Grape Sorting

Latest advances in grape sorting technology

In the June and July 2015 issues of the *Grapegrower & Winemaker*, the Australian Wine Research Institute's senior engineer **Simon Nordestgaard** summarised developments in destemming and sorting equipment. Following a visit to the 2018 edition of Vinitech-Sifel in Bordeaux, he provides the following update on grape sorting, including information on densimetric sorting systems and equipment aimed at larger wineries and vineyards.

Adoption of sorting — in-winery and on-harvester

The AWRI's major 2016 survey of Australian grape and wine production practices found that 30% of Australian wineries used some form of grape sorting. Hand sorting of bunches was the most common technique used, with smaller wineries more likely to perform some sorting than larger wineries (Figure 1). Roller sorting was used by around 6% of wineries producing more than 50 tonnes, sometimes through the purchase of destemmers with an integrated roller sorting stage.

Since 2016 there has also been some further adoption of this technology, for example, the use of roller sorting in wineries that crush more than 10,000t has risen from 4% to at least 16%. The equipment is typically used only for more premium grapes in these larger wineries.

Optical sorting has been adopted to a much lesser extent than roller sorting with only 1.5% of wineries crushing more than 50t using an optical sorter in 2016. Vibrating conveyors designed for hand-sorting and/or feeding other equipment, which achieve some degree of automated sorting via slots, are also used by wineries. One supplier estimated that it had sold twice as many vibrating conveyors as roller sorters.

On-harvester destemming and sorting systems are also in use. Some consist of just a destemming stage, while others consist of both explicit destemming and sorting stages. Destemming and sorting processes are inter-related processes in that they are both concerned with removing contaminants from harvested grapes. How aggressive the destemming process is influences the condition of the grapes and therefore how easily they can be sorted. It also influences the generation of stem fragments that then need to be sorted.

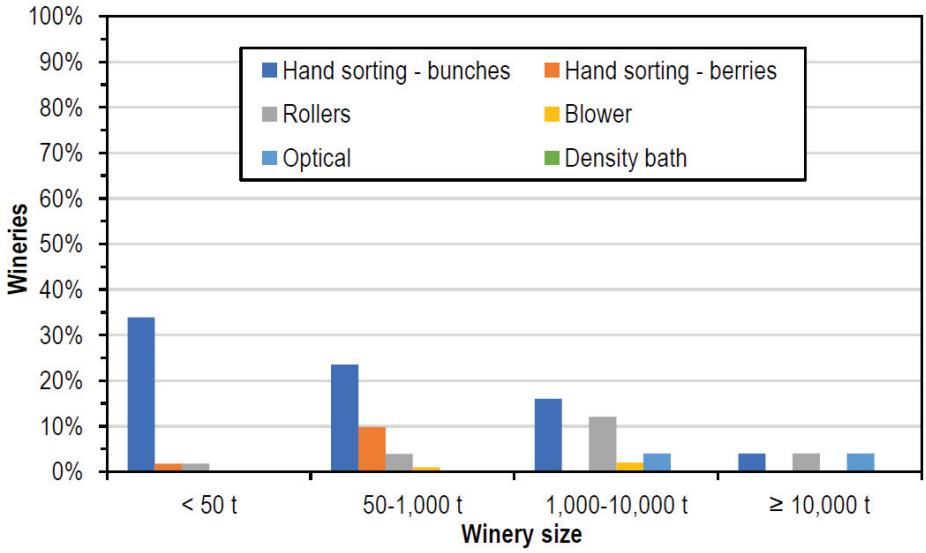

Figure 1. Percentage of wineries using sorting techniques at all in 2016 (AWRI Vineyard and Winery Practices Survey).

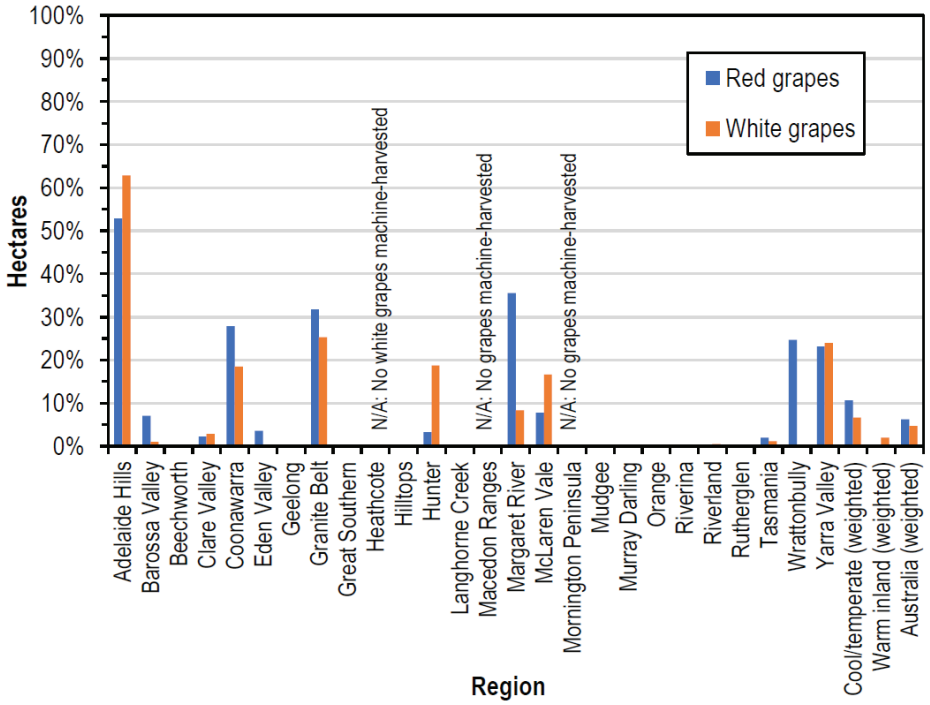

Figure 2. Percentage of machine-harvesting with on-harvester destemming in 2016.

In 2016, 6% of red and 5% of Australian machine-harvested white grapes (by hectare) were destemmed on-harvester (Figure 2). Use of this technology was higher in some regions than others, likely relating to locations where contractors

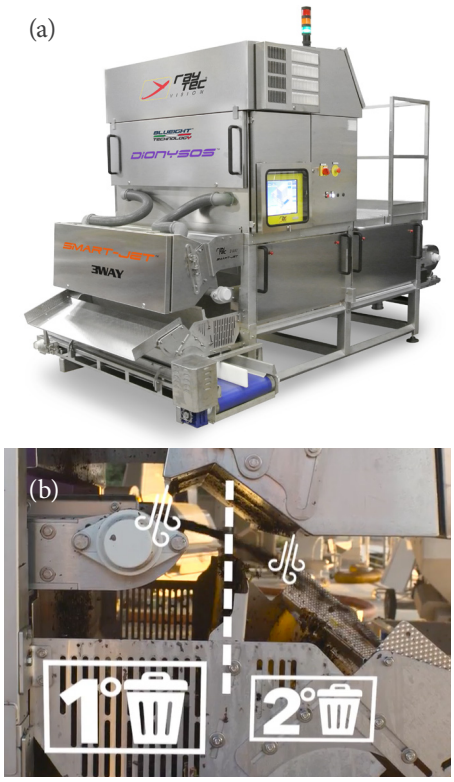

Figure 3. Raytec Vision Dionysos optical sorter: (a) overview, (b) three-way sorting

had purchased machines, grape prices, regional varietal mix and row yields among other factors.

Optical sorting – three-way sorting and delta robotics

Trials using optical sorters on winegrapes were first reported by Falconer and Hart (2005) and equipment has been available from wine industry suppliers since around 2008. Numerous suppliers now sell optical sorters to the wine industry, including Bucher-Vaslin, Pellenc, Scharfenberger (WECO), Enoveneta (Key), Defranceschi-Sacmi (Protec), and Armbruster. Adding to this list, at Vinitech, Raytec Vision received a citation for the Dionysos sorter (Figure 3) and CITF received the silver trophy for the Alien sorter (Figure 4).

A difference between the Dionysos and some of its competitors is that it does not just work in the visible spectrum (i.e. colours that humans can see); for example, it detects vegetal matter in the near-infrared region based on chlorophyll excitation and fluorescence. However, the performance of an optical sorter depends on both the hardware and the software, which can use parameters such as shape in addition to colour to distinguish objects. It is difficult to assess the size of the incremental

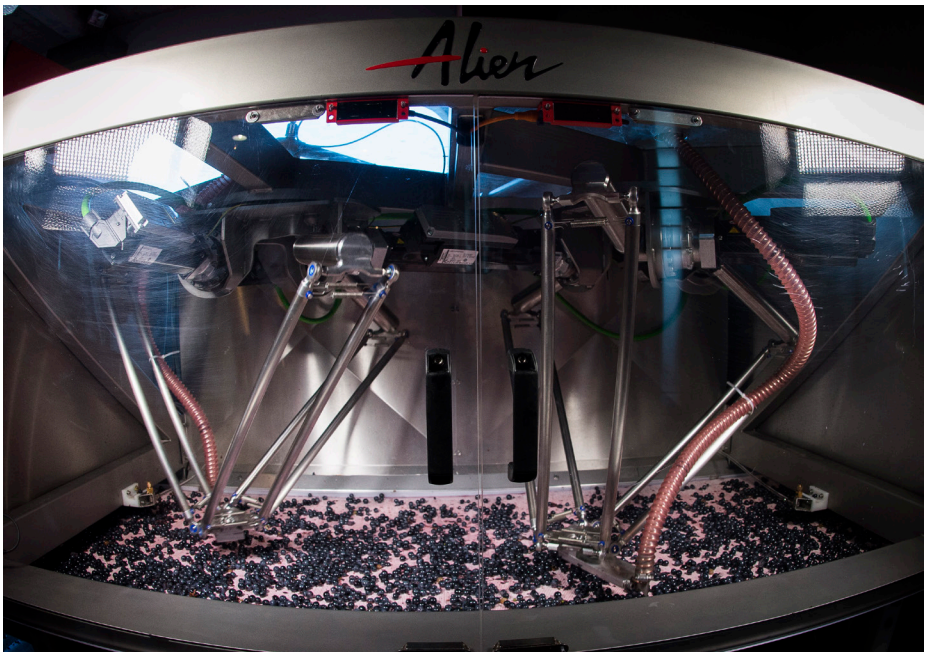

Figure 4. CITF Alien optical sorter with vacuum on delta robots for defect removal.

performance improvement from the additional sensors.

Another difference between the Dionysos and most other grape sorters is that it allows for three-way sorting (Figure 3b), where defects are removed by air-jets into two bins instead of just one. For example, over-ripe grapes could be kept separate from matter other than grapes (MOG) and still be made into wine. The Dionysos costs around $250,000 and, according to Raytec, it can process around 8t/hr. As with most sorting systems, there are likely to be other required peripherals and associated costs.

Optical grape sorters have generally used a bar across the width of the sorter with many valves for defect removal. When a defect is identified, the specific valve is opened, shooting a jet of air to reject that defect into a waste bin (like Figure 3b but usually with just one bin). In contrast, the CITF Alien uses delta robots to move a hose to the identified defect and vacuum it away. Delta robots are a type of parallel robot made up of three arms connected to universal joints at the base. There is no independent data on whether this is a better or worse approach than the standard air-jet arrangement.

At Vinitech, CITF indicated that an advantage of its system is the high defect removal speed, with it being able to remove 400 defects per minute. However, another supplier of optical sorting equipment disputed CITF's speed comparison, saying that the standard air-jet arrangement is much faster.

The fast-moving delta robots are visually very impressive, and this is probably not an unimportant feature in some of the very high-end wineries that might be interested in this design. While the delta robots are currently used to remove defects from a flat layer of individual grapes, just like air-jet systems, it is possible that in the future they might be able to be used in ways that air-jet systems cannot, such as removing parts from intact bunches.

Other suppliers of optical sorting systems at Vinitech had also made various upgrades to their systems, including simpler and more robust user interfaces and improved networking.

Densimetric sorting – more than just MOG removal

The concept of sorting based on density is an understandable approach given that density corresponds with ripeness. It is not a new idea. Singleton *et al.* (1966) used sucrose solutions of different Brix to understand ripeness distributions and suggested that "further study may even disclose commercial utility in making quality separations" based on this principle.

This century, the company that seems to have done the most work on densimetric sorting of grapes is Amos Industrie. Around 2005 it launched the Tribaie system and the latest version was on

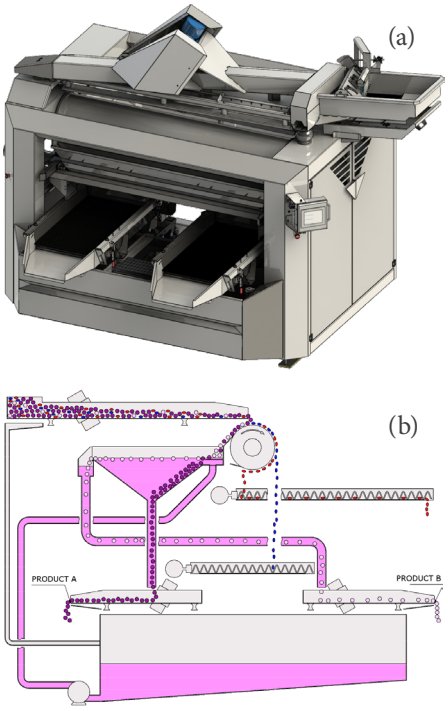

Figure 5. Amos Industrie Tribaie densimetric sorter: (a) overview, (b) simplified schematic.

show at Vinitech (Figure 5). The grapes are fed onto a drum which split berries and waste stick to, while whole berries roll off into a sugar/juice bath of set density. Ripe grapes sink and unripe grapes and other debris float. The segregated streams (Products A and B) then pass across screens to drain off the bath liquid, which is then recycled.

More recently, Bucher-Vaslin (Figure 6) and SOCMA (Figure 7) have released their own density bath sorting systems and both received citations at Vinitech. The Bucher-Vaslin Densilys uses a

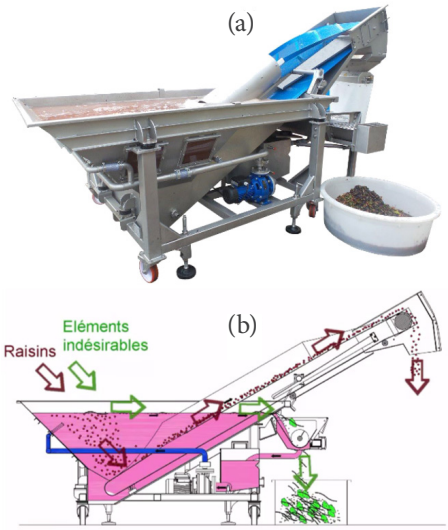

Figure 6. Bucher-Vaslin Densilys densimetric sorter: (a) overview, (b) simplified schematic.

draining conveyor to lift ripe grapes out from the bottom of the bath. The SOCMA Densibaie uses paddles on a chain loop, with the paddles at the bottom scraping the ripe grapes from the bottom of the bath at one end and scraping the floating unripe grapes/debris off the top of the liquid at the other end.

Apart from sorting berries, density bath systems can also be used for cleaning dust off whole bunches, or in combination with a refrigeration system for cooling. As with all sorting systems, the condition of the grapes before sorting influences the quality of sorting and would also gradually alter the bath density.

The increasing number of suppliers offering densimetric sorting systems

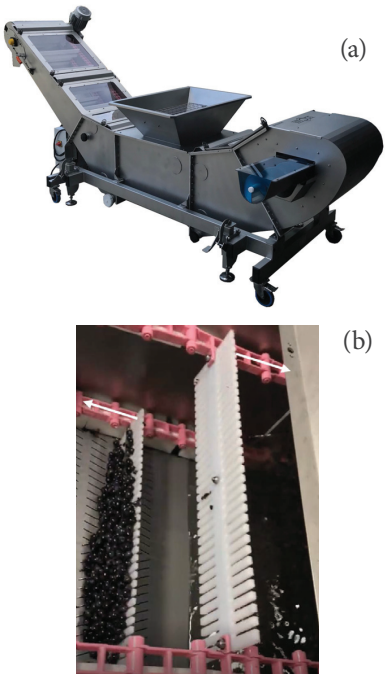

Figure 7. SOCMA Densibaie densimetric sorter: (a) overview, (b) bottom paddle on chain scraping ripe grapes up and out of the density bath, while the top paddle heads into the bath where it will scrape floating unripe grapes and debris off at the other end.

is an interesting development, behind which there are probably several drivers. The ability to potentially segregate grapes with subtle differences in ripeness, rather than only removing MOG and extremely green berries is a desirable aspect of the technology. Equipment price and the size of market at that price are also likely to be key factors. It's unlikely that there are that many wineries internationally that could justify the investment in equipment like an optical sorter (at current prices)

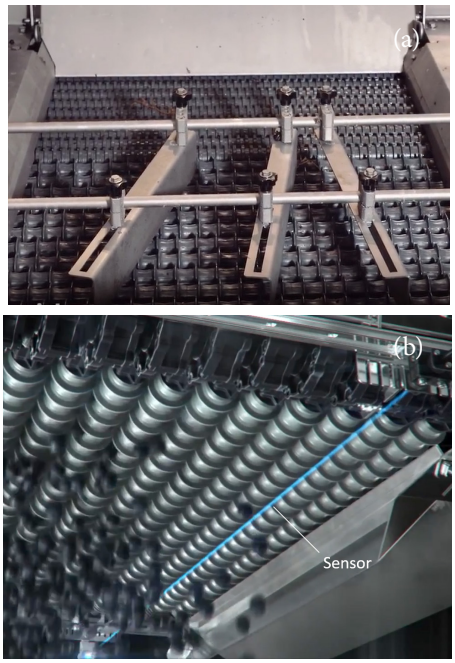

Figure 8. Pera-Pellenc Kliner high throughput roller sorter: (a) distributor bars, (b) sensor for automated roller spacing adjustment.

that have not already bought one, while a basic density bath sorter like the SOCMA Densibaie only costs around $40,000 (nominal maximum flow rate: 4t/hr).

Roller sorting – increased throughput

Roller sorting appears to have been introduced to the wine industry around 2008 by Pellenc as part of the on-harvester Selectiv' destemmer-sorters, and many suppliers now sell roller sorters. Relative to some other sorting equipment, roller sorters allow reasonably high throughputs (in the order of 10t/hr) for their price, but they have still mainly been used for premium grape processing. More recently, Pera-Pellenc and Bucher-Vaslin have released systems capable of much higher throughputs (in the order of 50t/hr).

To make the best use of the width of the table the grapes need to be evenly spread. The Pera-Pellenc Kliner uses distributor bars (Figure 8a), while the Bucher-Vaslin Trio XXL uses a sweeping arm distributor (Figure 9). To ensure that the length of the table is best used without losing grapes off the end, the Kliner has a photoelectric sensor on the second to last roller gap (Figure 8b). When too many grapes start to cut through this light beam it automatically widens the roller spacing. Similarly, if no grapes are getting to this point, the roller spacing is tightened to maximise the amount of sorting performed. The Trio XXL uses similar concepts, with sensors monitoring the level on the top of the table.

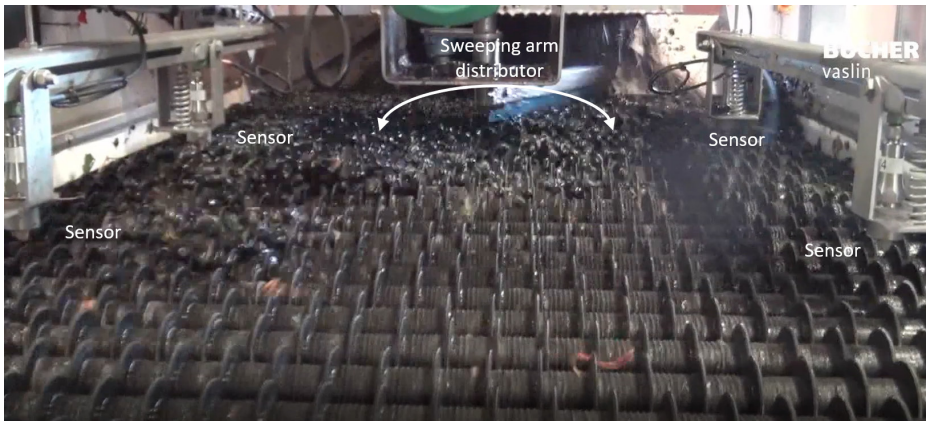

Figure 9. Bucher-Vaslin Trio XXL high throughput roller sorter with sweeping arm distributor and sensors for automated roller spacing adjustment.

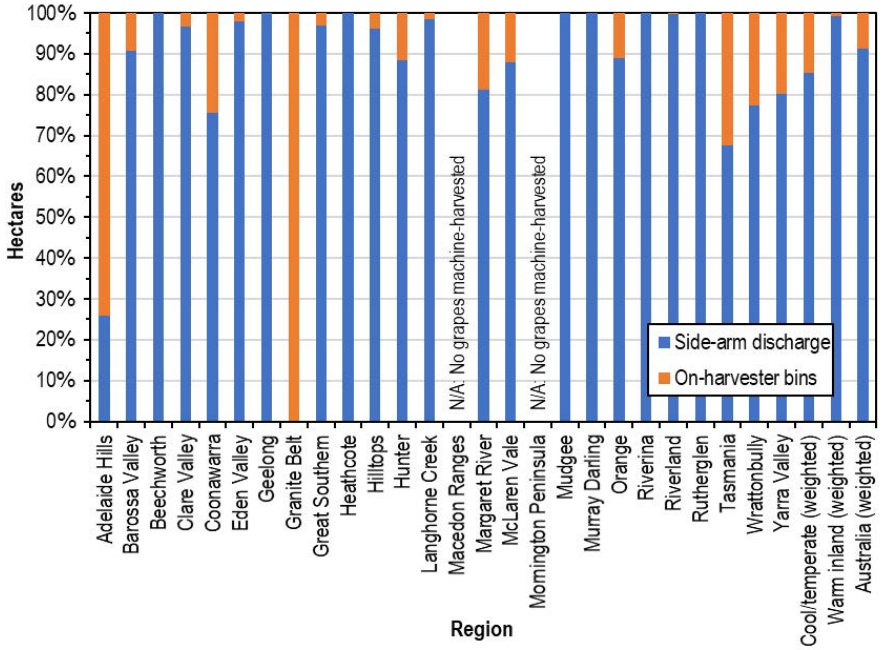

Figure 10. Percentage of machine-harvesting with side-arm discharge in 2016.

Harvester systems – side-arm compatibility

All the major grape harvester manufacturers have offered on-board destemming or combined destemming and sorting systems for some time. However, before 2016, the on-harvester destemming and sorting systems from the main French brands - Pellenc, Braud New Holland and Gregoire - were only available on their two-bin machines.

Harvesters with side-arm discharge conveyors are used for 90% of Australian harvesting (Figure 10). Two-bin machines are inefficient in longer row vineyards because the bins may become full part-way along a row and the driver must then stop harvesting and return to the end of the row to empty the bins.

To cater for the Australian and some other markets, around 2016 Pellenc released a harvester with a side-arm discharge conveyor and a modified version of its Selectiv' destemming and sorting system (Figure 11, see page 54). In this revised design the two destemmers drop grapes onto a large cross-conveyor which passes them onto a single large roller sorting table. The sorted grapes fall into a bin from which they are transported by cup-conveyors up and out, onto another conveyor and then onto the side-arm discharge conveyor.

Braud New Holland has now also released a harvester with a side-arm

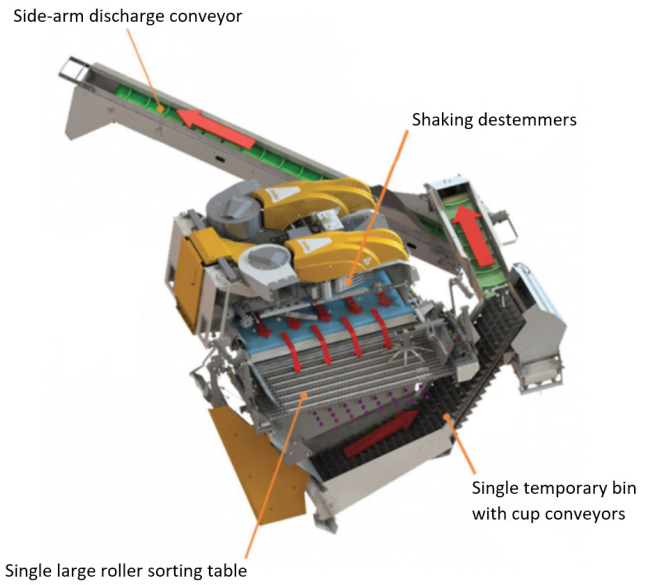

Figure 11. Simplified schematic of Pellenc harvester with Selectiv' destemming and sorting system and side-arm discharge conveyor.

discharge conveyor and SOCMA destemmers (Figure 12). The operation of this machine is similar to the company's regular side-arm discharge machine, except that there is a destemmer on both sides. When using the side-arm, the cross-conveyor is shifted to the left to catch the material from the left destemmer and move it to the right of the harvester and onto the side-arm.

The grapes from the right destemmer fall directly onto the side-arm. When changing out gondolas/bins, the cross conveyor is shifted to the right and its direction reversed to send grapes from the right-hand destemmer across to the on-board bin on the left of the machine, while the material from the left destemmer drops straight into the bin.

Braud New Holland has also made other modifications to its two-bin destemmer harvesters, such as a more widely-spaced and vibrating destemming grid, to make the new side-arm machine suitable for somewhat higher yielding vineyards with bigger berries.

In 2016 Gregoire replaced its Cleantech Vario destemming-sorting system with the EasyClean destemming system (Figure 13). It has fingers that move from side to side and rub the grapes through the destemming grid. This system was originally only available on two-bin machines, but it is now being offered on side-arm discharge machines where it is mounted on the side-arm (Figure 14).

One issue that is sometimes raised regarding harvester destemming systems is that there is extra juice in the bins. Destemming is an additional mechanical action, so it is logical that it could cause some extra juicing, with the amount varying depending on the specific design and how it is operated. It is also sometimes suggested that the extra juice in the bins may be a consequence of less juice being lost out

Figure 12. Braud New Holland harvester with SOCMA destemmers and side-arm discharge conveyor: (a) overview, (b) SOCMA finger-wheel destemmer.

the back of the harvester. The relative contribution of these factors has never really been established.

With regards to possible negative quality impacts from any extra juicing, it is unlikely to matter for red grapes, but it could potentially be important for white grapes. The benefits from sorting white grapes are also debatable, since any solid contaminants in the load will be removed during draining and pressing shortly after arrival at the winery. It is interesting that one of the countries that appears to have adopted on-harvester destemming and sorting most enthusiastically is New Zealand, which is predominantly a white wine producer. However, that white wine in New Zealand is mainly made from Sauvignon Blanc, a variety that is often given intentional skin contact in wineries, a little bit of extra juicing probably does not matter and may even be desirable. Another reason for the high adoption could just be that the timing of the New Zealand wine industry boom aligned with the release of on-harvester destemming and sorting systems.

Conclusions

Sorting equipment will continue to evolve. Adoption levels are currently low in Australia, but it is likely that this will increase. The workshop being held at the AWITC in July will present more information about the different options and considerations in grape sorting, including firsthand information from winemakers that have used the equipment.

Acknowledgements

The AWRI's communications are supported by Australian grapegrowers and winemakers through their investment body Wine Australia, with matching funds from the Australian Government. The AWRI is a member of the Wine Innovation Cluster in Adelaide. The author thanks the many equipment suppliers that provided information for this article and Australian grapegrowers and winemakers that took part in the AWRI Vineyard and Winery Practices survey. Sandra Trew from Promosalons is also thanked for the opportunity to attend the 2018 edition of Vinitech-Sifel.

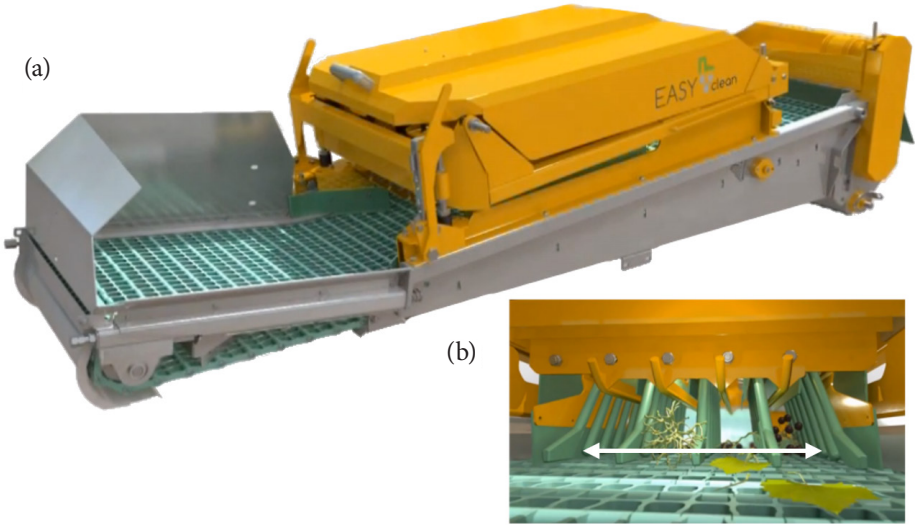

Figure 13. Gregoire EasyClean destemmer: (a) overview, (b) destemmer internals.

Disclaimer

Readers should undertake their own specific investigations before purchasing equipment or making major process changes. This article should not be interpreted as an endorsement of any of the products described.

References

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Figure 14. Gregoire EasyClean destemmer mounted on the side-arm discharge conveyor.

AWITC Workshop

A workshop on grape sorting will be held on 21 July 2019 in Adelaide as part of the 17th Australian Wine Industry Technical Conference. It will include a presentation on considerations when designing a sorting line, talks from winemakers that have trialled or adopted sorting equipment, wine tastings, and information from equipment suppliers on their latest offerings. Register now at: www.awitc.com.au

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