Heat and cold stability

Continuous Stabilization Methods

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Why adopt continuous process methods?

What are the options?

Two common systems

What system is best for me?
Continuous Processes

- Energy efficient
- Fast / just in time
- Lower losses
- Enables easier optimisation
- Cost effective
- Environmentally friendly (potentially)
Continuous Stab Methods

- Ion Exchange
- Rapid Contact
- Electro-dialysis
Ion exchange

- Cation exchange.

Wine In

Wine Out

Resin

K⁺

Na⁺
Ion exchange (cont.)

- At one point in time was widely used in Australia and USA.
  - Since 1950s in Australia.
- Cost:
  - Typically less than 10% of refrigeration (Rankine 2004).
- Sensory:
  - Dessert wine not detectably altered but delicate table wines can be affected (Rankine 2004).
- Increase in sodium can be undesirable.
- Highly saline wastewater from regeneration can be problematic.
- Complex regulatory issues:
  - Have fluctuated with regards to EC, apparently now allowed according to EC-Australia trade agreement (2009) and OIV Codex (2009) but there are additional qualifications about use in the OIV Code of practices (2010).
  - Would need to be entirely sure of country specific regulations before use.
Rapid contact stabilisation (continuous)

• Packaged continuous cold stabilisation systems have been offered by several companies.
  – Often try to avoid the addition of fresh seed crystals.
    • Employ some form of crystal retention.
  – DE filter or disc-stack centrifuge for final crystal removal.
  – Heat exchanger for energy recovery.
Rapid contact stabilisation (continuous)

- Vinipal system (1,000 – 30,000 L/hr).
Rapid contact stabilisation (continuous)

- Alfa-Laval Frigoflash (2,500 – 20,000 L/hr).
Rapid contact stabilisation (continuous)

- Della Toffola Polar (1,000 – 20,000 L/hr).
Membrane processes

- Nanofiltration.
Membrane processes (cont.)

- **Electrodialysis.**

The diagram illustrates the process of electrodialysis, where ions are separated by charged membranes. At the anode (+), cations (e.g., $K^+$) are attracted and pass through a cation-permeable membrane, while at the cathode (-), anions (e.g., $HT^-$) are attracted and pass through an anion-permeable membrane. The concentration of ions increases in the concentrated solutions (Conc.), and the wine (Wine) is purified.
Wine to be treated

Conductant holding tank (~0.1% HNO₃)

Conductant to recycling or waste

Wine to be treated

Membrane stack

Conductivity meter

PLC control

Pump skid

Untreated wine

Treated wine

Voltage and current under PLC control

Treated wine

Conductant to recycling or waste
## The results – previous trials

<table>
<thead>
<tr>
<th></th>
<th>Traditional Cold</th>
<th>Electro dialysis</th>
<th>Rapid Contact</th>
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<tbody>
<tr>
<td>Electricity Consumption</td>
<td>Various (15-80)</td>
<td>1.5-3</td>
<td>7</td>
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<tr>
<td>(Kwh/kL)</td>
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<tr>
<td>Water Consumption</td>
<td>75-150</td>
<td>250</td>
<td>100</td>
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<tr>
<td>(L/kL)</td>
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<tr>
<td>Waste Water Volume</td>
<td>75</td>
<td>250</td>
<td>100</td>
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<tr>
<td>(L/KL)</td>
<td></td>
<td></td>
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<tr>
<td>Time Taken (hrs/KL)</td>
<td>0.5</td>
<td>&gt;300</td>
<td>0.3</td>
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The trial – Energy Consumption

• Continuous methods are more energy efficient
  – Heat recovery
  – ED does not use temperature

• Price comparison (1.8c/L v 0.03 c/L does it really matter. Bottle = 45c, Cork = 25c, Screw Cap= 10c)

• What is your starting and finishing temperature? This has a big impact.
So what is the best method?

- Largely determined by winery needs
- Continuous methods have definite advantages
- Capital cost is high
- Labour up-skilling

- Current refrigeration capacity
Continuous Processing Benefits

• Faster processing time means greater control
• Repeat treatments
• Coupling with other JIT processes may have many benefits
• Recovery of Heat/COLD saves energy
• ED works differently – may not strip valuable long chain molecules that are beneficial in other ways