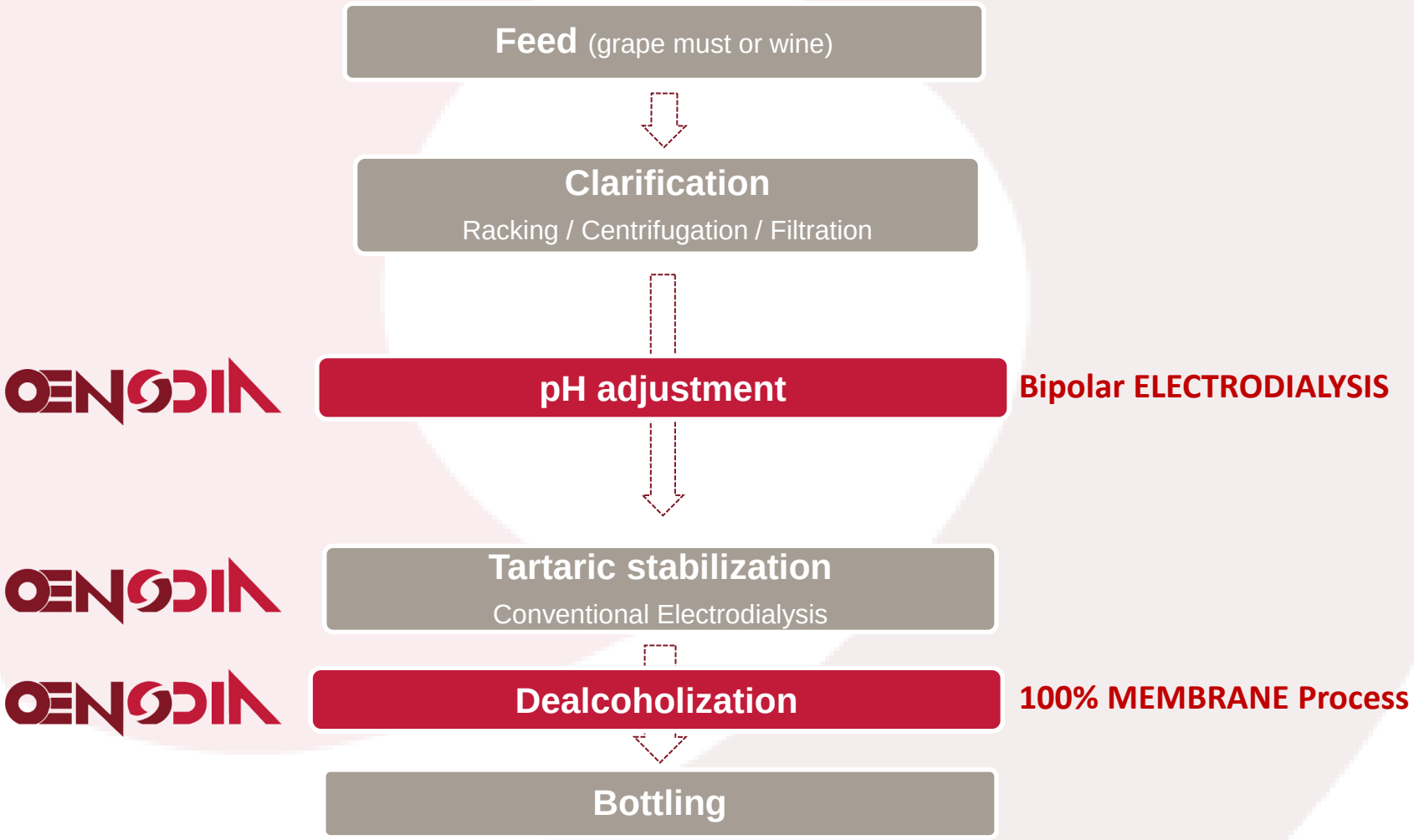
Average alcoholic%
(source AWRI)

12.4% in 1984
14.2% in 2002

Average pH « muscats de Frontignan »
(source cave coopérative de Frontignan)

3.5 in 1983
3.7 in 2003

Faced with « Global warming » and climate change, INRA and Oenodia has decided to jointly develop their solution for pH adjustment



Actual issue: instable pH and upward

- Average pH increase for the last 30 years: 0.2 / 0.3

WHY

- Global warming
- Maturity time shift
- Vineyard driving
- Microbiological unstability

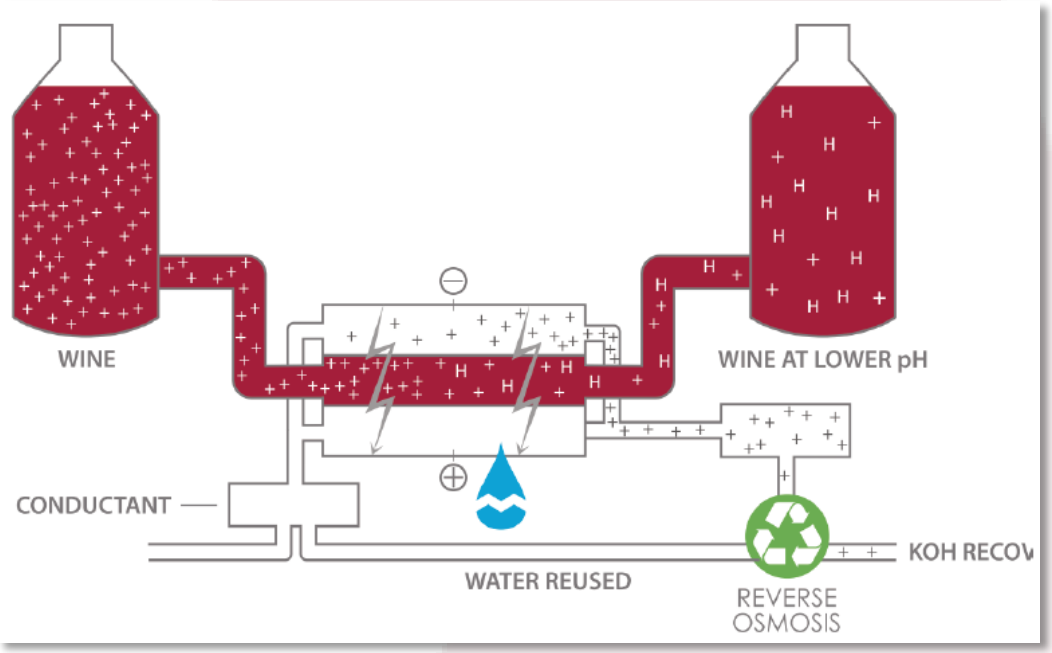
CONSEQUENCES

- Organoleptic impact (lack of freshness, lack of aromas / flavours, etc.)
- Oxidation and premature aging, aging issue
- Market loss due to a lack of quality (against the consumers expectations)

pH adjustment via electrodialysis
100 % membrane process / additive free

This sustainable process requires no chemical additives, and is based on continuous and single pass treatment which respects wine quality and consumer demands.

The process is based on bipolar-membrane Electrodialysis technology: a modular membrane stack with parallel compartments made up of alternate layers of membranes and spacers. Every other membrane compartment carries grape must or wine while the alternating membrane compartment carries water. Membranes are non-permeable and only allow specific ions to transfer. This ion transfer is generated by applying a weak electrical load to the membranes.



This process achieves an easily adjustable pH reduction of 0.1 to 0.5. It can be carried out at any point in the vinification process:

- on grape must,
- on wine after the alcoholic fermentation,
- before or after malolactic fermentation,
- or even before the bottling.

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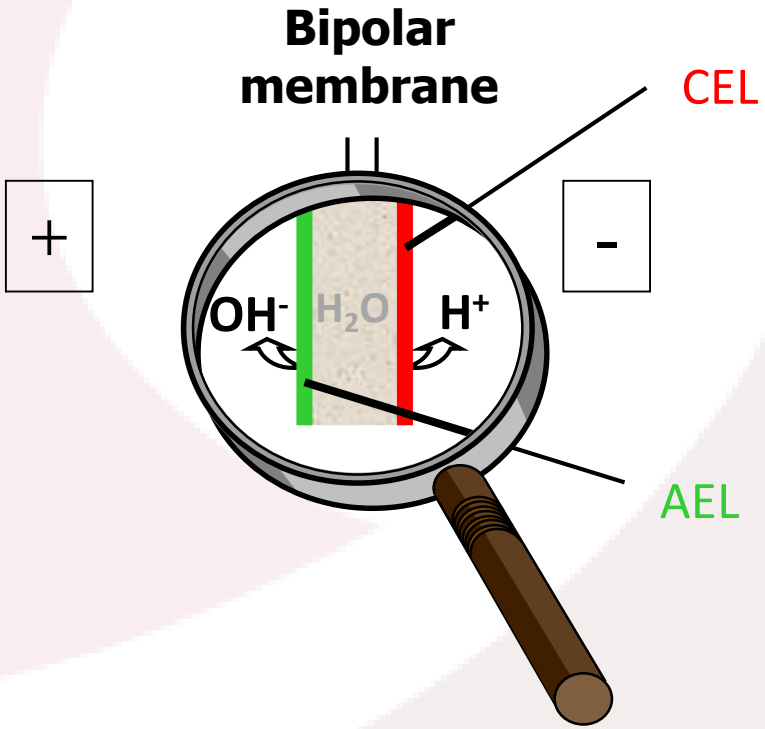
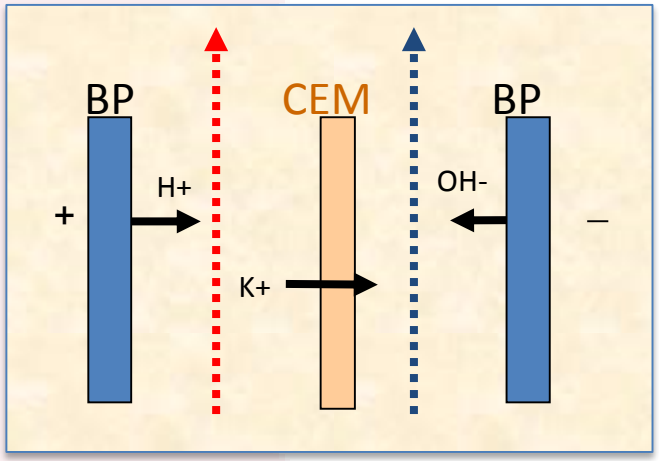
STARS$_{pH}$ Bipolar membrane: how does work?

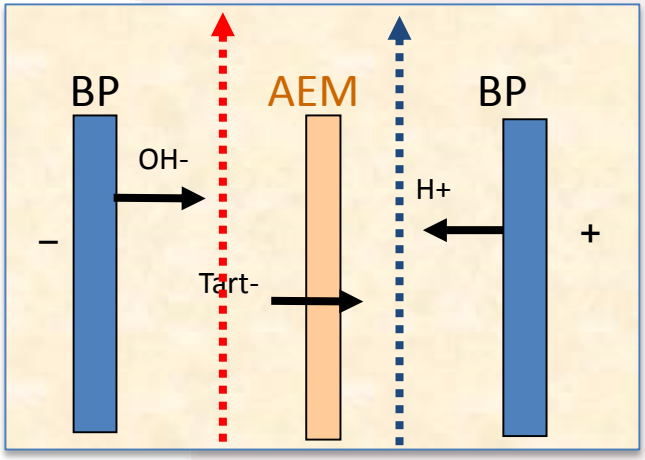


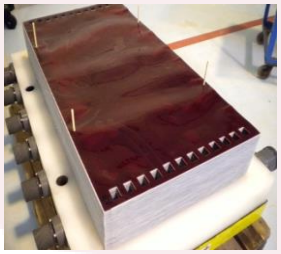
ED Process

Electromembrane process

Continuous Process



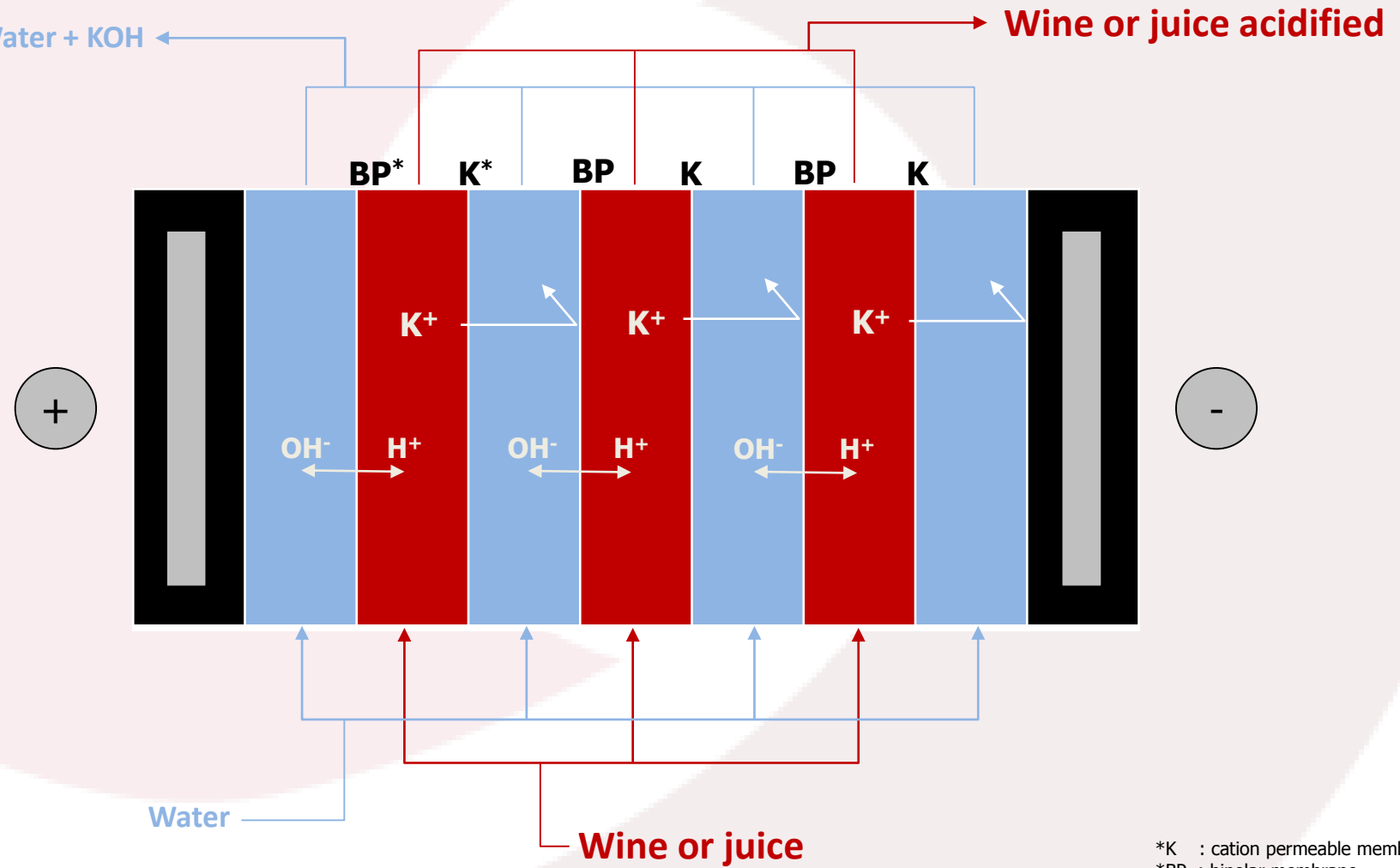




Acidification

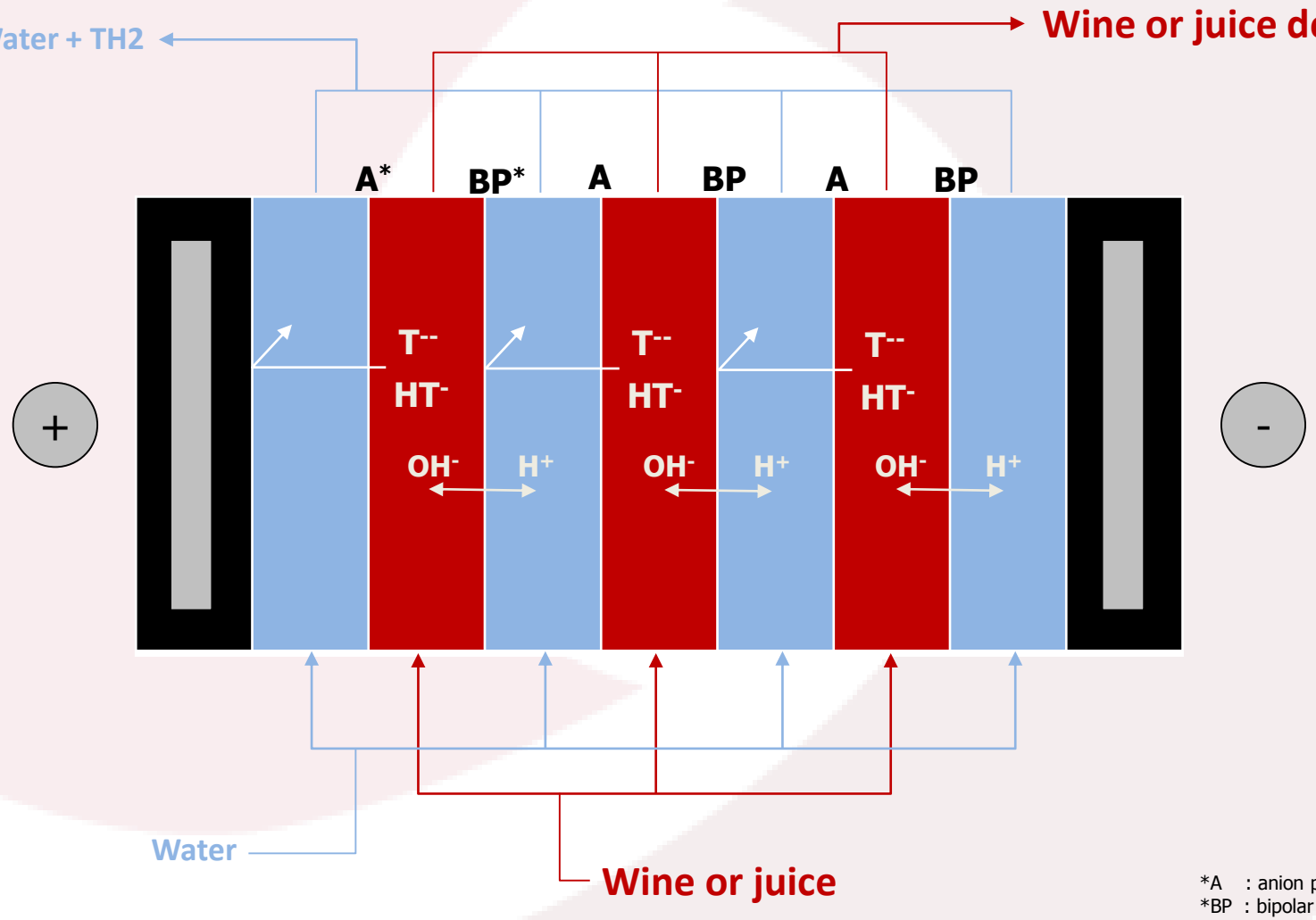
Acidity Reduction

STARS$_{pH}$ pH adjustment (acidification) : How it works?



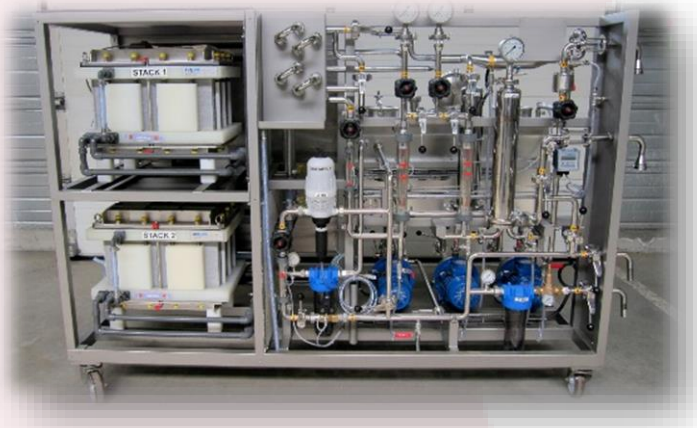
*K : cation permeable membrane
*BP : bipolar membrane

STARS$_{pH}$ pH adjustment (de-acidification) : How it works?



*A : anion permeable membrane
*BP : bipolar membrane

STARS pH adjustment
100% membrane process / additive free solution



BENEFITS

Technical

- Substractive method
- Easy pH adjustment (0,1 ~ 0,5 pH for wine and grape must),
- Optimizing SO_2 use
- Microbiological stability

Industrial

- Mobile service available,
- Effluent recovery (acid or base which can be used as cleaning solution),
- No wine loss,
- Low opex (<0,01 € per litre of wine treated)

Environnemental friendly

- No chemical additives required (no tartaric acid, no malic, lactic,),
- Low energy consumption (<0,002 kW per litre of treated wine)

Consumers

- Treatment well adapted for each wine quality
- Better conservation, ageing improved
- Better color intensity,
- Positive effect on taste, bouquet and or wine color.

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Membrane based pH Control and Adjustment

In order to provide the most effective response to the challenge of wine acidity, OENODIA has developed an innovative membrane-based technology which enables the pH of wine and musts to be adjusted naturally and with precision. The work carried out by OENODIA and the National Institute for Agronomic Research (Institut National de la Recherche Agronomique - INRA) has shown that pH values which could be considered too high are most commonly associated with excess cationic concentrations, in particular potassium (strong based salts).
Therefore, membrane-based acidification attempts to remove some of this potassium from must or wine in order to lower pH and optimize natural acidity.

IMPROVED QUALITY

STARS, the sustainable process developed by OENODIA requires no chemical additives, and is based on continuous and single pass treatment which respects wine quality and consumer demands. The process is based on bipolar-membrane Electrodialysis technology: a modular membrane stack with parallel compartments made up of alternate layers of membranes and spacers. Every other membrane compartment carries grape must or wine while the alternating membrane compartment carries water. Membranes are non-permeable and only allow specific ions to transfer. This ion transfer is generated by applying a weak electrical load to the membranes.
By controlling the application of the weak electrical load or current to the stacks, potassium contained in the grape must or wine is selectively extracted. This reduction in cationic concentration is immediately compensated by an addition of H+ ions, obtained by the dissociation of water molecules in the wine. The process has no effect on the final product other than controlling its acidity and consequently resulting in a natural improvement of its quality.This process can be carried out at any point in the vinification process (on grape musts, on wine after alcoholic fermentation, before or after malolactic fermentation, or even before or during bottling). It achieves an easily adjustable pH reduction of 0.1 to 0.5.

pH issues?

Excess of Acidity **?**

- *Ins* Meridional or austral areas,
  Cool vintages,
  Primeurs
- *Outs* « sharp » wines
- *Solutions* 1. Blending

  2. De-acidification (KHCO3 or CaCO3)
     - Impact on tartaric stability
     - STARS

pH issues?

Lack of acidity ***?***

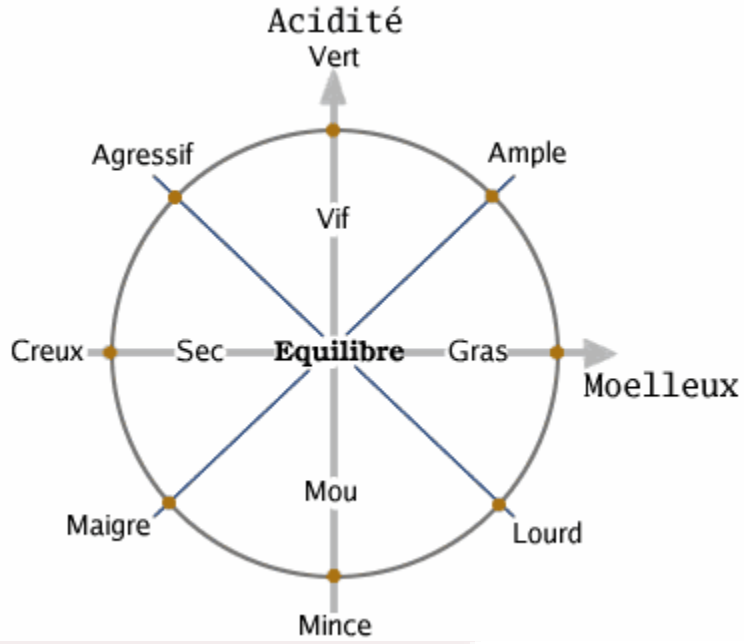
- *Ins* Global warming & oenological practice changes
  High-yield viticulture
- *Outs* Lack of freshness, vivacity
  Ageing potential (SO2) & microbiological stability (Bretts)
  Color drift, especially on Rosés
- *Solutions*

1. Acidification

Tartaric, malic, lactic, citric…
Likely to sharpen mouth tasting
Cost of 6 to 8 €/kg H_2T
Legal threshold of 1,5 g/l in France

2. IEX

3. Bipolar electrodialysis



1. Qualitative impact

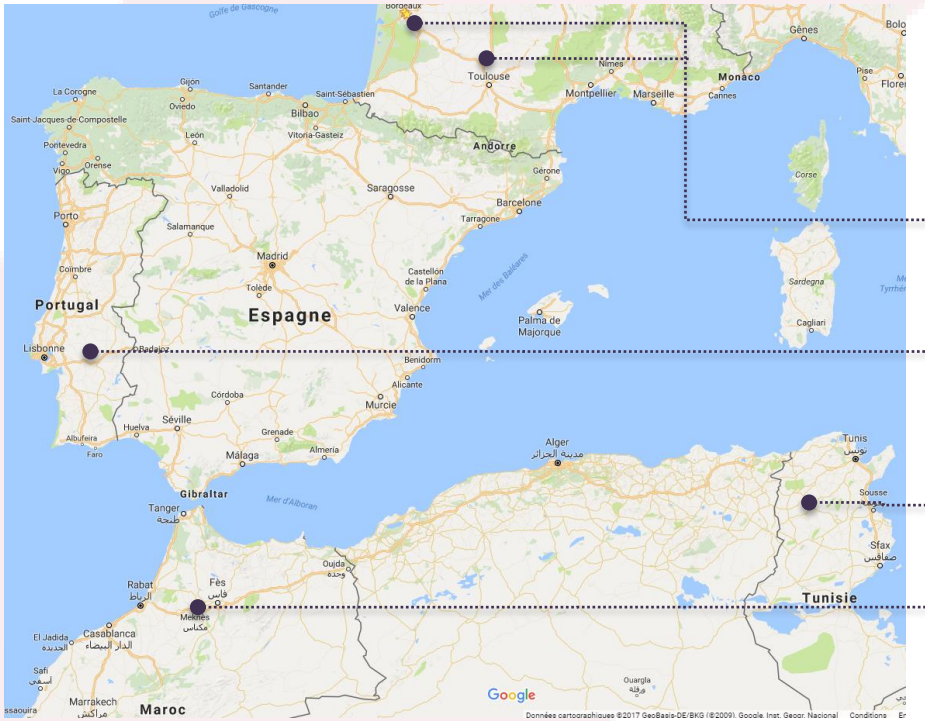
- ✓ Restore mouth acid balance
- ✓ Color impact on Reds and Rosés:
  - Increase color intensity
  - Reveal the blue component of anthocyanins (rejuvenation)

Centre du Rosé color chart

2. Wine ageing improvement

- ✓ Less suitable for bacterial growth
- ✓ Boost molecular SO2 action

Wineries using STARS pH



Where ?

- *France*
- *Portugal*
- *Tunisia*
- *Morocco*

Many New Prospects for coming years

- *France (Nothern vinyards)*
- *Tunisia*
- *USA, California*
- *México*
- *Argentina*
- *Italy*
- *Germany…*

Various realities, various opportunities

- *Icon Reds in Bordeaux & Alentejo* — *Overripe berries* — *Mouth balance & barrel ageing*
- *High yield in Morocco & Tunisia* — *K fertilization* — *Color and freshness*
- *Rosé at Fronton and Provence* — *Négrette grape variety* — *Color profile*

An eye-catching example

- *France* — *Provence* — *Finding the perfect tint or shade*

1. Targeting upmarket wineries

- ✓ Boutique wineries focused on Premium and Icon reds
- ✓ Base for sparkling wine
- ✓ No satisfactory technical solutions regarding pH adjustment

2. Providing Mobile Service

- ✓ On-site trials
- ✓ Key argument = tasting & ageing security
- ✓ Punch line : TASTE & BUY
- ✓ Small VS big volumes.

STARS® pH

3. Rely on Oenodia's support

- ✓ All of our winemakers know-how
- ✓ Implement industrial trials
- ✓ Specific offer to boost the technology

In a word…

- ***Pros*** *Additive free*
  Precise monitoring of the pH adjustment (0,1 / 0,2 / 0,3 / …)
  On-line tasting and adjustment regarding:
  - *Balance between alcohol / acid / tannins*
  - *Freshness in mouth*
  - *Color (rosé, Pinot Noir, …)*

- ***Use*** *After alcoholic fermentation (25 µm threshold)*
  Before barrel ageing (light filtration or racking off)
  Before bottling for slight adjustment

- ***Impact*** *Clear qualitative improvement*
  Microbiological and oxidative stability while barrel ageing
  Improve wine proper ageing over time

ADDITIVE FREE SOLUTIONS

OENODIA
ZAC ST MARTIN
IMPASSE ST MARTIN
84120 - PERTUIS - FRANCE
TEL : +33 (0)4 90 08 75 00

commercial@oenodia.com

www.oenodia.com