Wine Filtration Workshop
Review of Methods and Materials

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Thank you, Ms. Jones!

Wine Filtration Workshop

Location: Crystal Mountain Resort, Thompsonville, Michigan
Date: Thursday, February 28, 2008
Time: 8:30 am – 11:45 am
Chair: Christian Butzke, Enology Professor, Purdue University
2nd Vice President, American Society for Enology and Viticulture
Coordinator: Linda Jones, Executive Director, Michigan Grape and Wine Industry Council
Michigan Department of Agriculture
Theme: A hands-on review of commercial small-scale wine filtration techniques offering perspectives from leading wine industry suppliers, winemakers and wine scientists. Small groups of participants will rotate between techniques.

Techniques:
I. Pads and DE; CMF Demonstration
   Jim Smith & Gerry Lachut, The Hilliard Corporation
II. Depth-Filter and Sterile Cartridges
    Conor O’Hara, Cuno Incorporated
III. Membranes and Cross Flow
     Nicole Madrid, Pall Corporation

Agenda:
8:30 am Welcome, Introduction & Group Assignment
8:40 am Filtration Overview
   Dr. Christian Butzke, Purdue University
9:25 am Rotation 1: Group A/Technique I; Group B/Technique II; Group C/Technique III
10:00 am Rotation 2: Group A/Technique II; Group B/Technique III; Group C/Technique I
10:35 am Rotation 3: Group A/Technique III; Group B/Technique I; Group C/Technique II
11:10 am Filtration Roundtable Discussion w/Local Winemakers
   Dr. Dave Miller, VP of Winemaking and Viticulture, St. Julian Wine Company
11:45 am Adjournment

www.michiganwines.com
• Filtrosophy
• Filtration Systems
  • Pad/Cartridge/DE
  • Membrane
  • Cross Flow
    • Particle Filtration
    • Reverse Osmosis
• Filterability Testing
Particle Size

- 10 nm
- 10 µm
- 1 µm
- 100 nm
How to Unfilter?

- No Un-Filtration
- No Routine Filtration
Personal Filtration Preferences

[Images of a French press coffee maker and a drip coffee maker]
Particle Size

10 µm

.45 µm

.2 µm

1 µm

10 nm

100 nm
Pad Filtration
Oxygen Pick-up?
Pad Filtration
Pad Sanitation

w/out counter pressure!
Pad Sanitation

With counter pressure!
Proper Cork Storage
Proper (TCA-free) Storage

Filter Pads/DE

Bentonite
Pore Seize vs. Flow Rate
Modular Depth Filters

Stacked disks
Modular Depth Filters

Cartridge packs
Diatomaceous Earth is a mineral filter aid mined from the fossilized silica shell remains of algae from the class Bacillariaphyccae, better known as Diatoms.
Diatomaceous Earth
Diatomaceous Earth

http://www.filtrox.ch
Diatomaceous Earth
DE/Rotary Drum Vacuum Filter
Membrane Filtration

0.45µm
Pad/DE vs. Membrane

Depth

Surface
Membrane Filtration

Saccharomyces cerevisiae

Electron Microscope Image by Bill Plunkett @ Clarkson University
Membrane Filtration

Oenococcus oeni

Electron Microscope Image by Bill Plunkett @ Clarkson University
Membrane Filtration

- Surface Filtration
- Perpendicular
- Removal of Microbes
- “0.2 - 1.2”μm Pores
- Integrity Tests
Membrane Filtration Setup
Sterile Filtration

1. Cellulose
2. Membrane 1.20 µm
3. Membrane 0.45 µm
4. Cellulose

Depth
Surface
Membrane Filtration

- Mount
- Integrity Test
- Sterilize
- Bottle
- Re-Test

“Bubble Point”

- Flood membrane with water
- Pressurize to 80% with N₂ gas
- Increase pressure by 2 psi/min
- Note pressure when bubbling starts
- Compare to filter specifications
Integrity Tests

- Bubble Point
- Forward Flow
- Pressure Hold
Membrane Filtration

Bubble Point Integrity Test

Capillary Forces vs. Surface Tension

Gas Pressure

Largest Pore Size
Bubble Point Integrity Test

Bubble Release

- *largest* pore diameter
- pressure differential
- surface tension (Water vs. Wine!)

"steady stream of bubbles"

Result:

- membrane integrity
- correct filter size
- correct mounting
- Note: 4 to 6 psi variation
- NOT tested: sterility downstream
Membrane Pore Sizes

“.45 µm Nominal Pore Size”
Pore vs. Protein Size

Mannoprotein Size: 0.003 - 0.135 µm (10 – 450 kDa)

Pore Size Sterile Filter: 0.450 µm
Shriveled Bacteria?

Oenococcus oeni: 1.0 µm
Pore Size Sterile Filter: 0.45 µm

"viable but non-culturable“
Always do your Bubble Test!
Sources of Re-Contamination

- Hoses, Lines, Gauges
- Valves
- Gaskets
- Inert Gas
- Vacuum Line
- Rinse Water
- Filler Bowl
- Bottles
- Conveyors
- Condensate
- Filler Heads
- Corks
- Filtered Air
- Hopper
- Vacuum Line
- Corker Jaws
- Winemakers

Millipore Corp. in PW&V 1989
Fouling
Filter Fouling

“undesirable accumulation of materials on the surface of the filter”

- Yeast/Bacteria Cells (alive or dead)
- Biofilm Formation (Polysaccharides)
- Colloidal Materials (Pectine, Protein etc.)
- Fining Agent Residue (Bentonite etc.)
Cross Flow
Cross Flow

Wine -> Permeate = Filtered Wine

Permeate = Filtered Wine

Retentate
Cross Flow: Automation
Reverse Osmosis
Reverse Osmosis

Wine

Permeate

Retentate

= Filtered Wine
Reverse Osmosis

Removal

- Alcohol
- Volatile Acidity (+ Ion Exchange)
- 4-Ethylphenol/guaiacol ?
- Oxidative Aroma (Aldehydes) ?
- Reduced Aroma (Sulfides) ?
Cross Flow/Reverse Osmosis

Questions:

• Product heating/churning?
• Aroma loss?
• Product loss?
• Storage/inspection/cleaning?
• Permeate use/DSP license?
Reverse Osmosis

No absolute cut-off!
### Reverse Osmosis

**Molecular Weights:**

- Ethyldecadienoate: 196
- Oak Lactone: 156
- Vanillin: 152
- 4-Ethylphenol: 122
- 2-Phenylethanol: 122
- Methoxypyrazine: 110
- Ethylacetate: 88
- Diacetyl: 86
- Molecular SO$_2$: 64
- Acetic acid: 60
- Ethanol: 46
- CO$_2$: 44
- Water: 18
Osmotic Distillation

- Hollow Fiber Membrane
- 2 Liquid Phases: Wine vs. Water
- EtOH/CO₂/SO₂/H₂S Evaporates Through Membrane
- @ Room Temperature and Low Pressure

www.liqui-cel.com
Filterability Testing

• How many pads/cartridges do we need?
• Will it go through the membrane?
• How much wine can we filter?
• Can we keep up with the bottling line?
• When can we go home?

Suggested reading: www.winerysolutions.com/filter.html
The Wine Grape Action Team is a cooperation between Purdue University’s Department of Food Science and the Indiana Wine Grape Council to serve the State’s vintners and growers and help propel the Indiana wine/grape industry into world-class competitiveness. The 4-member team is available at any time to troubleshoot emerging issues in your vineyard and winery.

- **2008 Spring Grape and Wine Workshop** - **Wednesday, March 19**
  - Host: Oliver Winery
  - Program & Registration (Jill Blume)

- **2008 Italy for Wine Professionals**
  - Program May 10-10 (Christian Butzke, Bruce Bordelon & Jill Blume)
  - Registration

- **2008 Wineries Unlimited**
  - Program (March 4-7, King of Prussia, PA)
  - Registration

- **2008 Michigan Wine Industry Annual Meeting**
  - Program (February 28, Crystal Mountain Resort, Thompsonville, MI)
  - Wine Filtration Workshop (Christian Butzke)

enology.butzke.com
And now:

Filtration Techniques

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