Crystar® Filtration Technology (FT)
MICROFILTRATION MEMBRANES FOR WINE CLARIFICATION

KEY BENEFITS of CRYSTAR® FT R-SiC MATERIAL

Crystar FT is composed of recrystallized silicon carbide (R-SiC), an outstanding ceramic material with a myriad of advanced mechanical, thermal and chemical properties.

Attributed to their well-controlled and engineered microstructure of high-purity R-SiC from the membrane to the carrier, Crystar FT membranes feature:

- Enhanced permeate fluxes enabling higher throughput filtration at lower operating costs with more compact and lighter installations.
- Superior chemical resistance allowing the use of harsh cleaning agents.
- High thermalmechanical resistance enables shorter chemical cleaning cycles at high temperature without risking structural damage to the membrane.
- Low adsorption of organic matter and other negatively charged compounds, enabling fast and efficient cleaning procedures in high-fouling liquids.
- Excellent efficiency in reducing high levels of suspended solids, bacteria, and other particulates in challenging streams.

WEIGHT LOSS AFTER 200 HOURS + 200 HOURS OF CHEMICAL CORROSION

- Alumina 200 nm
- Crystar FT 250 nm
- Competing SiC 40 nm

THERMAL SHOCK RESISTANCE ASSESSMENT BY HASSELMAN METHOD

- Crystar FT
- Titanium dioxide (TiO2)
- Alumina (Al2O3)

TOGETHER WE MAKE THE MATERIAL DIFFERENCE

1 product out of 4 sold by Saint-Gobain today didn’t exist 5 years ago
Nearly 400 patents filed in 2017
Neatly 3700 Researchers
One of the top 100 industrial groups in the world
Present in 67 countries
2018 net sales €41.8 billion

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MICROFILTRATION MEMBRANES FOR WINE CLARIFICATION

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Crystar® Filtration Technology (FT)

MICROFILTRATION MEMBRANES FOR WINES CLARIFICATION

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<table>
<thead>
<tr>
<th>WEIGHT LOSS AFTER 200 HOURS + 200 HOURS OF CHEMICAL CORROSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH 14 - pH 0</td>
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<tr>
<td>pH 13 - pH 1</td>
</tr>
</tbody>
</table>

- 0.0%
- 0.1%
- 0.2%
- 0.3%
- 0.4%
- 0.5%

Crystar FT 250 nm | Competing SiC 40 nm | Alumina 200 nm

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NASDAQ: SIOB
CROSSTRADE: SIOB

www.crystarfiltration.com

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THERMAL SHOCK RESISTANCE ASSESSMENT BY HASSELMAN METHOD

<table>
<thead>
<tr>
<th>Temperature difference [°C]</th>
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<tbody>
<tr>
<td>0.00</td>
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<tr>
<td>0.25</td>
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<tr>
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<table>
<thead>
<tr>
<th>Normalized breaking load</th>
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<tbody>
<tr>
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Sold by Saint-Gobain

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**CRYSTAR® FT250**

**A REVOLUTION IN WINE CLARIFICATION**

Crystar FT250, Saint-Gobain’s newly developed silicon carbide membrane provides:

- Excellent filtered wine quality.
- High productivity thanks to superior filtrate fluxes.
- Unmatched robustness for fast and efficient cleaning procedures.

These features offer the most cost effective and reliable wine processing, especially for difficult red wines.

**Success story at an Australian wine maker:**

Achievements of Crystar FT250:

- Increased Production capacity without capital investment in new equipment.
- Reduced maintenance due to higher membrane robustness.

**Performance**:

- High and stable wine permeate fluxes: 50% higher productivity than oxide ceramic membranes.
- Improved filtered wine quality (turbidity and fouling index).

Shiraz wine, 32 NTU

**Analysis of a Bordeaux red wine with initial turbidity = 150 NTU**

**Anthocyanins and Polyphenols**

No significant impact of Crystar FT250

**Lactic Bacteria**

Strong reduction by Crystar FT250

**CHROMATIC CHARACTERISTICS**

No significant impact of Crystar FT250

**MICROBIOLOGY RETENTION**

Strong reduction by Crystar FT250

**THE QUALITY OF YOUR WINE IS PRESERVED**

A PhD work in collaboration with the Institut des Sciences de la Vigne et du Vin*, University of Bordeaux and the Laboratoire de Mécanique, Modélisation & Procédés Propres**, University of Aix Marseille, demonstrates that Crystar® FT:

- Does not alter the chromatic characteristics of the wine.
- Does not retain anthocyanins and polyphenols.
- Provides an effective barrier against lactic bacteria and yeast.

**Analysis of Bordeaux white wine with initial turbidity = 78 NTU**

**TOTAL POLYPHENOLS INDEX**

No significant impact of Crystar® FT250

**ABSORBANCE OD420**

Improvement in white wine clarity and no significant impact on color

**WHITE WINE CLARIFICATION**

Chardonnay 7 NTU
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Shiraz wine, 32 NTU

Permeate flow rate [l/h]
Transmembrane pressure [bar]

Red wine retentate > 1500 NTU

No significant impact of Crystar FT250

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Anthocyanins and Polyphenols

Lactic Bacteria

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Chromatic Characteristics

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Analysis of Bordeaux white wine with initial turbidity = 78 NTU

White Wine Clarification

* Science Institute of Vine and Wine
** Laboratory of Mechanics, Modeling & Clean Processes

The Quality of your wine is preserved.

In Wine Clarification

A revolution in wine clarification.
**CRYSTAR® FT250**

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**Analysis of a Bordeaux red wine with initial turbidity = 150 NTU**

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**Analysis of Bordeaux white wine with initial turbidity = 78 NTU**

**WHITE WINE CLARIFICATION**

**CHROMATIC CHARACTERISTICS**

No significant impact of Crystar FT250

**MICROBIOLOGY RETENTION**

Strong reduction by Crystar FT250

**TOTAL POLYPHENOLS INDEX**

No significant impact of Crystar® FT250

**ABSORBANCE 00420**

Improvement in white wine clarity and no significant impact on color

**Feed Sample**

**Filtrate Sample**

**Retentate Sample**

**ANTHOCYANINS AND POLYPHENOLS**

**LACTIC BACTERIA**

**Impr**

**Incr**

**Red wine retentate > 1500 NTU**

**Shiraz wine, 32 NTU**

**Permeate flow [liters/hours]**

- Initial flux = 58 LMH
- Flux after 9h = 65 LMH

**Transmembrane pressure [bar]**

- Initial press = 0.313 bar
- Press after 9h = 0.4 bar

**Permeate turbidity [NTU]**

- Initial turbidity = 0.088 NTU
- Turbidity after 9h = 0.018 NTU

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SAINT-GOBAIN PERFORMANCE CERAMICS & REFRACTORIES

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