Te Mata Mushrooms | Eave/Curtain design of Bunkers for Odourous Gas Capture

Subject:	Bunker eave extension design
Outline:	Consideration on efficacy of eave extension for odourous gas capture
Client:	Te Mata Mushrooms
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1 Introduction

Armatec Environmental Ltd are leaders in designing and installing industrial odour control systems including hoods, covers, ducting, fans and treatment systems in Wastewater Treatment Plants (WWTP) around New Zealand and Australia. We have over 30 years' experience in eliminating air odour problems in waste water treatment plants and deliver world-leading technologies in conjunction with international experts.

We have wide experience in odour capture systems and technologies, and built odour treatment facilities for other large-scale mushroom plants in New Zealand with odours of the same nature to Te Mata.

Te Mata Mushrooms are a large-scale mushroom producer based in the Hawkes Bay Region. It is planning an extension of production and redesign of parts of its plant and process. A part of this proposed change is the subject of this report.

2 Scope

Armatec has been commissioned to give its considered opinion on the efficacy of the odour capture provided by the proposed eave and curtain design on the composting bunkers, assisted by the extraction system. These eaves and curtains are designed to capture rising, hot gases during the bunker-to-bunker transfer.

As in all odour management systems, the appropriate design and operation of the biofilter/treatment facility of the extracted gases is a very important facility of the appropriate overall operation. Detailed design of this component of the process will be undertaken prior to installation of the eaves/curtains and is not within the scope of this report.

3 Process Description

It is not the intention of this report to fully describe the process at Te Mata and other reports are more detailed in this description. The focus of this report is on the composting process within the bunkers only. Below is a description of the current bunker composting process description, which will be similar to the future process.

Mushroom growing requires high quantities of high quality compost which is made onsite with a combination of hay and chicken droppings, and at high temperatures (70-80 degrees celcius). Currently, and until production reaches 200 tonnes per 7 days, hay begins its composting process outdoors, and then after a number of days are mixed with chicken droppings. Then this mixture is transferred to the bunkers with a front-end loader. Then after the bunker is filled the doors are closed, and air is injected from below to aerate the compost.

An extraction fan is used to remove odours generated. When the doors are closed this extraction system is balanced with the aeration system to maintain a vacuum within the bunkers during this composting process. Maintaining a vacuum is best practice process to contain and treat odours generated by processes. This requires encapsulation of the odours and low total opening area so that a minimum of 0.5 to 2m/s air velocity is achieved and maintained to ensure an absolute minimum of fugitive odorous air escape. On inspection of the current operation, site measurements confirm an observed air velocity of over 0.5 m/s – of air being sucked *into* the bunkers – at openings around the closed doors. This represents good practice for odour capture.

Bunker doors – closed. Insert shows side profile of same doors – with "bend" in the door walls from the vacuum suction internally. No gases observed escaping the bunkers.

*Air velocity tests at openings around doors when doors are closed – all tested air velocities exceeded 0.5m/s – of air being sucked *into* the bunkers.*

A vacuum is achieved with the appropriate balancing of air blowing and extraction rates. Current extraction fan capacities (for both bunkers together) are approx. 4.1 m^3/s, and the biofilter is rated to 3.5 m^3/s *(see separate report from Beca Infrastructure Ltd titled "Te Mata Mushrooms*

Composting Biofilter Compliance Testing", November 2011). It is understood that the extraction and treatment system will be upgraded to appropriately suit the upgraded bunkers.

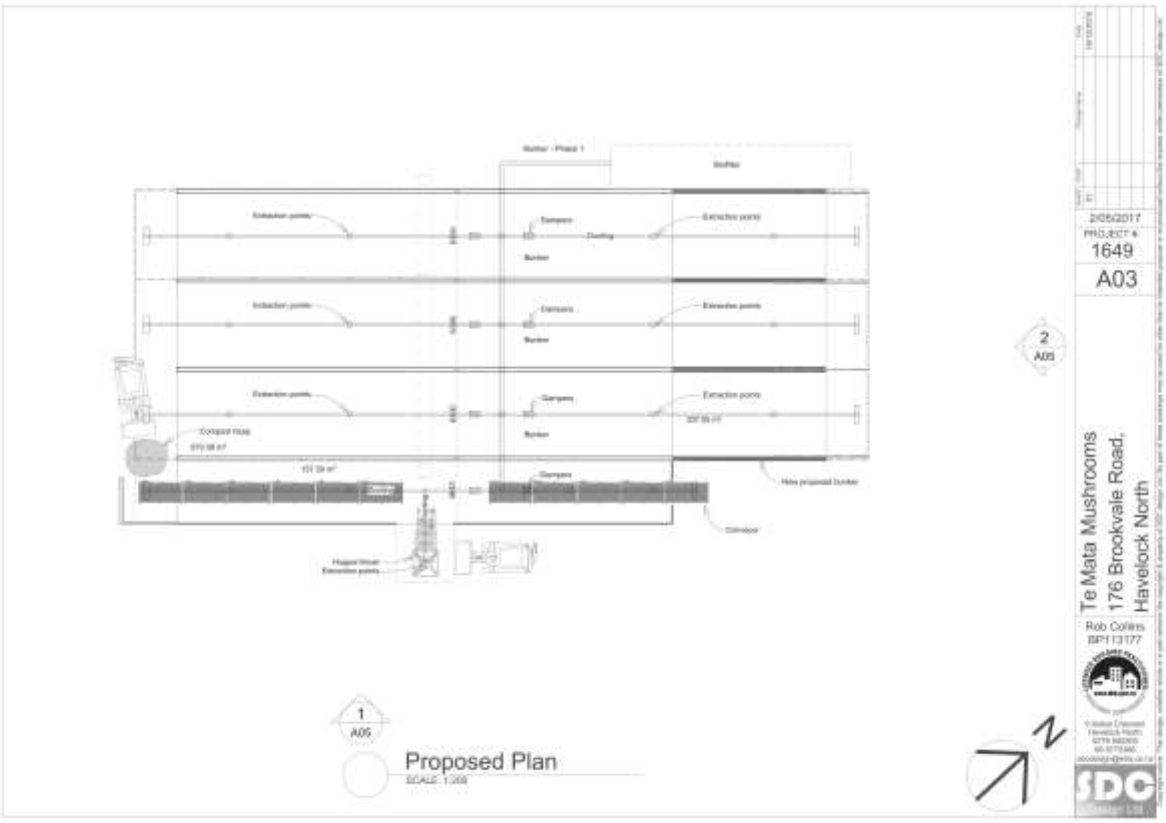
A biofilter treats the odours in this exhausted air. This is outside of the scope of this report but must be noted that an appropriately designed and operated odour treatment facility is a very important element to the overall design.

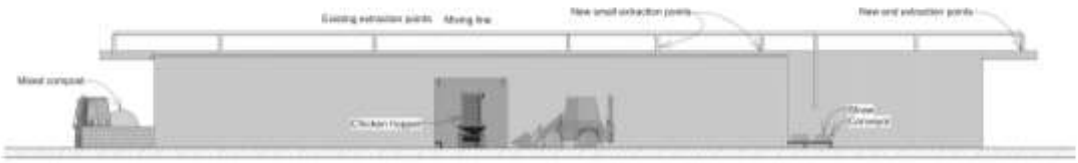
During times when the doors are open, then a vacuum is unable to be maintained. The doors must be opened to allow front end loaders to come in and out of the areas. An eave system and curtains are proposed so that during this time, the majority of rising gases from the compost are captured within the Bunkers and treated appropriately. The curtains, which are an extension of the original proposal are expanded upon below.

The doors are open during: (1) pre-mixing, (2) bunker-to-bunker transfers and (3) mixing prior to transfer to the Tunnels. This is the proposed process for the new plant also – see below. This is when the Eave and Curtain design has the most impact.

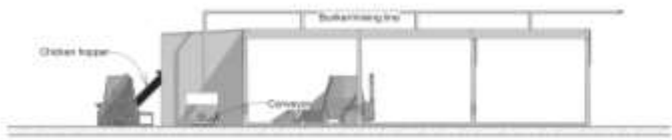
4 Proposed Eave and Extraction Design

The proposed bunker extensions, eave design and general extraction points are shown in the below drawings provided by Te Mata Mushrooms. Note the curtains are not included in the drawing.





Elevation 1
SCALE: 1:200



Elevation 2
SCALE: 1:200

5 Gas Movement & Eave/Curtain design

Below is a photo of the current operation during one off these operational times. The set up on the RHS bunker is the "typical operation" at Te Mata with just an eave, and no drop curtain, and the LHS is a recent addition, with Te Mata experimenting with a drop curtain across the existing door ceiling. The proposed design is to extend the eaves further horizontally out from the bunker, include a drop curtain at the ends of the eaves, and have ducted extraction points in the eaves to remove gases that build up behind the curtains.

In terms of gas behaviour: as the compost is disturbed during moving, the gases coming off the compost are hot, and rise relatively quickly to the ceiling of the bunker – shown as ❶ (1) in the picture below. Then they spread out at the roof space of the bunker, as shown in ❷ (2). Gases then move to escape the bunker and rise out of the door opening.

The eaves and curtains provide this capture point for the gases at the roof line, as the hot gases attempt to rise up out of the bunker, at ❸ (3). The bunker on the RHS has no curtain. The LHS bunker has a curtain. In the LHS bunker the curtain blocks the hot gases' exit from the bunker, and the gases accumulate and are forced to move under the curtain to escape, whereas in the RHS bunker the gases escape directly.

6 Proposed Extraction Locations

Currently there is a single, central duct extraction point on the bunkers – drawing air from the centre of the bunkers. This is effective for gas extraction and odour control during times when the doors are closed, but suboptimal during times when the doors are open. Therefore adjustments are planned for.

The planned extraction design is to have:

a. More extraction points along the ceiling of the bunker(s) for more equalised removal along the bunkers
b. Extraction points along the width of the bunker eave behind the curtain to optimise the extraction of the built-up hot gases during the times that the doors are open.
c. Increased controls on extraction rates at the provided points to better direct/prioritise the total extraction airflow to maximise gas capture prior to escape. For example, when a door is open, then controls will be adjusted so the maximum possible extraction rate is achieved in those bunkers near the openings to minimise gas escape.

An appropriately-sized extraction system is an important part of this design.

7 Hoppers / Mixers loading / unloading areas

The same approach is planned for the conveyor lines around the hopper / mixer , with a similar theory of approach to capture the hot, rising gases with an eave and curtain design and extraction points along this process chain with ventilation controls to optimise extraction rates during operation.

8 Effectiveness

The purpose of this report is to comment on the proposed eave and extraction location design during worst-case conditions. These conditions for odour are (1) when the doors are open, coupled with (2) still/low wind non-ideal atmospheric conditions that permit odours to linger, stay low, and be noticeable by neighbours. These times are typically during cold, still morning scenarios.

It must be noted that due to the nature of the operation, during the times when the doors are open, it is considered not possible to capture all gases evolved – which would entail complete enclosure with a negative vacuum achieved at all times. When the doors are open, this negative vacuum is not possible. Additionally, when compost is outside the bunkers and eaves, evolved gas is not captured in this system. Therefore, the idea for the eave is to capture as much as reasonably practicable while allowing operation to continue.

Based on the detail presented in this report, it is the opinion of Armatec that the combination of an appropriately-designed and constructed extended eaves and curtains roof design coupled with appropriately sized ducted extraction design and rating, implementation and operation will have a positive effect on gas and odour capture so that the majority of evolved gases are captured for treatment.

It is noted that machinery movement and onsite wind speeds do have an impact on the behaviour of gases within the bunkers and their escape – in that: (1) when machinery moves in and out of the bunker it creates a mass airflow in and out of the bunker; and (2) when the wind is higher, then gases will be more likely to be blown out of the bunkers and the eave/curtain is less effective. However, this last phenomenon also tends to be times when atmospherics tend to reduce the likelihood of odour being noticeable by neighbours – in that higher winds carry and disperse odour more quickly.

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