Science for Communities

ASSESSMENT OF FUMIGANTS USED IN THE TREATMENT OF TIMBER - ADDENDUM

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Genera are in the process of preparing an application for renewing their consent for use of methyl bromide and phosphine as fumigants at the Port of Tauranga (POT). Beca has been engaged to prepare the consent application including a statutory assessment and preparation/coordination of the supporting documentation. ESR provided a report in October 2019, including an assessment of the risks associated with methyl bromide fumigation activities at POT.

Due to the production of multiple air dispersion models for methyl bromide release at POT, the New Zealand Environmental Protection Authority (NZEPA) convened an expert conference of air dispersion modelling practitioners, to agree best practice for air dispersion modelling for methyl bromide. An amended version of the Sullivan *et al.* (2018) report was produced, as a consensus position of the modelling experts ("the SEC report").

The SEC modelling approach appears to be sufficiently conservative for conclusions based on the model outputs to be considered health protective. The SEC report suggests that model maxima are inappropriate exposure concentrations for regulatory comparisons. ESR concurs with this position, as our experience of exposure modelling suggests that model maxima often represent unrealistic combinations of circumstances.

The dispersion modelling identifies no concerns for bystander exposure for any timeframe (1-hour, 24-hour or chronic) at any of the presented percentiles of the concentration distributions. This includes exposure concentrations at the 99.99th percentile for 1-hour exposures. The 1-hour exposure at the 99.99th percentile of the concentration distribution identifies a slight excursion of the 1 ppm concentration isopleth outside the port boundary into the industrial estate to the south-east. This excursion is not apparent at the 99.5th percentile of the concentration distribution. Given the very low probability of this excursion (equivalent to approximately 1 hour per year) and the conservatism in the exposure model and the tolerable exposure limit (TEL), this excursion is unlikely to be a cause for concern. The conservatism in the 1-hour TEL is discussed further in the main ESR report.

A similar excursion above the TEL is apparent in the chronic concentration modelling for the same zone. However, given that the identified zone will not be continuously occupied, the effective mean chronic exposure concentration in this zone will be below the TEL.

1. INTRODUCTION

1.1 BACKGROUND

Genera are in the process of preparing an application for renewing their consent for use of methyl bromide and phosphine as fumigants at the Port of Tauranga (POT). Beca has been engaged to prepare the consent application including a statutory assessment and preparation/coordination of the supporting documentation. ESR provided a report in October 2019, including an assessment of the risks associated with fumigation activities at POT.

1.1.1 Reassessment of dispersion modelling

During March 2020, the New Zealand Environmental Protection Authority (NZEPA) convened an expert conference of air dispersion modelling practitioners, to agree best practice for air dispersion modelling for methyl bromide (Sullivan *et al.*, 2020a). The expert conferencing was initiated due to the production of several air dispersion modelling reports related to methyl bromide use at POT (Bender, 2020; Golder Associates (NZ), 2019; Sullivan *et al.*, 2018; Todoroski, 2019). The expert conferencing agreed on key aspects of the modelling, including (Sullivan *et al.*, 2020a):

- CALMET meteorological data set
- Range of recovery scenarios
- Near-field and far-field modelling
- Model settings and outputs.

An amended version of the Sullivan *et al.* (2018) report was produced, as a consensus position of the modelling experts (Sullivan *et al.*, 2020b). The amended report ("the SEC report") notes that:

"The panel's recommendations led to increased conservatism in the modeling approach in multiple ways, including:

- The Base (Validation) Scenario, which represents the status quo, was conservatively modeled using the low end of the recapture/destruction rates recorded by Genera Science and Innovation as the technology has been tested under commercial conditions at the Port of Tauranga. The range in testing was from ~ 30 to 80 percent. The low end of the range (30 percent) was used to ensure that this assumption did not result in biasing the model to overstate.
- Log stacks were segregated into 5 different groups ranging from smallest to largest. For each of the five log stack group sizes the largest volume within each group was used to represent all venting within that particular group. This conservative approach again overstates the actual volume, and thereby emission rate, for most of the venting operations.
- A deterministic modeling approach was used to augment the planned probabilistic, Monte Carlo-based assessment of concentration distributions. For the deterministic approach, Sullivan Environmental Consulting (SEC) assumed that the maximum emission rate associated with the first hour of venting applied during every hour from 7:00 A.M. to 7:00 P.M. This conservative approach overstates worker exposure by a wide margin.
- Distributions in the probabilistic analysis for locations within the port were based only on hours with active venting in progress rather than all hours. In addition, additional analysis was conducted to add additional conservatism by computing alternative distributions based only on the first hour (highest) emission periods.

- Rather than base distributions only on the three-year period for each model run, a total of 8 model runs with reset hourly emission files based on Monte Carlo sampling was used to show emissions variability by simulating 24 years of port operational practices for the Base (Validation) Scenario."

2. METHYL BROMIDE HEALTH IMPACT ASSESSMENT

2.1 NEW ZEALAND EXPOSURE LIMITS

Methyl bromide was reassessed by the New Zealand Environmental Risk Management Agency (ERMA) in 2009 (ERMA, 2009). The reassessment included proposal of tolerable exposure limits (TELs). These are summarised in Table 1.

Table 1. Tolerable exposure limits (TELs) for methyl bromide

	Acute (1 hour)	Acute (24 hour average)	Chronic
Volume based (ppb)	1000	333	1.3
Mass based (mg/m^3)	3.9	1.3	0.005

The derivation of these TELs is outlined in the previous ESR report.

2.2 HEALTH IMPACT ASSESSMENT OF METHYL BROMIDE DISPERSION MODELLING, PORT OF TAURANGA

In the methodology section of the SEC report it is noted that:

"As a point of caution, however, there is a relatively high probability at the extreme of the modeled distribution for model artifacts/outliers to occur. SEC considers such results are unreliable. For this reason, SEC's experience is that the highest percentiles are not used in air dispersion modelling to inform regulatory decisions" (Sullivan *et al.*, 2020b).

ESR concurs with this comment and does not support the comparison of model maxima with regulatory exposure limits. In the SEC report, all concentration estimates for points beyond the port boundary were based on distributions of methyl bromide concentrations for all hours, rather than the more conservative options of basing concentration distributions on venting hours only or the first hour of venting only. This is certainly appropriate for consideration of chronic exposure and should be acceptable for acute exposure assessment by consideration of 'equivalent percentiles'. The equivalent percentile refers to the fact that, for example, for a 1 hour averaging time the 99.5th percentile of the concentration distribution based on all hours of active venting will be equivalent to the 98th percentile of the concentration distribution based on the first hour of venting only. For longer averaging times the percentiles tend to converge.

The SEC report does not explicitly consider stack venting and ship venting as separate events, but includes actual information on the frequency and timing of these events in the model.

The following discussion assesses the risks to human health represented by high percentile concentrations and any relevant mitigating factors. Risks are considered relative to the TEL values, derived by ERMA/EPA. Risks are considered to (a) bystanders (nearest residential dwelling), and (b) occupational bystanders (maximum offsite location). In this context bystanders are permanent residents of the area, who could potentially be exposed to methyl

bromide residues on an acute or chronic basis. Occupational bystanders will be employees of surrounding businesses who are potentially exposed to methyl bromide residues for up to 8 hours per day (nominal). It has been assumed that workers directly involved with the fumigation will be using personal protective equipment, which will minimise exposure.

2.2.1 Acute exposure (1-hour)

TEL = 3.9 mg/m^3 (3,900 μg/m^3) or 1 ppm

The SEC report presents a 99.99th percentile 1-hour distribution of methyl bromide concentrations beyond the port boundary (Sullivan *et al.*, 2020b). While the modelling shows concentrations exceeding the TEL (1 ppm) over the sea to the west and north-west, on the landward side the 1 ppm concentration isopleth only passes the port boundary for a small area of the industrial estate to the south-east of the port. The 99.99th percentile equates approximately to 1 hour per year. Given the conservativism in both the dispersion modelling and the TEL, the 1 ppm isopleth excursion from the port boundary is unlikely to be a cause for concern.

Lower percentiles of the concentration distribution are only shown for areas within the port boundary. The 99.5th percentile concentration, based on active venting hours only, indicates that concentrations of methyl bromide at the port boundary would not exceed 0.25 ppm.

2.2.2 Acute exposure (24-hour)

TEL = 1.3 mg/m^3 (1,300 μg/m^3, bystanders) or 0.33 ppm, 3.9 mg/m^3 (3,900 μg/m^3, occupational bystanders) or 1 ppm

For the 98th percentile of the concentration distribution, 24-hour methyl bromide concentrations do not exceed 0.1 ppm on the landward side of the port and only exceed 0.05 ppm in industrial areas. As these areas will not be continuously occupied for 24 hours, the TEL is adjusted to an 8-hour equivalent of 1 ppm.

2.2.3 Chronic exposure

TEL = 0.005 mg/m^3 (5 μg/m^3) or 0.0013 ppm

For assessment of chronic exposure, consideration of high percentiles of the methyl bromide concentration distribution is not appropriate, as it is unrealistic that such concentrations would be sustained over a chronic time-frame. The SEC report correctly reports annual concentrations as means (averages).

The 0.0013 ppm concentration isopleth shows a slight excursion beyond the port boundary to the south-east, into the adjoining industrial estate. The SEC report states that “annual average concentrations in the range 0.0016 to 0.0023 ppm, occur near the southern-most sources”. Given that any individual within this zone is only likely to be present at this location for a maximum of about 40 hours per week (24% of the time), this would equate to a maximum mean annual exposure concentration of 0.00055 ppm or approximately 50% of the TEL. Consequently, this excursion is not of concern with respect to chronic exposure to methyl bromide.

2.2.4 Summary

The dispersion modelling conducted by SEC is based on the agreed outcomes of an expert conferencing exercise. The modelling approach appears to be sufficiently conservative for conclusions based on the model outputs to be considered health protective. The SEC report

suggests that model maxima are inappropriate exposure concentrations for regulatory comparisons. ESR concurs with this position, as our experience of exposure modelling suggests that model maxima often represent unrealistic combinations of circumstances.

The dispersion modelling identifies no concerns for bystander exposure for any timeframe (1-hour, 24-hour or chronic) at any of the presented percentiles of the concentration distributions. This includes exposure concentrations at the 99.99th percentile for 1-hour exposures. The 1-hour exposure at the 99.99th percentile of the concentration distribution identifies a slightly excursion of the 1 ppm concentration isopleth outside the port boundary into the industrial estate to the south-east. This excursion is not apparent at the 99.5th percentile of the concentration distribution. Given the very low probability of this excursion (equivalent to approximately 1 hour per year) and the conservatism in the exposure model and the TEL, this excursion is unlikely to be a cause for concern. The conservatism in the 1-hour TEL is discussed further in the main ESR report.

A similar excursion above the TEL is apparent in the chronic concentration modelling for the same zone. However, given that the identified zone will not be continuously occupied, the effective chronic exposure concentration in this zone will be below the TEL.

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