SARTORIUS

Application Highlight

April 2021

Keywords or phrases:
Cubis® II, Wine, Filterability, Q Apps

Filterability Testing of Wine with Software Application

Filterability Index Software Application for Cubis® II Balances (QAPP004)

Abstract

Filterability testing is used to identify wines that have the potential to be problematic during sterile filtration by clogging the membrane with particulate and colloidal materials. Particulates include microbes and crystals whereas large colloidal particles can be associative colloids and macromolecular colloids. Filterability testing can measure both particulates and colloid particles, in contrast to light scattering techniques such as turbidity, which only measures potential membrane-clogging particulates.

Introduction

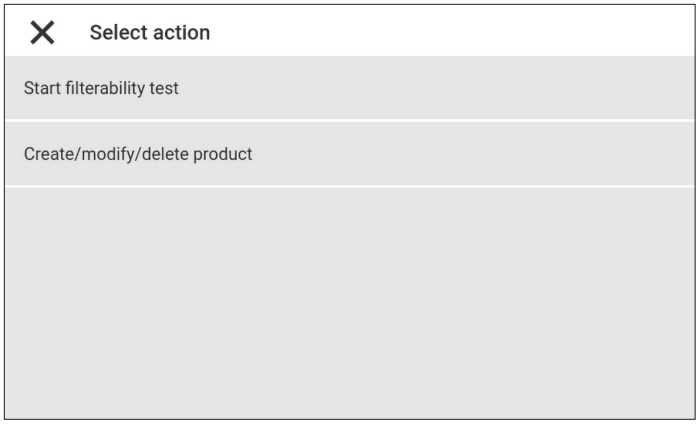
Wine bottling facilities frequently measure nephelometric turbidity units (NTU) by light scattering to evaluate the particulate loading of wines that are going to be sterile filtered prior to bottling. The assumption is that with higher levels of particulates such as silt, yeast, bacteria, amorphous and crystalline materials, filterability decreases. An NTU ≤1 is considered suitable for bottling in terms of visual appearance and the risk of clogging, including sterile filtration membranes. With an NTU >1, it is recommended that the wine is subjected to an extra filtration step such as crossflow or depth filtration. While these NTU ranges are not wrong, the use of light scattering measurement technology does not provide an indication of small colloid aggregate levels such as polysaccharides, proteins, phenolic compounds, carboxymethylcellulose (CMC) which are held together by weak intermolecular forces such as van der Waal's forces, hydrogen bonding and hydrophobic interactions or strong molecular charge interactions. As such, NTU misses and important fraction of macromolecules that influence filterability of a wine; this canresult in what appears to be a very clean wine as defined by NTU clogging the filtration media. Filterability index testing includes the influence of colloid aggregates that could to lead to membrane clogging, providing a more accurate determination of a wine's true filterability.

Figure 1: *System for measuring the filterability of wine includes a Cubis® II MCA balance and filter system with stainless-steel tank, filter holder and pressure regulator.*

Filterability measurements are performed by passing wine through a membrane filter with a 0.45 µm pore size at constant pressure (usually 2 bar/200 kPa), and the temperature at which the wine to be filtered is stored the cellar. Nylon, cellulose acetate or polyethersulfone (PES) is typically used as the filter material. The weight of wine filtered is monitored during filtration and the time it takes to filter defined volumes is measured in seconds.

Sartorius offers an integrated system including a stainless-steel tank, valves, a filter holder and pressure regulator and a Cubis® II MCA precision balance with the Filterability Index software application (see Figure 1).

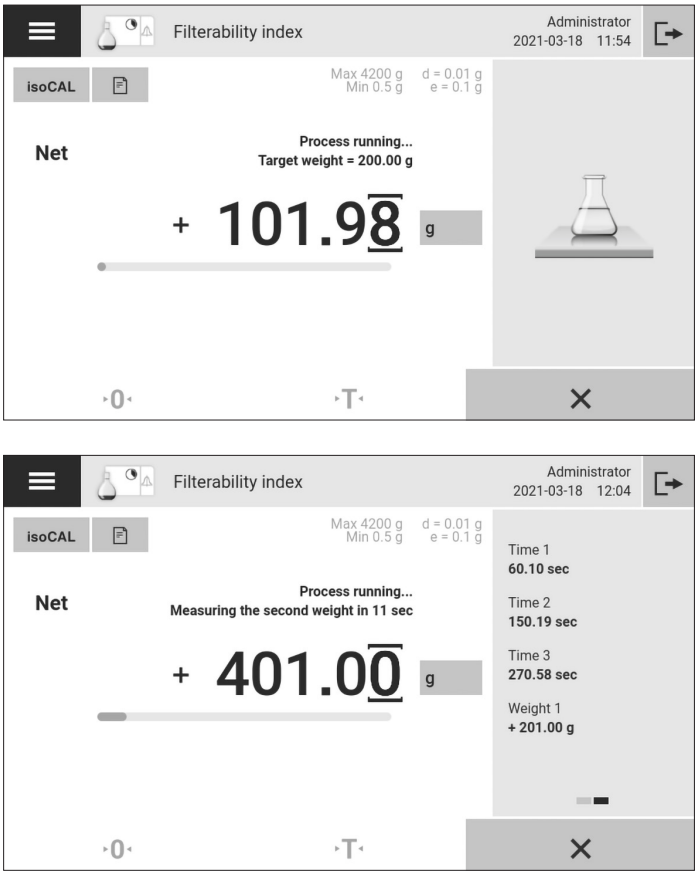
Figure 2: *Main menu and screen used to enter product parameters in the Filterability Index software application. Product parameters are saved to the balance's internal database.*



Access to the product database can be limited to users with the specified rights (Task Management); users without this right can only select saved products from the database and start the measurement procedure.

The user adds the wine to the stainless-steel tank (see Figure 1) and depending on the equipment used, controls the valve manually or has the software application automatically switch the valve as required. The software application guides the user through the process and continuously measures the filtered volume (weight) and counts the time (see Figure 3).

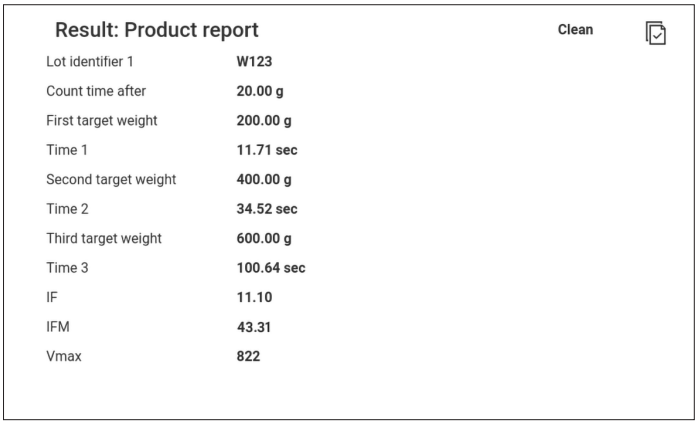
Figure 3: *The target weight (volume) and measured times are displayed to the user during the filterability test.*



Based on the measured values, the software application automatically determines the filterability according to the Italian and French method. For the Italian method, the software measures the time for the initial flush and three set volumes to calculate the Filterability Index (IF), Modified Filterability Index (IFM) and Vmax1 (see Figure 4). The Filterability Index is calculated from the time difference in seconds it takes to filter two set volumes (commonly 200 mL (T200) and 400 mL (T400)): FI = T400 - 2 * T200. The Modified Filterability Index (IFM) is a more stringent method and takes three time points into consideration (commonly 200 mL (T200), 400 mL (T400) and 600 mL (T600)): IFM = (T600 - T200) – 2 * (T400 - T200). The IF and IFM values are often similar, indicating that the filtration characteristics did not change rapidly over time. In contrast, if the IF is two- or threefold as high as the IFM value, the wine will most likely pose a problem during filtration. Vmax1 is calculated from the times measured for the first two filtered volumes: Vmax1 = (T400 - T200) / ((T400 / 400) - (T200 / 200)). The Vmax value predicts the capacity of filters using constant pressure testing and allows prediction of filter lifetimes without having to continue the measurement until the filter is completely plugged.

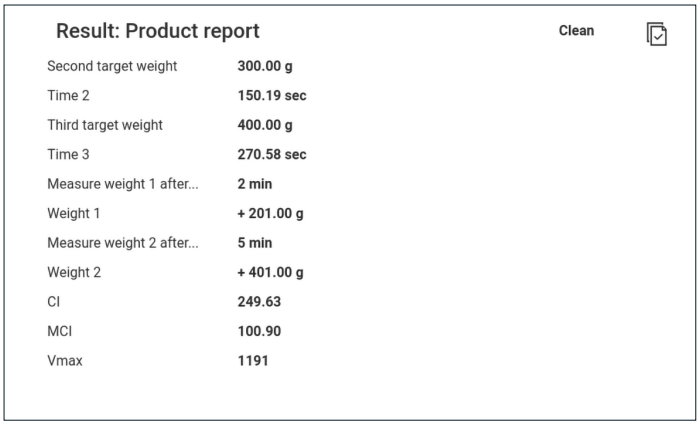
For the French method, the Clogging Index CI, Modified Clogging Index MCI, and the volumes (weights) filtered at two set time points are determined to calculate Vmax2 (see Figure 4). The Clogging Index calculations include a factor to consider the time in minutes and are expressed as a percentage of loss in flow rate. Similar to the Filterability Index determination, an increase in loss of flow rate by comparing the Modified Clogging Index (MCI) with the Clogging Index (CI) indicates clogging of the filter with increased volumes. The Clogging Index calculation also uses the first two volumes (commonly 200 mL (T200) and 300 mL (T300)) and a factor of 1.66 to adjust the value to the time in minutes and is expressed as percentage of loss in flow rate: CI = (T300 - 2 * T200) * 1.66. For the Modified Filterability Index, three Modified Clogging Index time points are taken into consideration (commonly 200 mL (T200), 300 mL (T300) and 400 mL (T400)) and a factor of 3.33 is used to adjust the value to the time in minutes: MCI = ((T400 – T300) – (T300 - T200)) * 3.33. Vmax2 is calculated using the time in minutes and filtered volumes (weights) measured at these time points: Vmax2 = (Time 2 – Time 1) / ((Time 2 / Volume 2) – (Time 1 / Volume 1).

Figure 4: *Report generated by the QApp Filterability Index according to the Italian (left) and French (right) method. For the Italian method, the time to filter 200 mL, 400 mL and 600 mL is measured and the Filtration Index (FI), Modified Filtration Index (IFM) and Vmax are calculated. For the French method, the time to filter 200 mL, 300 mL and 400 mL and volumes filtered after 2 and 5 minutes are determined and the Clogging Index (CI), Modified Clogging Index (MCI) and Vmax2 are calculated.*



Result: Product report Clean

Lot identifier 1	**W123**
Count time after	**20.00 g**
First target weight	**200.00 g**
Time 1	**11.71 sec**
Second target weight	**400.00 g**
Time 2	**34.52 sec**
Third target weight	**600.00 g**
Time 3	**100.64 sec**
IF	**11.10**
IFM	**43.31**
Vmax	**822**



Result: Product report Clean

Second target weight	**300.00 g**
Time 2	**150.19 sec**
Third target weight	**400.00 g**
Time 3	**270.58 sec**
Measure weight 1 after...	**2 min**
Weight 1	**+ 201.00 g**
Measure weight 2 after...	**5 min**
Weight 2	**+ 401.00 g**
CI	**249.63**
MCI	**100.90**
Vmax	**1191**

Filterability analysis is superior to light scattering measurements because all particulates and colloids that may contribute to membrane fouling are considered.

The Sartorius filterability testing solution includes the Cubis® II MCA balance with the Filterability Index software application (QAPP004) guides the user through the process, automatically measures the relevant values and calculates the results.

While filterability analysis is not standardized in terms of volumes to be filtered, membrane composition, diameter and pore size, the results delivered by this integrated solution offer a robust prediction of the impact on membranes of a specific wine during sterile filtration. Process automation also prevents handling and calculation errors and helps to ensure reliable results.

Germany
Sartorius Lab Instruments GmbH & Co. KG
Otto-Brenner-Strasse 20
37079 Goettingen
Phone +49 551 308 0

USA
Sartorius Corporation
565 Johnson Avenue
Bohemia, NY 11716
Phone +1 631 254 4249
Toll-free +1 800 635 2906

For further information, visit
www.sartorius.com

Status: 04 | 2021