conditions based on a proven integrated wine packaging system that delivers a consistent quality product every time is required to solve this problem. In addition this product (and the system supporting it) needs to reflect the consumers desire for environmentally sustainable packaging in order to minimise its overall carbon footprint but at the same time allow the delivery of a wine that maintains its integral balance and profile from the winemaker to the consumer no matter where that consumer is located with a stable shelf (up to and over 12 months) has been a long felt commercial requirement for winemakers and wine vendors globally.

Shelf life is defined as the period after packaging during which wine retains its intended appearance, aroma and taste and is likely to be regarded as palatable by a consumer. The concept of shelf life implies that, over time wine can change after packaging from a product showing the attributes of a designed and intended quality or style to a product with a significantly lowered quality or different style. This change is significantly attributable to the packaging medium used, especially in aluminium containers, that the wine is stored and transported in which can negatively impact on these essential wine characteristics commencing once the wine is packaged with significant changes occurring in less than 6 months.

It is an object of this invention to package wine in aluminium containers whereby the quality of the wine does not deteriorate significantly on storage and transport the shelf life remains stable up to and beyond 2 years.

## 1. Summary ~~of the Invention~~

In one aspect, there is provided a filled aluminium container containing a wine characterised in that the maximum oxygen content of the head space is 1 % v/v and the wine prior to filling is micro filtered and dissolved oxygen levels throughout the aluminium container filling process are maintained up to 0.5 mg/L and final levels of dissolved $CO_2$ are from 50 ppm for white and sparkling wines and from 50 ppm to 400 ppm for red wines, prior to filling the container, wherein the filled aluminium container of wine has a molecular sulphur dioxide content of between 0.4 and 0.8 mg/L.

In one aspect, there is provided a method of filling an aluminium container with wine characterized in that the wine prior to filling is micro filtered and dissolved Oxygen levels throughout the container filling process are maintained up to 0.5 mg/L and final levels of dissolved $CO_2$ are from 50 ppm for white and Sparkling wines and from 50 ppm to 400 ppm

for red wines, prior to filling the container, wherein the filled aluminium container of wine has a molecular sulphur dioxide content of between 0.4 and 0.8 mg/L.

~~This invention provides~~Provided herein in one form is a filled aluminium container containing a wine characterised in that the maximum oxygen content of the head space is 1 % v/v and the wine prior to filling is micro filtered and dissolved Oxygen levels throughout the aluminium container filling process are maintained up to 0.5 mg/L. and final levels of dissolved $CO_2$ are at least 50 ppm for white and sparkling wines and 50 ppm to 400 ppm for red wines, prior to filling the container.

This ~~invention~~disclosure is predicated on the discovery that controlling levels of dissolved $CO_2$ in wine are essential in maintaining the wines varietal character. The recommended minimum level of dissolved $CO_2$ will reduce the oxygen content of the wine and

assist with protecting the wine from oxidation during the transport of bulk wine from the winery to the aluminium container filler. For still white wines the preferred dissolved $CO_2$ is from 50 ppm to 1200 ppm.

This ~~invention~~disclosure is also based on the realization that Oxygen management in wine is a key factor to consider for maintaining wine quality and integrity. Dissolved Oxygen level is the amount of oxygen aeration sustained by the wine at any given time during the wine making process. Surprisingly adherence to Dissolved Oxygen (DO) levels below 0.5 mg/L for canned wines in combination with minimum dissolved CO2 has been found to be critical in achieving product quality, stability and longevity.

Preferably the maximum oxygen content of the head space is 1 % v/v.

Preferably the head space after sealing the container with the closure comprises or has the composition nitrogen 80 - 97 % v/v, and carbon dioxide 2 - 20 % v/v. In a 250 ml container the head space volume is less than 3 ml preferably less than 2 ml and more preferably about 1 ml. Generally the head space volume is less than 1 %, preferably less than 0.5 % of the sealed volume of the container.

Preferably liquid nitrogen is added just prior to the seaming of the closure to the body of the aluminium container.

Alternatively the wine is carbonated before it is filled in the aluminium container whereby the head space after sealing is predominantly carbon dioxide.

The pressure within the aluminium container is preferably maintained at a pressure above 15 psi at 4°C, so that the corrosion resistant lining in the aluminium container is less likely to fracture or crack exposing fissures as a result of external container damage in storage and transport. In addition the walls of the container are less likely to be buckled which can also lead to damaging the internal lining which can then damage the integrity of the wine.

In this ~~invention~~disclosure microfiltration (preferably sterile grade) microfiltration is used to remove bacteria and yeasts from the wine prior to filling. Microfiltration is generally understood as filtration using 1.0 µm pore size and lower. Preferably removal of microbial cells is best achieved by implementing a multistage in line sterile grade membrane filtration system using a grade with fine enough pores to remove all yeast and bacteria likely to be found in wine but not damage the integrity of the wine. The preferred pore diameters for this purpose are about 0.60 µm in the first

stage filter housing and in at least one subsequent stage filter housing 0.20 µm to 0.45 µm. Filter integrity testing ensures that the filters ability to retain bacteria has not been compromised and there are no damaged membranes (pores) present that may allow the passage of microbial cells in the wine.

The size of the filter pores indicates the size exclusion characteristics of the filter, i.e. a filter with a pore size of 0.60 µm will filter off particles of above 0.60 µm. The size of the filter pores is indicated for commercially available products and can be determined by standard methods known to the skilled person.

To ensure successful membrane filtration, the filters are sterilised and tested for integrity prior to use. The sterilizing time and temperature regime is preferably 80°C for 20 minutes. After membrane filtration, successful sterile canning of wine requires filling through sterilised equipment. All equipment, including the onsite wine storage tank downstream from the final membrane filter (lines, valves, filler etc) are preferably sterilised and operated in a sterile state. Preferably the filling heads are sprayed with 70 % ethanol prior to start up and repeated when filler downtime exceeds 10 minutes. Preferably a full sterilization is performed if the filler is subjected to down time longer than 4 hours.

Molecular $SO_2$ is the form of free $SO_2$ that has antimicrobial action. International wine organisations and regulatory bodies such as the Australian Wine Research Institute (AWRI) recommends at least 0.825 mg/L of molecular $SO_2$ in wine to eliminate cell viability.

Sulphur dioxide ($SO_2$) is an antioxidant that can be added to wine. The addition of $SO_2$ in this invention is to inhibit the reaction of oxygen with the wine and to prevent damage to the wines integrity; colour, aroma and flavour compounds. This ~~invention~~disclosure is in part based on the discovery that excess levels of Free $SO_2$ will elevate the wines corrosive effect on the can and can lining used in today's can manufacturing. In addition the inventors have found that it will also affect the nose (odour-sulphidic characters) and the taste (sharp, astringent) of the wine in the finished product. Low levels of Free $SO_2$ by itself, will reduce the shelf life, stability and quality of the wine in the finished product. Therefore we have invented a product to balance these competing effects on wine in an aluminium container that is outlined in this patent.

~~In this invention~~As disclosed herein the functions of $SO_2$ for wine in aluminium containers include the control of microbiological issues and minimise oxidation affects in the wine in an aluminium container. For wine at filling to have a Free $SO_2$ level of <35ppm the wine ex winery is preferred to be Free $SO_2$ level of 38 - 44 ppm this final ppm level dependent on the distance from winery to the filling plant. Free $SO_2$ depletion rate is approximately 2 - 3 ppm per day during transport and during storage at filling facility this needs to be taken into consideration when preparing the wine for transport from the winery to the filling facility.

At a pH of 3.5, wine with 35 mg/L of free $SO_2$ contains 0.70 mg/L of molecular $SO_2$, lower than the recommended AWRI minimum to eliminate cell viability. Wines filled according to this ~~invention~~disclosure will not contain sufficient free $SO_2$ to eliminate cell viability.

These structured wines will preferably contain sufficient molecular $SO_2$ to inhibit microbial growth without negatively impacting on the wines integrity in an aluminium container. Given that the primary control mechanisms in place are sterile grade membrane filtration and preferably filler sterilization, this level of molecular $SO_2$ has been found to be adequate as an adjunct to prevent microbial spoilage.

It is not necessary to use post-packaging pasteurisation (heating) to inactivate microbial cells in the filled aluminium wine containers.

Wine in an aluminium container with low alcohol content is particularly susceptible to microbial spoilage. In this invention where the wines have less than 9% v/v alcohol the antimicrobial agent sorbic acid is added at a level greater than 90 mg/L preferably greater than 120 mg/L. This addition will assist in preventing microbial growth and spoilage of the product in storage and transport.

References to conditions prior to or at the time of filling preferably mean immediately prior to filling or at the time of filling the container.

Preferably the corrosion resistant coating is a thermoset coating and of greater thickness as opposed to the usual industry lining specifications in aluminium containers used to package soft drink and beer that are not suitable for wine/wine products.

Yeasts are the most likely cause of microbial spoilage in packaged wine due to their tolerance of alcohol, low pH and anaerobic conditions. We have discovered that Yeast growth in wine in an aluminium container is inhibited by high volumes of

carbon dioxide. Sparkling wine packed according to this invention contains high levels of carbon dioxide, preferably 3.3 - 3.8 volumes. Yeast growth in sparkling wine packaged using the protocols in this invention are extremely unlikely.

Preferably the wine is chilled before filling.

The advantages that result from using maximum levels of dissolved oxygen below 0.5 mg/L and minimum levels of dissolved carbon dioxide of at least 50 ppm include:

- Less $SO_2$ required.
- Shelf life increased
- Less corrosion susceptibility due to low $SO_2$ levels.
- Increased stability of wine
- Maintain wine profile- nose, taste, colour

This ~~invention~~disclosure may be used for still carbonated and sparkling wines (including fortified, sweet and semi sweet wines) and also wines mixed with Mineral water, juice, flavours etc.

The reference to the features or protocols of the present invention in the present specification is to be understood to include all possible combinations of the single features unless these features are pure alternatives. Thus, the single features are combinable within the scope of the present ~~invention~~disclosure as determined by the attached claims.

**Detailed Description of the Invention**

Preferred embodiments of the invention will now be described.

In filling aluminium containers with wine there is a need to preserve the wine in the state it is in at the time of filling and to guard against microbial deterioration of the wine. In bottled wine sulphur dioxide has been used to control microbial deterioration but corked bottles allow for dissipation of excess sulphur dioxide. In the hermetically sealed environment of an aluminium container too much sulphur dioxide can affect the wine and also lead to corrosion of the container and liner further adversely affecting wine quality and shelf life.

Figure 1 illustrates this problem.

Grape Varieties used in in the preferred embodiments of the invention are shown in Table 1.

**The claims defining the invention are as follows:**

1. A filled aluminium container containing a wine characterised in that the maximum oxygen content of the head space is 1 % v/v and the wine prior to filling is micro filtered and dissolved oxygen levels throughout the aluminium container filling process are maintained up to 0.5 mg/L and final levels of dissolved $CO_2$ are from 50 ppm for white and sparkling wines and from 50 ppm to 400 ppm for red wines, prior to filling the container.

2. A filled aluminium container as defined in claim 1 wherein the filled aluminium container of wine has a molecular sulphur dioxide content of between 0.4 and 0.8 mg/L

3. A filled Aluminium container as claimed in Claim 1 in which the levels for Total Plate Count, Yeasts and Moulds and Lactobacillus are all <1CFU.

4. A filled aluminium container as defined in claim 1 to 3 wherein for still white wines the dissolved $CO_2$ level is from 50 ppm to 1200 ppm.

5. A filled aluminium container as defined in any one of claims 1 to 4 wherein a multi stage microfiltration treatment, in particular a two stage microfiltration treatment was used.

6. A filled aluminium container as defined in claim 5 wherein the filter pore diameters are 1.0 µm or less, preferably at least 0.60 µm in a first filter housing and 0.20 µm to 0.45 µm in at least one subsequent stage filter housing.

7. A filled aluminium container as defined in any one of claims 1 to 6 wherein the head space in the can is less than 1 % of the volume of the sealed container and preferably comprises the composition nitrogen 80 – 97 % v/v and carbon dioxide 2 – 20 % v/v.

8. A filled aluminium container as claimed in any one of claims 1 to 5 in which the alcohol content is below 9 % v/v wherein sorbic acid is added at a level greater than 90 mg/L.

9. A method of filling an aluminium container with wine characterized in that the wine prior to filling is micro filtered and dissolved Oxygen levels throughout the container filling process are maintained up to 0.5mg/L. and final levels of dissolved $CO_2$ are from 50 ppm for white and Sparkling wines and from 50 ppm to 400 ppm for red wines, prior to filling the container.

10. A method of filling an aluminium container with wine as claimed in claim 9 wherein a multi stage microfiltration treatment, in particular a two stage microfiltration treatment is used.

11. A method of filling an aluminium container with wine as claimed in claim 10 wherein the filter pore diameters are 1.0 µm or less, preferably at least 0.60 µm in a first filter housing and 0.30 µm to 0.45 µm in at least one subsequent stage filter housing.

12. A method of filling an aluminium container with wine as claimed in any one of claims 9 to 11 in which the alcohol content is below 9 % v/v wherein sorbic acid is added at a level greater than 90 mg/L.

13. A method of filling an aluminium container with wine as claimed in any one of claims 9 to 12 wherein for still white wines the dissolved $CO_2$ level is from 50 ppm to 1200 ppm.

**Claims**

1. A filled aluminium container containing a wine characterised in that the maximum oxygen content of the head space is 1 % v/v and the wine prior to filling is micro filtered and dissolved oxygen levels throughout the aluminium container filling process are maintained up to 0.5 mg/L and final levels of dissolved $CO_2$ are from 50 ppm for white and sparkling wines and from 50 ppm to 400 ppm for red wines, prior to filling the container, wherein the filled aluminium container of wine has a molecular sulphur dioxide content of between 0.4 and 0.8 mg/L.

2. A filled aluminium container as defined in claim 1 wherein for still white wines the dissolved $CO_2$ level is from 50 ppm to 1200 ppm.

3. A filled aluminium container as defined in any one of claims 1 or 2 wherein a multi stage microfiltration treatment, in particular a two stage microfiltration treatment was used.

4. A filled aluminium container as defined in claim 3 wherein the filter pore diameters are 1.0 μm or less, preferably at least 0.60 μm in a first filter housing and 0.20 μm to 0.45 μm in at least one subsequent stage filter housing.

5. A filled aluminium container as defined in any one of claims 1 to 4 wherein the head space in the can is less than 1 % of the volume of the sealed container and preferably comprises the composition nitrogen 80 - 97 % v/v and carbon dioxide 2 - 20 % v/v.

6. A filled aluminium container as claimed in any one of claims 1 to 4 in which the alcohol content is below 9 % v/v wherein sorbic acid is added at a level greater than 90 mg/L.

7. A method of filling an aluminium container with wine characterized in that the wine prior to filling is micro filtered and dissolved Oxygen levels throughout the container filling process are maintained up to 0.5 mg/L and final levels of dissolved $CO_2$ are from 50 ppm for white and Sparkling wines and from 50 ppm to 400 ppm for red wines, prior to filling the container, wherein the filled aluminium container of wine has a molecular sulphur dioxide content of between 0.4 and 0.8 mg/L.

8. A method of filling an aluminium container with wine as claimed in claim 7 wherein a multi stage microfiltration treatment, in particular a two stage microfiltration treatment is used.

9. A method of filling an aluminium container with wine as claimed in claim 8 wherein the filter pore diameters are 1.0 μm or less, preferably at least 0.60 μm in a first filter housing and 0.30 μm to 0.45 μm in at least one subsequent stage filter housing.

10. A method of filling an aluminium container with wine as claimed in any one of claims 7 to 9 in which the alcohol content is below 9 % v/v wherein sorbic acid is added at a level greater than 90 mg/L.

11. A method of filling an aluminium container with wine as claimed in any one of claims 7 to 10 wherein for still white wines the dissolved $CO_2$ level is from 50 ppm to 1200 ppm.