Measuring smoke density and smoke composition in vineyards

AGRICULTURE VICTORIA

Information sheet 3 of a series of 5

Scientists have been developing commercial smoke detectors known as nephelometers to measure the obscuration (density) of smoke and a sampling system using Tenax tubes to measure the composition of smoke from controlled burns and bushfires. This factsheet describe how these sensors work, how they can be deployed and how smoke samples can be collected in a vineyard.

Planned burns are an integral part of bushfire management and are mandated in Victoria. Burns generally occur in March, April and May due to suitable and safe conditions and this may be before harvest when grapes are susceptible to absorbing smoke taint compounds. In addition, many vineyards are located close to native forests that are vulnerable to bushfires.

Smoke taint is correlated with the composition, density and duration of exposure of grapes to smoke. Research to date has confirmed that short durations (10 min) of dense smoke in close proximity of a vineyard can cause smoke taint; however, smoke must contain the volatile phenolic compounds to cause taint and this can vary. For example, young smoke is high in volatiles, but there is evidence that these volatiles can alter and condense out of smoke over time and during cooling conditions (e.g. at night).

NEPHELOMETER

A nephelometer measures smoke obscuration in the air (i.e. degree of impairment to see through the air due to smoke). It consists of a pump and tubing system that draws in air from just above the vines, and a sensor that measures the fine (< 2.5 µm) particulate matter from smoke (Figure 1).

Figure 1. A nephelometer with telemetry for remote access.

Data can be recorded at any time interval to produce a real-time chart of smoke obscuration (Figure 2). A level of 1% obs/m is equivalent to a viewing distance of only 45 m and 0.1% obs/m is equivalent to a viewing distance of 4 km. Clean air is approximately 0.06-0.08% obs/m.

Data can be accessed directly through an RS232 cable to a computer or remotely by a modem to display data at another location.

Nephelometers have been shown to accurately record particulate matter from smoke levels in vineyards across Victoria; however, such observations do not necessarily mean that smoke taint particles are in the smoke. As the smoke compounds react relatively quickly in the air, fresh smoke directly downwind of a fresh burn will have much higher levels of smoke taint compounds than older smoke observed at a distance from the fire or days after a fire has declined. Thus, nephelometers provide an indication only that smoke is present and further testing is necessary to determine if smoke taint compounds are at levels high enough to taint wine.

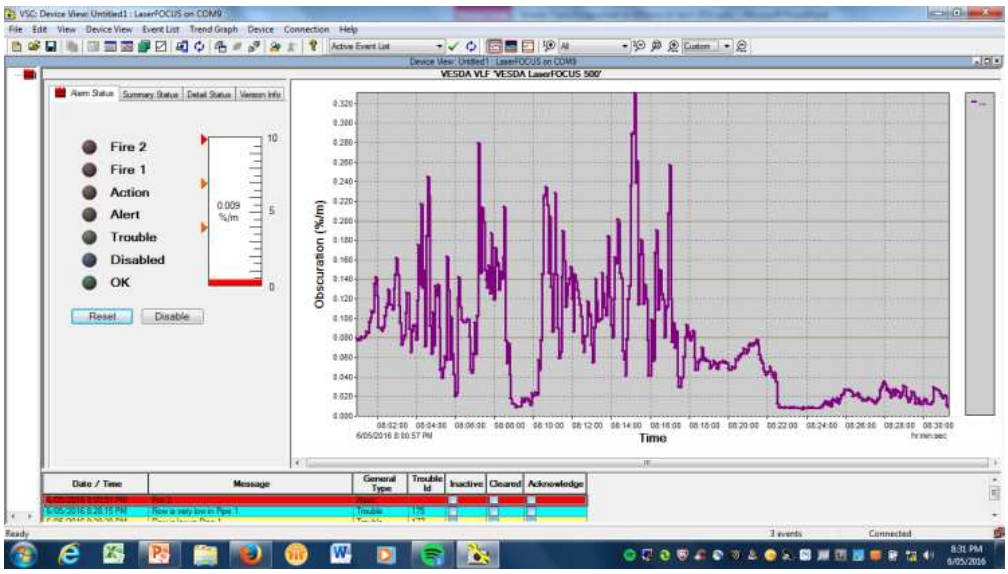

Figure 2. A typical nephelometer print out of smoke obscuration showing the changes over a short 30-minute period.

TENEX TUBES

A sampling system has been developed that uses Tenax tubes to capture smoke taint compounds (see fact sheet No.1, Smoke taint in wine).

The system consists of sampling the same air that is being measured by a nephelometer into a Tenax tube using special low flow pump (100 ml/min) (Figure 3). The smoke taint compounds are captured onto a resin in the Tenax tube over a defined time period and this allows for an accurate calculation of the concentration of taint compounds in the smoke. The resin is then processed in a laboratory and analysed using a gas chromatograph to determine the concentration of individual smoke taint compounds (Table 1).

Figure 3. A Tenax tube attached to a nephelometer inlet tube enabling smoke taint compounds to be determined from controlled burns or bushfires.

Recently, six vineyards in Victoria made collections of smoke samples during smoke events and these are being used to develop thresholds and risk models for potential smoke taint in vineyards across Victoria.

Table 1. The concentration of smoke taint compounds (fg/ml) at different levels of obscuration from a 1 h intense burn.

Smoke taint compound	Smoke density (% obs/m)				
	0	2.5	10	20	> 30
Cineole	0	0	0	0	2267
Phenol	14	113	243	766	621
o-Cresol	4	35	74	229	482
m-Cresol	4	26	51	150	380
p-Cresol	3	21	40	116	263
Guaiacol	10	90	193	665	512
Syringol	3	50	118	361	11288

FUTURE OPPORTU NITIES

Measuring smoke density can be done routinely; however, linking it to the concentration of smoke taint compounds is more difficult. Recent observations are showing that many observations of smoke haze at a distance from a fire contain low and potentially insignificant levels of smoke taint compounds. Linking nephelometers with Tenax tube information and weather data modelling should enable better management of controlled burns and minimise the risk of smoke taint within specific regions.

ACCESSIBILITY

For more information, please contact the Project Leader, DEDJTR Victoria – Centre for Expertise in Smoke Taint Research, Agriculture Research Branch on 136186.

This document is also available in PDF format at www.victoriangovernmentdepartment.vic.gov.au

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