# Keeping Oxygen Out and Freshness In: Bag-in-Box Films

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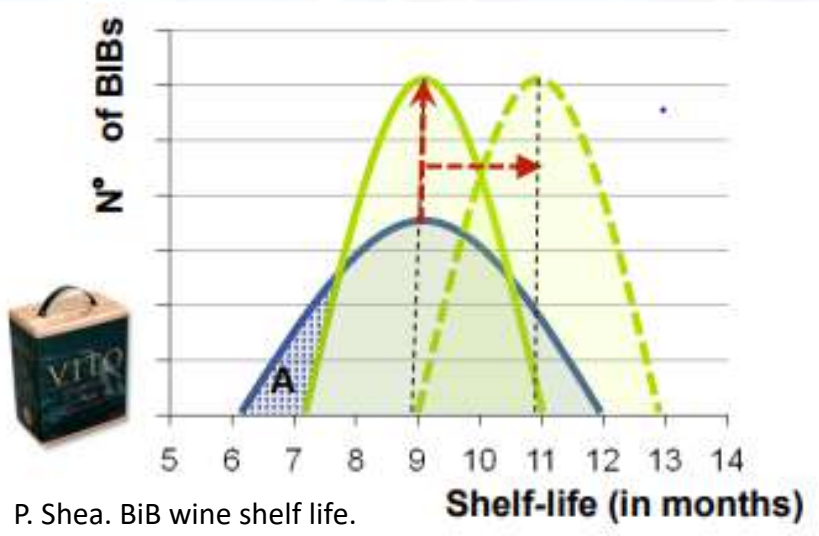
# Background


## Tighten the Bell-curve (less variance and/or shift to the right




P. Shea. BiB wine shelf life.
https://www.finewines.se

## Ways to extend shelf life of BIB wine

- Addition of appropriate amount of sulfur dioxide ($SO_2$)
- Proper final filtration and filling line sterility
- Select/design packaging with high gas barrier/low permeability
- Minimise damage to the barrier film
- Minimise storage temperature
- Minimising oxygen ($O_2$) pickup during filling

## Parameters determining wine acceptability

- Colour
- Taste (Titratable acidity/pH)
- Free $SO_2$ > 10 mg/L
- Judgement of professional tester
- Comparison of same wine in glass bottle with a screw cap

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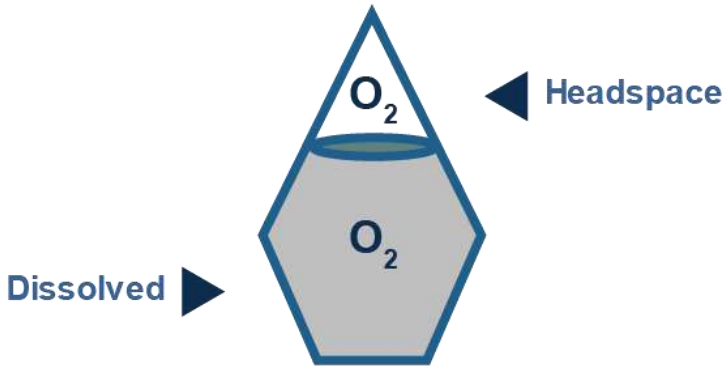
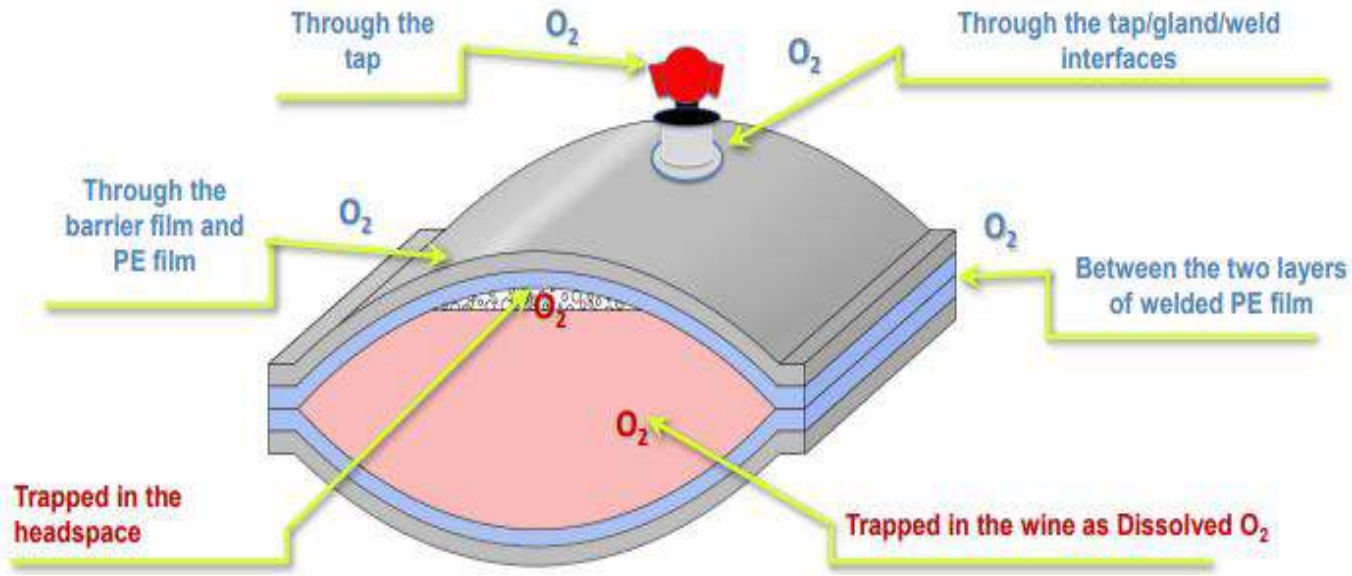
# Factors that affect the shelf life of wine




**A series of chemical reactions due to oxidation diminishes the quality of wine, such as colour, aroma, etc.**



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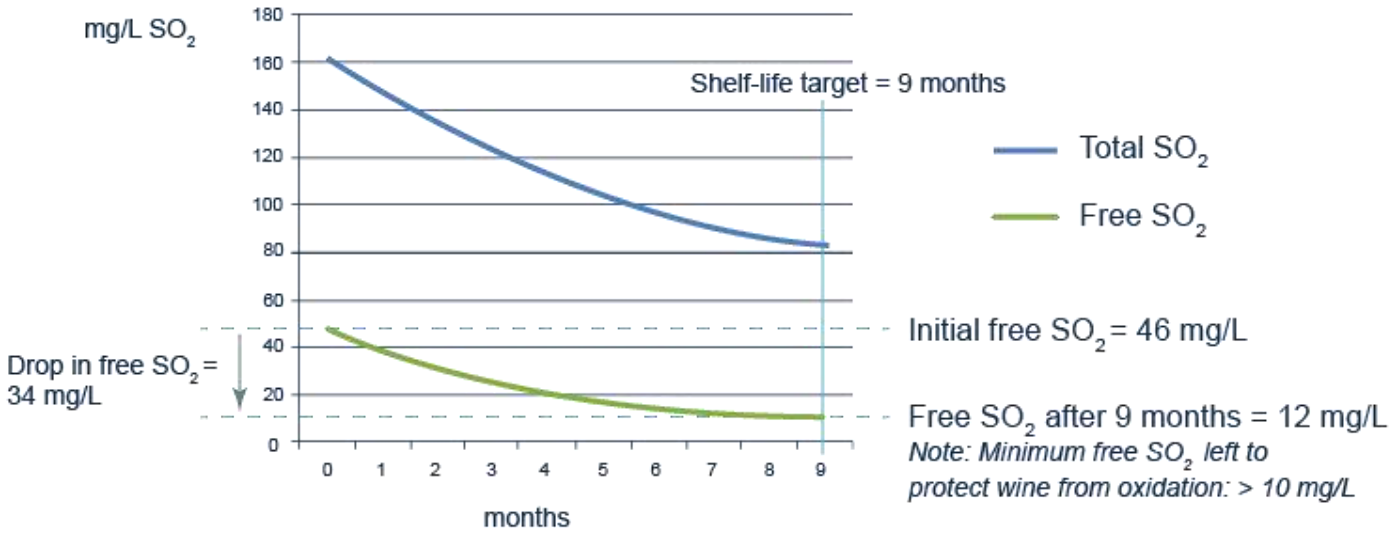
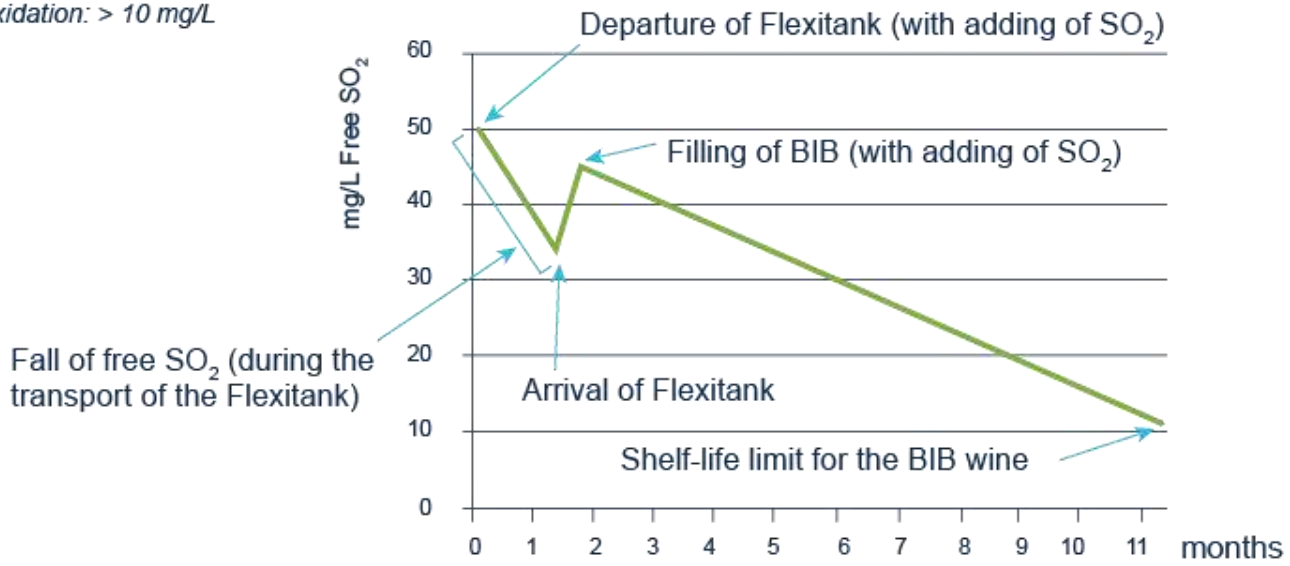
# Factors that affect the shelf life of wine, cont.

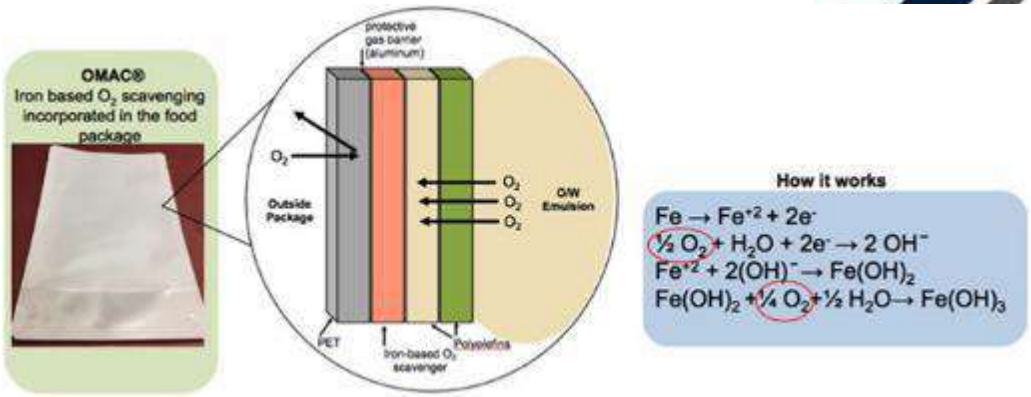


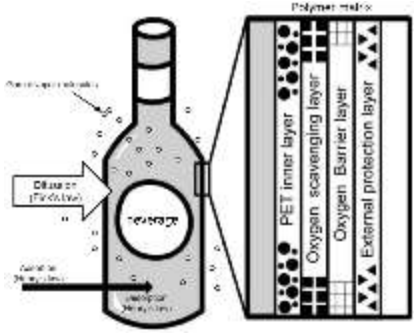
# Available solutions

Using a **sachet or adhesive labels** containing:

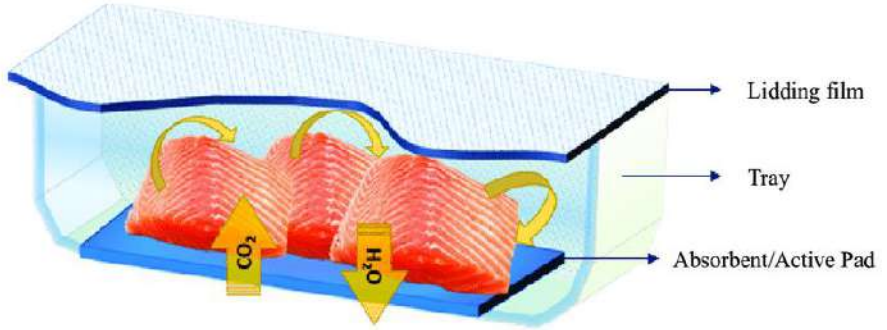
- Metal-based ***$O_2$ scavenger*** (e.g. Shelfplus $O_2$, Zero 2)




- ***Improved barrier***: Oxygen block together with nanoclay platelets



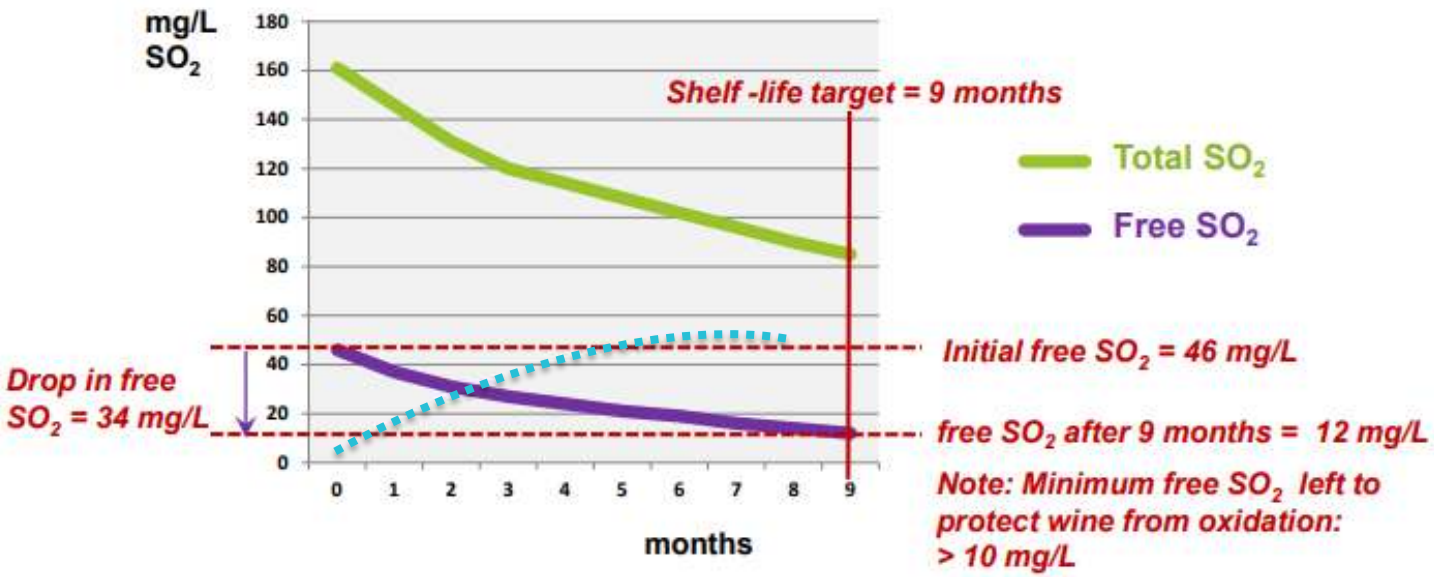

- Iron-based carbon dioxide ***($CO_2$) emitter*** (such as Ageless, Fresh Pac)



# Approach

**Oxidation causing short shelf life**

- Loss of $SO_2$ used to prevent oxidation
- Binding of $SO_2$ with anthocyanin causing discoloration of wine
- Less $CO_2$ and flattened taste

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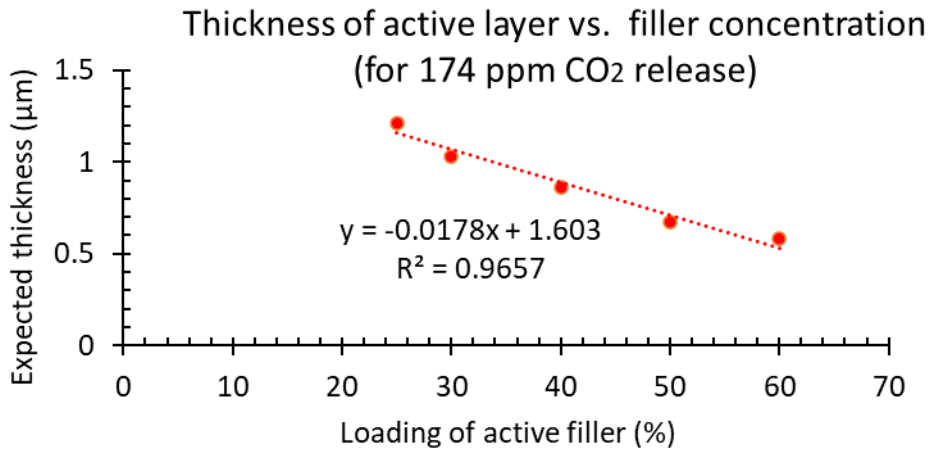
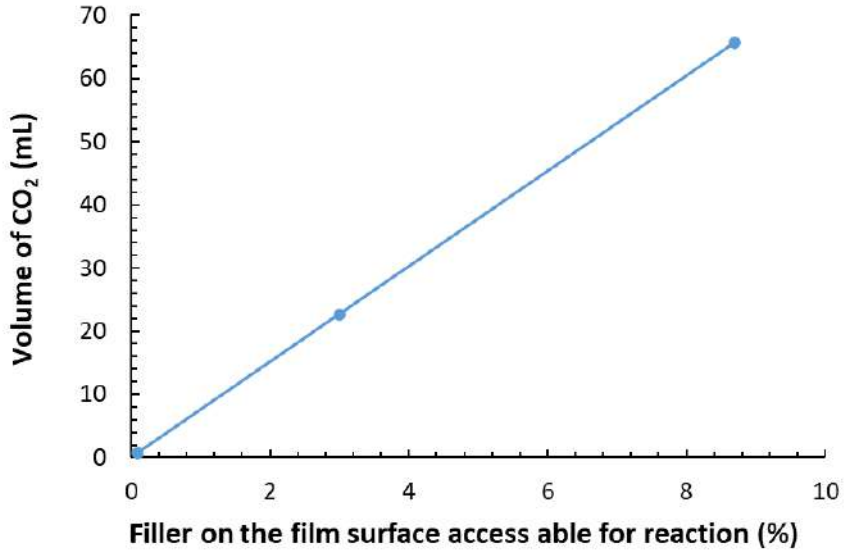
# Acceptable dose of $CO_2$ in wine

| Accepted dose | Active film |
|---|---|
| • According to the wine maker, specifications are about a maximum of 400 mg/L for reds and 600-800 mg/L for whites.<br>• Recommended concentrations of $CO_2$ (at 20 °C) in still, semi-sparkling and the sparkling wines are < 2 g/L, 2 to 5 g/L and > 6 g/L, respectively. | Expected amount after 12 months ~ 174 ppm |



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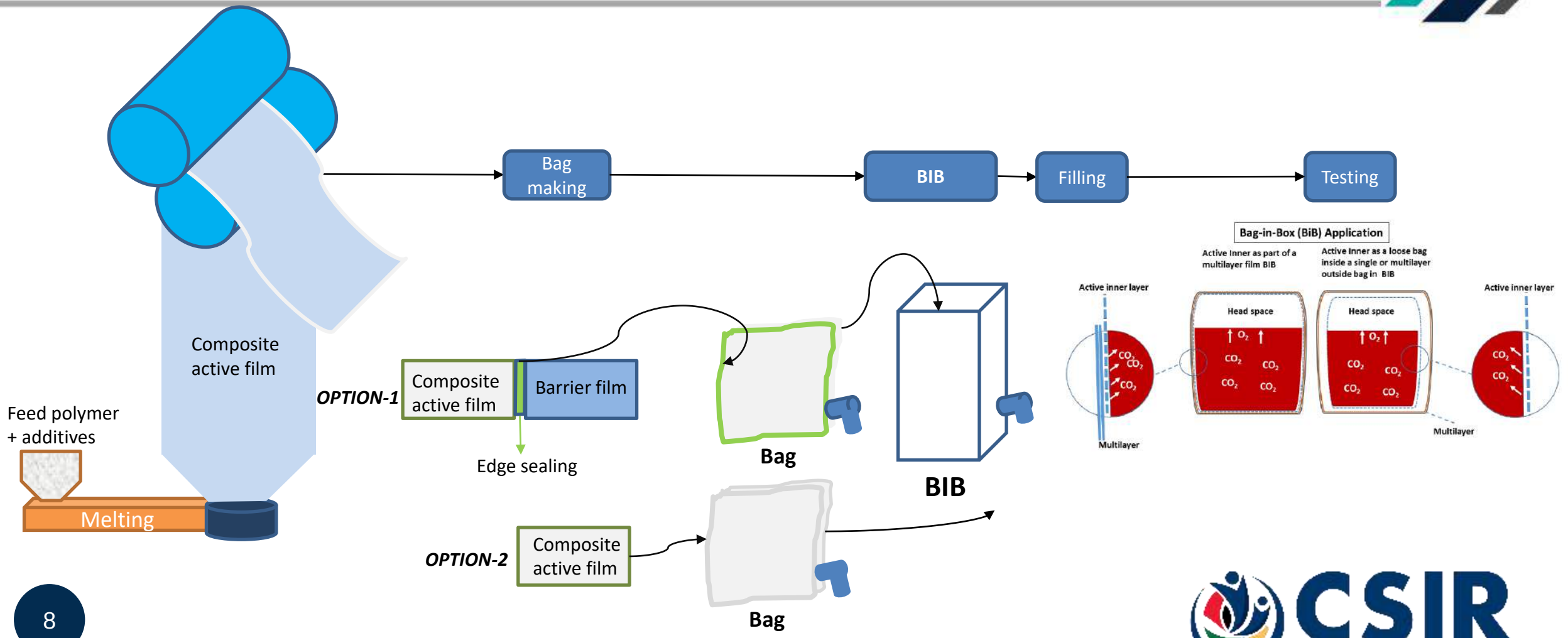
# Films for packaging foodstuffs - US 2021/0138775 A1



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# Value chain and market players


BASIC WINE

Additive
Polymer
Mix polymer
Make film
Make bags
Fill bags
Retail
Wine producers/ Brand owners
Polymer
Film
IMPORTS
Bob Cork Agencies
Conscious Packaging Solutions



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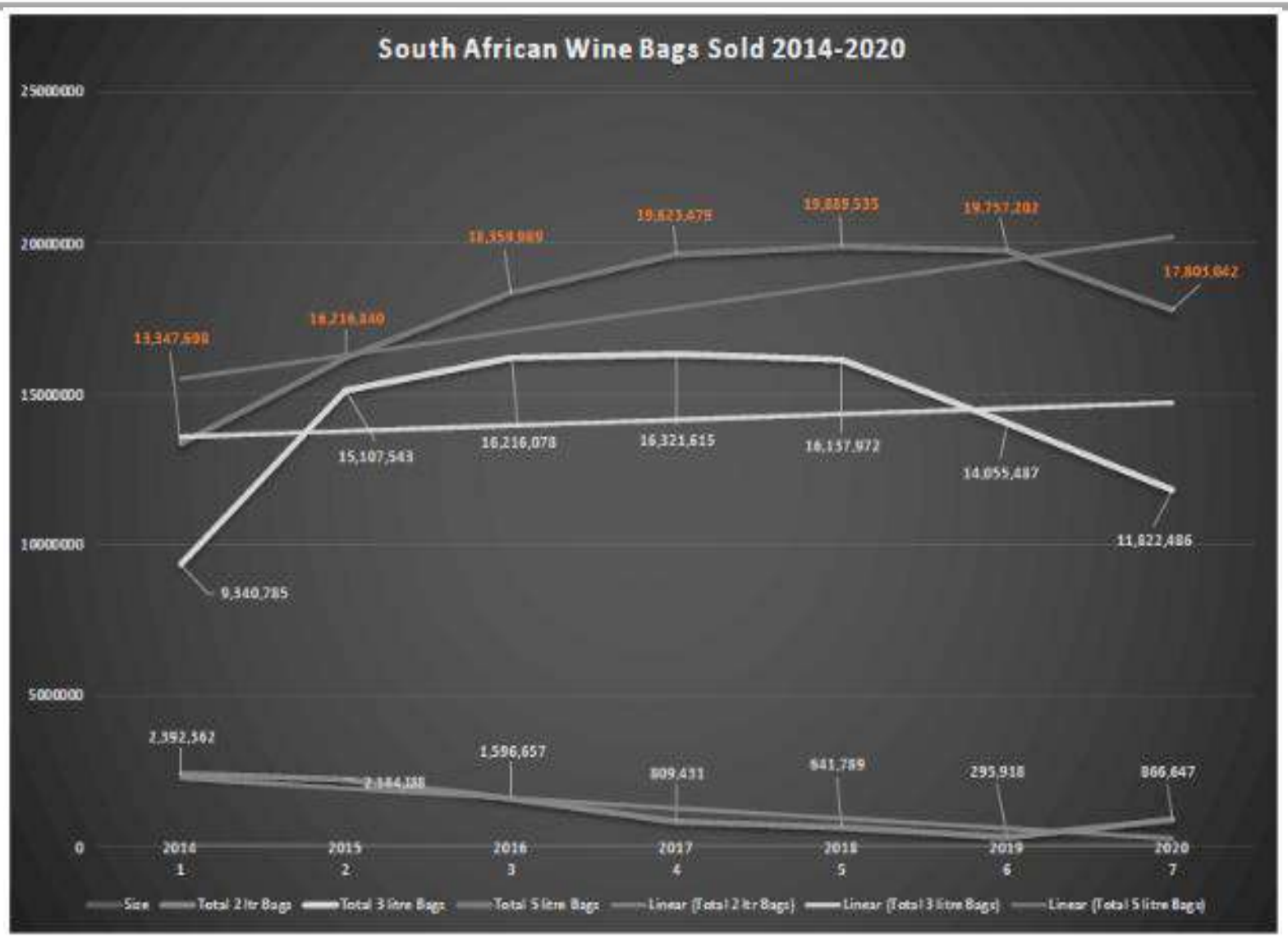
# BIB market statistics in SA




**5L: > 17million**

**3L: > 11 million**



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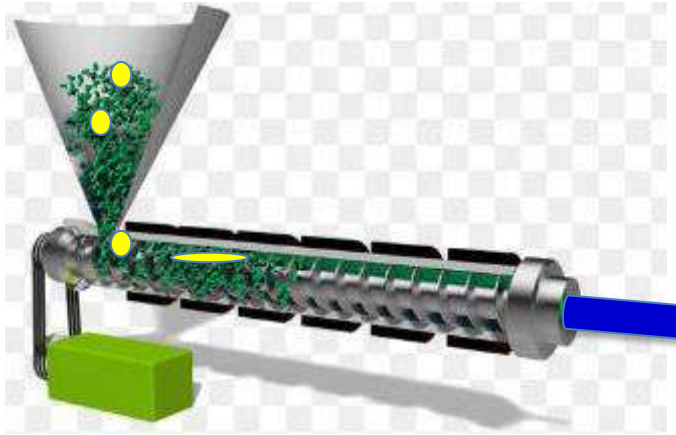
# Material and process optimisation

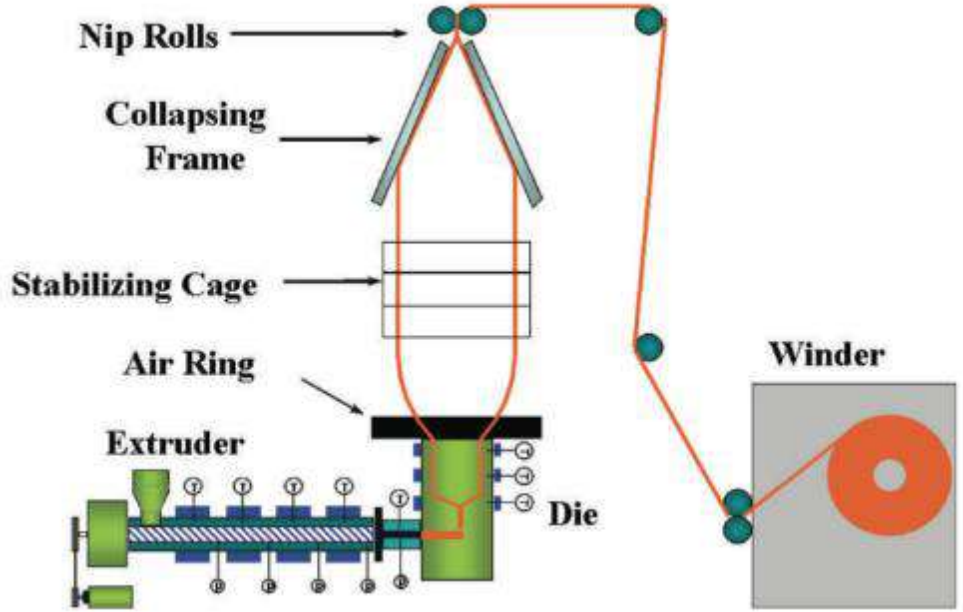
## Neat polymer

| Crystallisation peak temperature | Melting peak temperature | Onset degradation temperature | MFR |
|---|---|---|---|
| 105.0 °C | 121.9 °C | 362.24 °C | 1.05 g/10 min |



## JA790 Masterbatch

| Crystallisation peak temperature | Melting peak temperature | Onset degradation temperature | MFR |
|---|---|---|---|
| 111.8°C | 121.8 °C | 425.4.24 °C | N/A |



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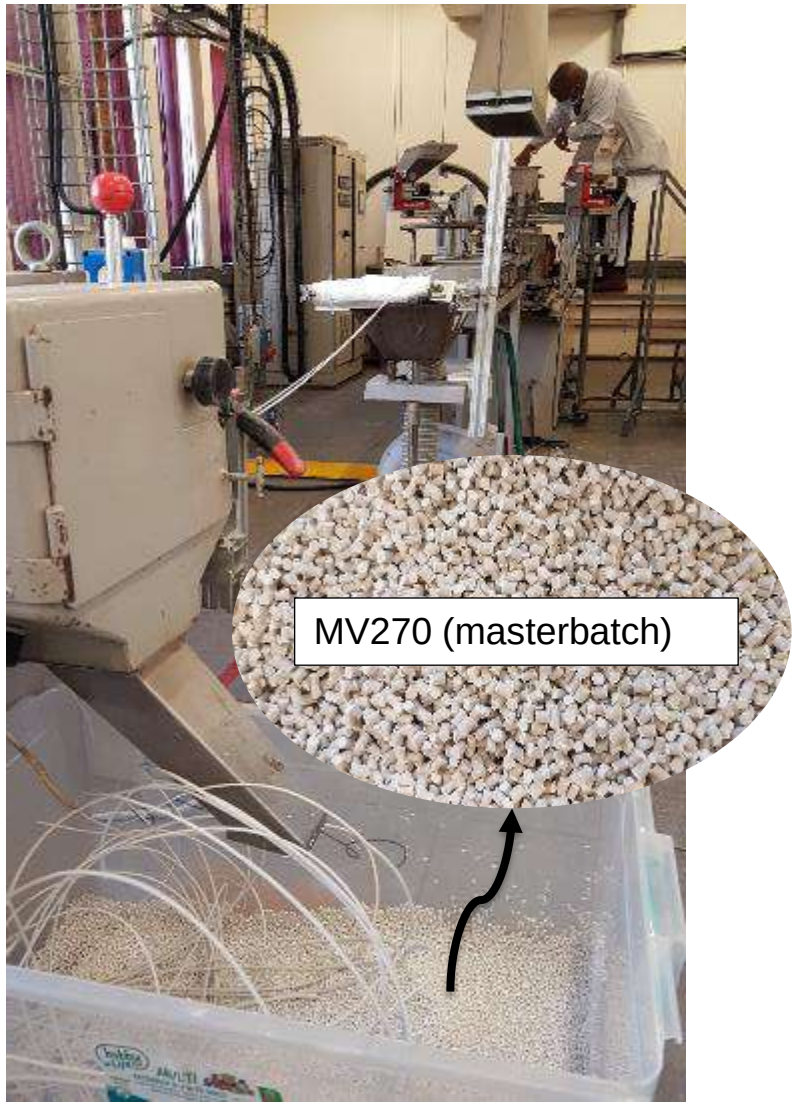
# Product development challenge and learning




| % | |
|---|---|
| 0.32 | • Moisture content in as received filler |
| 0.14 | • Moisture content in dried  filler |
| 0.06 | • MV270 MB – dried – bagged |
| 0.07 | • MV270 MB – after 1 day |
| 0.04 | • MV270 MB – after 2 days |
| 0.07 | • MV270 MB – after 3 days |

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# Technical data sheet

***Preliminary product data sheet***

Polyzimo®
MV270

CSIR

## *Active Polyethylene Formulation*

| *Features* | *Applications* |
|---|---|
| • Releases carbon dioxide ($CO_2$) if in contact with acidic food (see Figure 1)<br>• Wine bag-in-box application: Compensation of loss of sulphur dioxide over time that can extend shelf life, prevent discoloration of wine and possible reduction of sulphite. | • Bag-in-box<br>• Acidic food and beverage packaging |

## *Suggested usage*

Polyzimo®MV270 can be used directly during the film processing.
Polyzimo®MV270 can be diluted with polyethylene of desired choice during film processing to achieve the desired level of $CO_2$ release.

## *Material properties*

| Properties * | Test method | Test method | Value | Unit |
|---|---|---|---|---|
| Density | Immersion method | ISO 1183 | 1.16 | g/cm³ |
| Melting temperature | At heating rate 10 °C/min | ASTM D3418 | 121.23 | °C |
| Crystallization temperature | At cooling rate 10 °C/min | ASTM D3418 | 111.99 | °C |
| Onset degradation temperature | 5wt% loss under $O_2$ at 10 °C/min | ASTM E 2550 | 432.92 | °C |

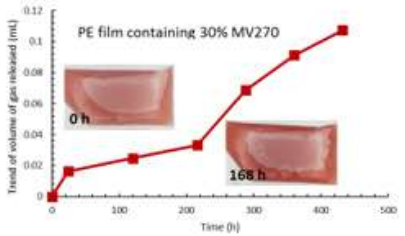


Figure 1. The trend of $CO_2$ released as a function of time.

## *Expected film properties*

The film properties will depend on the thickness of the blown film as well as the polymer grade used in the dilution. Trend of inert $CO_2$ release from the 1L bag made of polyethylene film containing Polyzimo®MV270 as a function of time is demonstrated Figure 1.

## *Packaging*

Polyzimo®MV270 is supplied in pellet form packed in 25 kg bags.

## *Storage*

Refrain from direct sun light. Polyzimo®MV270 is recommended to store in a cool and dry condition. Drying is preferable before film processing.

***Date of issue: August 2021***

* Specimens used for characterizations are in the pellet form. The information provided in this document is of good faith. Properties might differ depending on the polyethylene grade and hence respective processing conditions.



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# Film and BIB production at industrial scale




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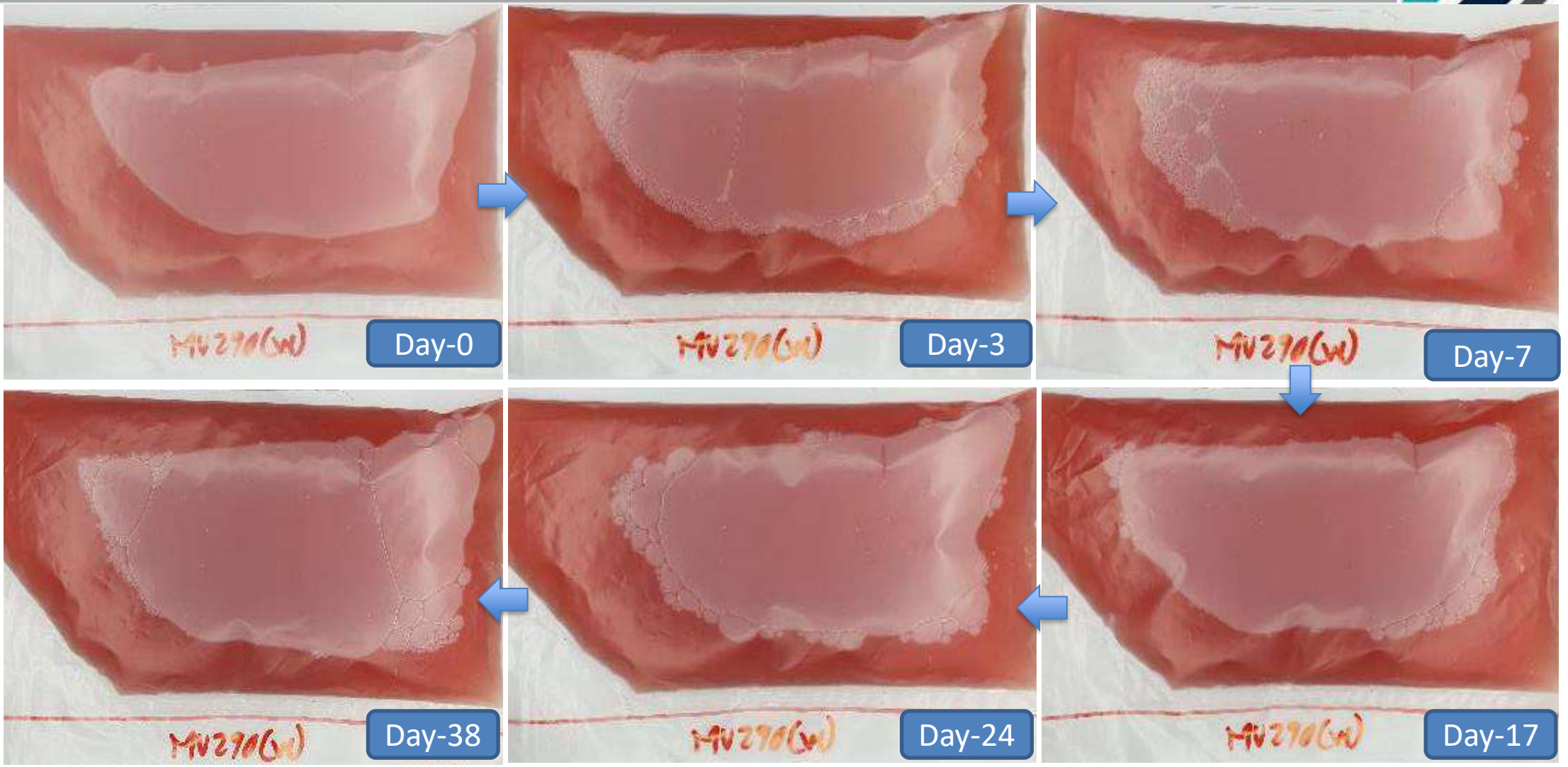
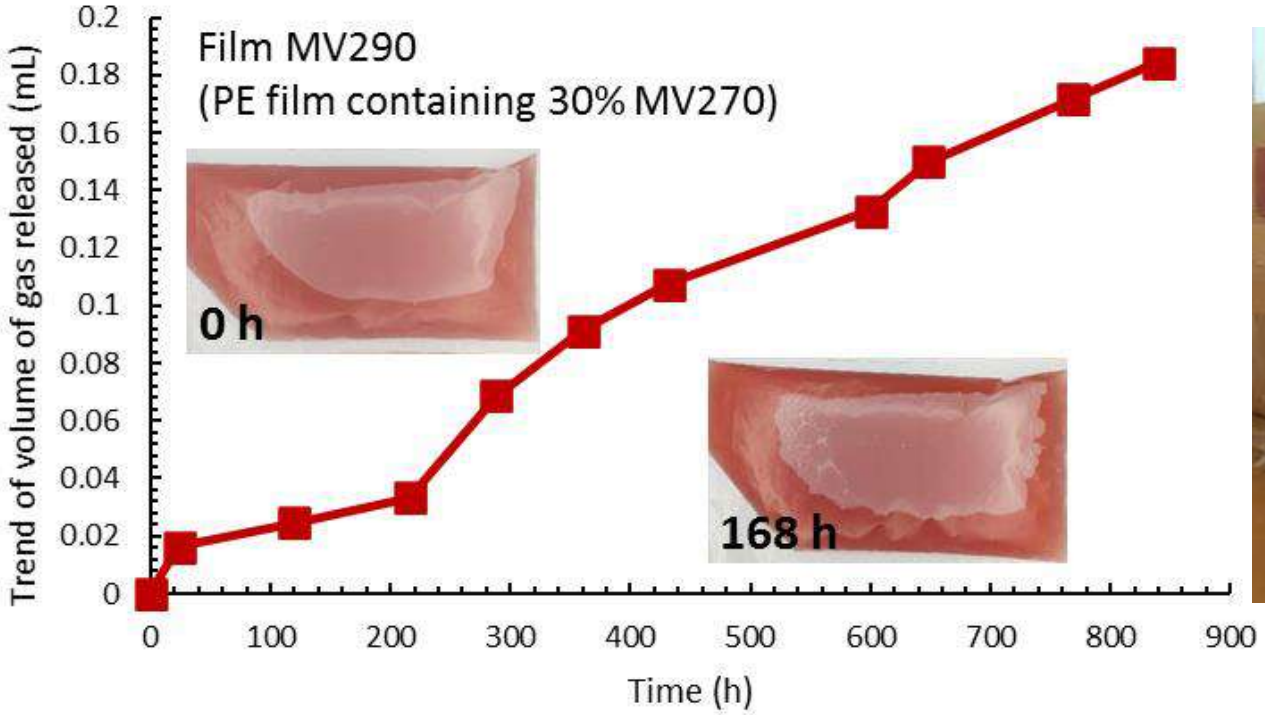
# Film properties



# $CO_2$ release





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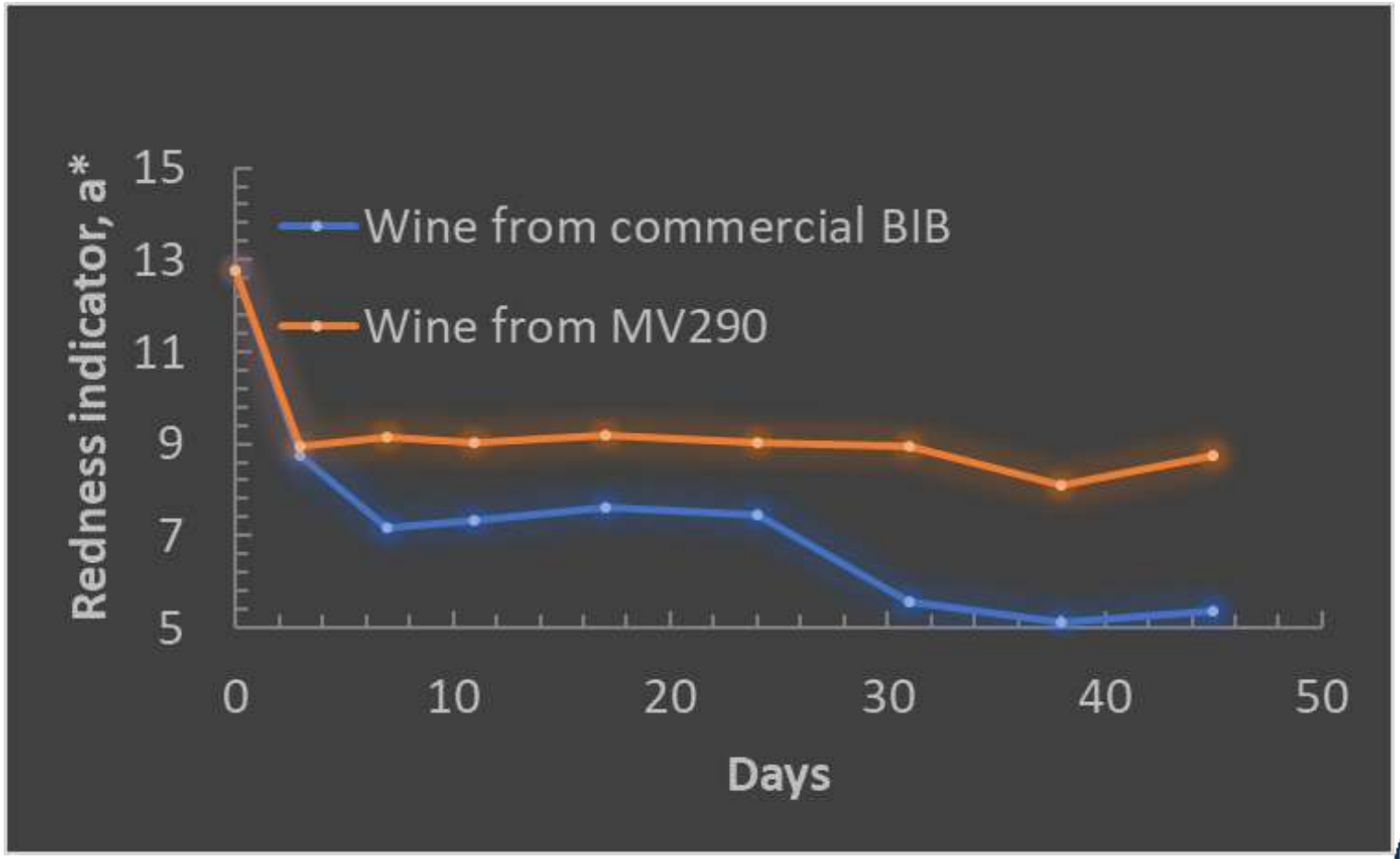
# Retention of wine colour



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# Prototyping and filling wine using automated filling line



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# Preliminary industry test results



**Bubble volume, turbidity, oxidative browning (420 nm):**

No specific trends were observed. Variation in results is considered normal.

**Sensory composition**

For red wine, no differences in sensory composition between the control and treatment were observed up until 30 days after filling.

| Wine | Storage | TA (g/L) | pH |
|---|---|---|---|
| Red wine (CABS/MERL) from tank | Before filling | 5.39 | 3.68 |
| Red wine in control BIB | After filling | 5.17 | 3.71 |
| Red wine in active BIB-1 | After filling | 5.20 | 3.71 |
| Red wine in control BIB | 30 days after filling | 5.19 | 3.73 |
| Red wine in active BIB-1 | 30 days after filling | 5.17 | 3.73 |

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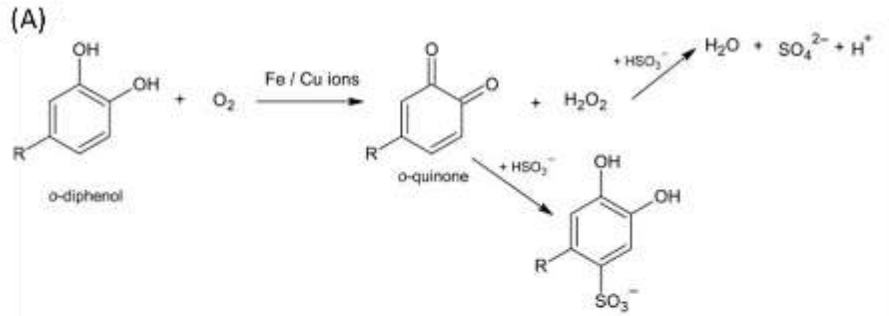
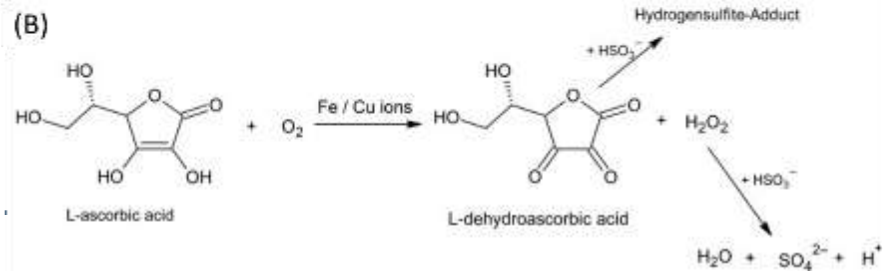
# Way forward

- Establishment of test protocol: Confirmation of $CO_2$ release and how to separate the effect of $SO_2$ and $CO_2$.
- Possible chemical reactions responsible for $SO_2$ depletion in wine.
- Shelf-life testing of wine and crystallise the value proposition.
- Technology transfer and manufacturing process optimisation.




(C) $2HSO_3^- + O_2 \leftrightarrow 2H^+ + 2SO_4^{-2}$



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# Conclusion

**ID, Patent application**
Active composite
TRL 4-5
2016-2017

**TD – TRL 7**
Demonstration of active composite inner layer of the active-passive barrier film
2017-2019

**Modification of method following industry need**
Development of concentrated active composite
and
film production with varying concentration of the active composite at pilot scale
2020

**Technical validation – Trial 1**

Film blowing at industry
2020-2021

**Optimise production process**

Active composite production at pilot scale to control the moisture content
2021

**Technical validation – Trial 2**

Successful film blowing at industry

Film testing at CSIR and industry
2021

**BIB bag production at industry**

**TRL 7**

Bags are produced at industry and delivered to the CSIR

Commercialisation plan

Independent testing at wine testing facility
2021

**BIB filling and testing**

Bags are filled with wines using commercial automated production line

Testing including shelf life

2022

# Acknowledgements


- DSI-CSIR Centre for Nanostructures and Advanced Material
- TIA
- Industries assisted with technical validations
- Colleagues

# THANK YOU

***Technology development and testing for advanced and sustainable packaging addressing food security and striving towards a circular plastics economy***

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