Local Government Air Quality Toolkit

Composite structural products guidance note

Information on good design and management practices to reduce air emissions from manufacturing and finishing processes

Acknowledgement of Country

Department of Climate Change, Energy, the Environment and Water acknowledges the Traditional Custodians of the lands where we work and live.

We pay our respects to Elders past, present and emerging.

This resource may contain images or names of deceased persons in photographs or historical content.

The Local Government Air Quality Toolkit has been developed by Department of Climate Change, Energy, the Environment and Water in collaboration with the NSW Environment Protection Authority, the NSW Department of Planning, Housing and Infrastructure, Local Government NSW and local councils.

Cover photo: A worker preparing a composite structural product. Alex Potemkin/iStock

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1. Introduction

1.1 Industry overview

This guidance note provides general information on manufacturing and finishing processes, along with the related air pollution, control measures and key considerations for local councils. It does not cover water quality management and work health and safety.

Smaller-scale operations that manufacture composite structural products are not usually scheduled activities under the *Protection of the Environment Operations Act 1997* (the POEO Act) and so do not require an environment protection licence.

Local government has regulatory responsibility for environmental protection of these non-scheduled activities. The environmental management and resolution of any air pollution or off-site impacts caused by air emissions from such premises is primarily the responsibility of the site owner and operator.

The most common composite structural product is fibreglass-reinforced plastic (FRP). FRP is used in manufacturing a diverse range of products including boats, surfboards, bathroom fixtures (shower stalls, baths, vanity units, spas), kitchen fixtures and fittings, swimming pools, storage tanks and piping, simulated marble products and motor vehicle and truck fixtures and panels. FRP and other composite materials are extremely versatile, so their applications as manufactured products continue to grow.

FRP usually contains unsaturated polyester resins and some form of fibre reinforcement – typically fibreglass – although other materials may be used. Some composite products contain polyamide (nylon), epoxy, polyurethane or polycarbonate resins, but this is uncommon in Australia at present. About 80% unsaturated polyester resin is used in reinforced applications and extended with various inorganic fillers, such as calcium carbonate, talc, mica or small glass spheres. Advanced reinforced products use carbon fibre, aramid fibre and aramid/carbon hybrids.

Some resin-based products contain little or no reinforcement with the use of other materials, but they can also generate emissions that can impact the local air quality.

While the composition, shape and size of FRP products can vary significantly from one product or premises to another, the mould-based manufacturing process used is similar throughout the industry.

As of 1 July 2024, the use, supply and manufacture of engineered stone benchtops, panels and slabs will be prohibited, with a transitional period of 12 months. This is intended to manage the risk of exposure to respirable silica (SafeWork NSW 2023).

1.2 Manufacturing processes

Most FRP manufacturing facilities include the following processes or equipment:

- mould preparation
- gel-coating and laminating
- equipment and tools clean-up
- ventilation and air filtration systems
- resin or gel coat transfer and storage systems.

The principle behind manufacturing these ‘plastic’ products involves using viscous liquid organic monomers (the resin) and a chemical catalyst (e.g. methyl ethyl ketone peroxide) to promote a chemical reaction that causes the monomers to combine (i.e. link or cross-link) and cure into a hard plastic (the polymer).

Monomers and solvents

The monomers and solvents used are volatile materials that evaporate into the air and have distinctive, strong odours associated with them. Some monomers have extremely low odour thresholds; that is, the compounds can be readily smelt at extremely low concentrations in air (i.e. parts per billion to a few parts per million).

The styrene monomer content of the polyester resin is typically 25–55% by weight (w/w) of the gel coat. The gel coat also contains methyl methacrylate monomer in varying percentages. The acrylate monomers have very low odour thresholds (i.e. are highly odorous). The solvents used in these preparations include acetone, toluene, xylene and alcohols. Safety data sheets (SDS) from product suppliers can provide information on the exact composition of resins, catalysts and gel coats.

> The abbreviation ‘w/w’ means ‘weight for weight’ and simply means that the composition is in terms of the relative weights of the constituents, rather than their volumes (‘v/v’).

Details of the production processes are provided below.

Mould preparation

Mould preparation is the first step in manufacturing an FRP product. Moulds are usually handmade, often using standard patterns. After a mould is formed it is cleaned, waxed and transported to a spray booth where a thin layer of gel coat is applied.

For further information about spray painting and surface coating, see the stand-alone Local Government Air Quality Toolkit – *Spray painting and surface coating operations guidance note*.

Casting

After gel-coating, moulds proceed to the casting process, which takes place in the mixing room.

Resin, filler (crushed marble for example), and catalyst are mixed in a closed process and applied to the moulds, which are then mechanically vibrated to remove bubbles and allow the resin to settle.

Laminating

Alternatively, a layer of fibreglass matting is applied to cover the mould and then a layer of resin is applied, followed by another layer of fibreglass matting, then more resin, and so on.

This lamination process builds up the product to a desired thickness and strength.

Curing

The completed mouldings are then allowed to cure and harden in the curing area. In some applications a curing oven may be used to control or speed up the curing process.

Finishing

After the resin has hardened, the products are polished and sanded in the finishing (or grinding) room. Lastly, the finished products are taken for packaging and shipment. Particulates generated during the grinding and sanding operations are collected and filtered via air extraction systems before discharge to atmosphere.

The entire production operation can be completed in a large single room, with the exception of the grinding and sanding area. This part of the process is usually contained in a separate, enclosed area within the manufacturing room.

In the mixing room and casting area, indoor air is usually discharged directly to atmosphere via fans. Fresh air is introduced through floor level vents, or open windows and doors.

> Workplace health and safety regulations require that the indoor air is vented outside at different points within the manufacturing process or throughout the premises, either through a series of exhaust fans, or through suitably designed collection and extraction hoods and ducting to an exhaust stack.

2. Potential emissions to air

2.1 Overview

Air emissions from FRP and other composite products manufacturing include:

- particulate matter
- volatile organic compounds
- odours.

Air emissions may be discharged from:

- a point source (e.g. a stack or flue)
- venting a process or piece of equipment (e.g. spray booth)
- wall fans discharging indoor air horizontally to the outside
- a fugitive source from a building (such as passive venting out of doors or windows).

Figure 1 shows a typical FRP production layout depicting the major elements of the manufacturing process and potential air pollutants.

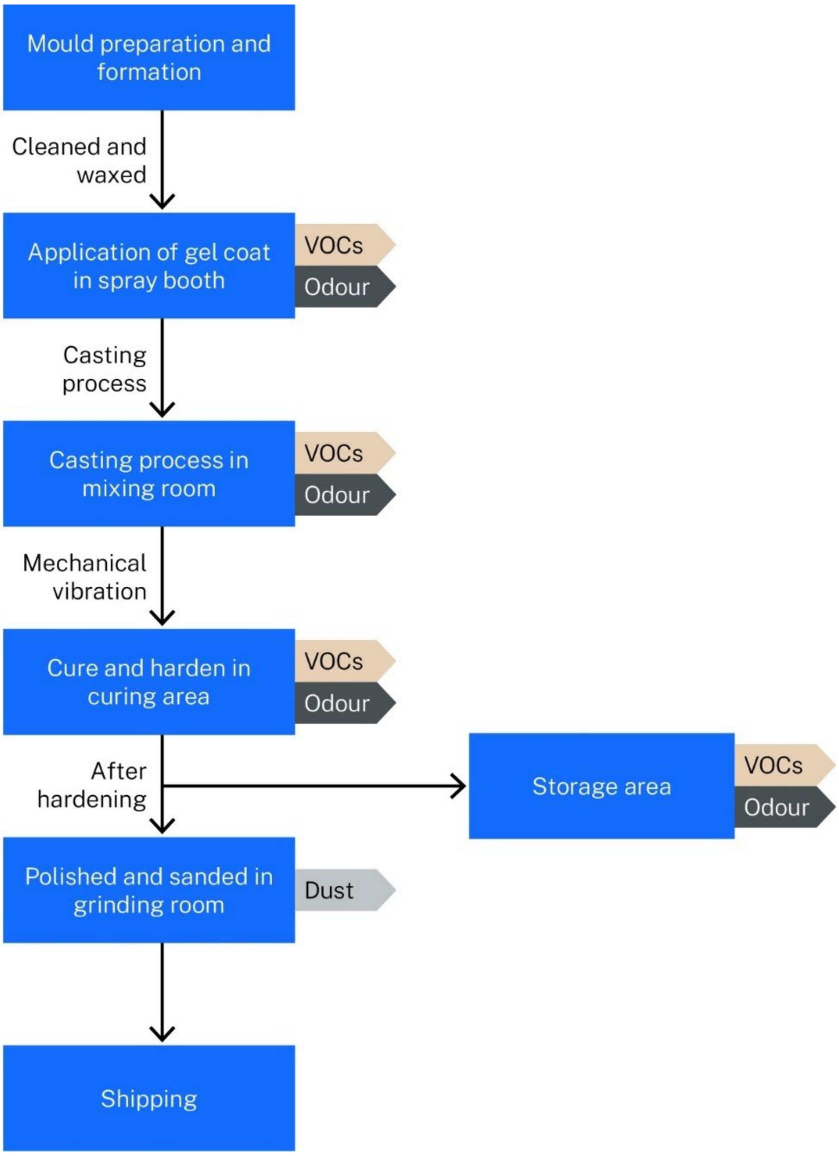

Figure 1 Potential air emissions from the FRP manufacturing process

2.2 Particulates

Particulates are generated from:

- grinding, sanding and polishing operations during the finishing process
- handling and cutting fiberglass matting
- handling, storage and transfer of inorganic fillers.

2.3 Volatile organic compounds (VOCs)

The major sources of VOCs are:

- applying gel coats to moulds
- laminating resin and fiberglass matting onto moulds
- storage areas
- handling of resins and associated organic solvents
- mixing room
- spray booth
- curing area or oven.

The VOCs associated with FRP manufacturing are:

- styrene
- methyl methacrylate
- methyl ethyl ketone
- toluene
- xylene
- acetone
- propanol.

Some VOCs can be smelt at concentrations well below those of health concern and before there is concern about their toxicity (e.g. styrene), and others can exceed the relevant exposure criteria (based on toxicity) before being of sufficient concentration to be detected by the human nose (e.g. acetone).

2.4 Odour

Odour sources can include:

- storage areas
- mixing rooms
- spray booths
- curing areas or ovens.

Odour from VOCs is a real driver for emission controls in FRP production.

VOCs arising from FRP manufacturing operations should not be able to be smelt beyond the boundary of the premises. No such odours should be detectable in residential or other sensitive land uses (e.g. schools, hospitals).

> Detecting odours from FRP manufacturing operations is indicative of exposure to these substances.

Odour and toxicity

Sense of smell cannot be relied upon to assess whether the exposure is concerning in terms of toxicity. People complaining about chemical odours may well be seeking assurances that the level of exposure is not hazardous to their health. This can be difficult for mixtures of VOCs because some may require a significant increase in concentration above the odour threshold of an individual chemical for toxicity to be of concern (e.g. a factor of about 220 times for propanol). However, other compounds may require significantly lesser increases for these issues to be of concern (the health-based criterion is 3 times higher than the odour threshold for methyl ethyl ketone).

In situations where there is any doubt about possible health implications, an assessment of potential impacts should be carried out using the techniques described in the EPA publication *Approved methods for the modelling and assessment of air pollutants in New South Wales* (EPA 2022a).

3. Managing air pollution

3.1 Housekeeping

The following are good housekeeping practices:

- Wastes such as empty drums and other containers must be tracked in accordance with the Protection of the Environment Operations (Waste) Regulation 2014. Waste must be stored in an environmentally safe manner.
- Fibreglass matt offcuts that cannot be used in the production process should be sealed in plastic bags before disposal to prevent the release of fibres.
- Baghouse waste collectors need to be emptied regularly and not allowed to overflow and create unnecessary particulate emissions. The frequency of baghouse waste collector emptying will be site or application-specific, and should be determined via a regular, formalised inspection protocol.
- The workplace should be kept tidy and free of excessive quantities of dust and other debris.
- Spills should be cleaned up promptly.
- Lids, bungs or caps should always be in place to seal containers whenever the material is not being used.

3.2 Managing the FRP production process

This section includes a summary of key management measures in the production process.

Object size and air exchange

The surface area of the object being manufactured will have a significant influence on the amount of odour generated during the lay-up and curing processes.

Sufficient air exchange within the workplace will be necessary to meet workplace exposure standards (refer to the Safe Work Australia *Workplace exposure standards for airborne contaminants* (SWA 2024)). The preference should be to discharge odorous indoor workplace air to atmosphere via a stack of suitable configuration to disperse and dilute odours to a level that does not cause nuisance or offence off site.

Flammability of gases

Where VOCs are being collected and discharged, the potential flammability of the gases should be considered with respect to the potential for a fan or switches to act as an ignition source. This is a specialised area of knowledge. If the status of electrical equipment, switches, fans and lighting is unknown or they are considered to be in poor condition, SafeWork NSW can be contacted to follow up on these compliance aspects.

Estimating emissions

The usage and consumption rate of resins and other volatile organic materials (such as solvents) needs to be understood to estimate emissions from these types of activities.

Simple odour test

The simplest way to determine if a potential odour problem exists is to stand downwind at the property boundary (e.g. the footpath outside or the shop entrance), or at the nearest premises from which complaints may be or have been generated, on a day with low wind speeds and when production is at maximum capacity (in terms of anticipated emissions).

If the odour is coming from a stack or roof ventilator, it should not be detectable at the point where the odour plume reaches the ground. The technique for detecting and tracing odour sources is outlined in the Local Government Air Quality Toolkit – Module 4, *Practical regulation of air pollution* and should be used in the investigation. The principles of stack configuration are covered in the Local Government Air Quality Toolkit – Module 3, *Air pollution control techniques*.

> If the odours associated with FRP production processes can be clearly discerned downwind and off site, it is likely that operations at the premises could potentially cause nuisance and health impacts. In this case, either pollution control at source or improved dispersion of pollutants is required, or both.

3.3 Managing finishing processes

If particulate emissions generated by FRP finishing processes are visible at their point of discharge to atmosphere or have been a source of nuisance or complaints off site, the particulates should be collected and filtered using a fabric filter dust collector before discharge to atmosphere.

Allowing emissions of particulates from doors or windows, or conducting finishing operations outside, can also be a source of nuisance to adjacent land users.

Where possible, such activities should occur inside and with dust collection and extraction equipment in place. This should be a requirement for new workshops.

3.4 Particulate matter control options

Where the source of particulates is confined to a particular activity and location, purpose-designed extraction or collection systems can be used to stop particulates and fugitive emissions entering the workplace. If the potential particulate loading is high, such collection systems could also employ fabric filter dust collectors (e.g. baghouses) to minimise particulate discharges to atmosphere and their potential amenity impacts.

Where the particulate loading is high, a baghouse with a self-cleaning mechanism should be used. Cyclones do not collect fine enough particulates to be of value in this type of application.

Grinding and sanding operations should have some form of particulate control. Other potential particulate sources should only require control where it can be demonstrated they are generating nuisance or occupational exposure standards are not being met.

Relevant SDS should be examined to confirm whether any potential hazards exist (e.g. respirable silica levels in mica). Glass fibres from fibreglass matting are known to present a respiratory hazard and be an irritant to mucus membranes (i.e. eyes, nose, throat, lungs).

3.5 VOC and odour control options

The VOC and odour control options include:

- discharge via general exhaust fans
- collection and discharge from a stack of suitable configuration (see Local Government Air Quality Toolkit – Module 3, *Air pollution control techniques*)
- extraction and removal using an activated carbon filter before discharge.

If monomer is adsorbed rapidly onto activated carbon, the activated carbon may act as a catalyst, and the heat of adsorption and reaction may raise the temperature high enough to start a fire in the activated carbon bed. In this case, another emissions management system to replace the activated carbon may be needed. Carbon filters should be replaced when they are no longer effective.

Without adequate controls, these emissions can be fugitive in nature and not released through a purpose-designed vent or stack. Discharges through doors and windows are typically at low heights, and therefore adequate dilution and dispersion does not occur, leading to potential impacts in the neighbourhood of the premises.

4. Considerations for local councils

4.1 Scheduled or non-scheduled activity

As discussed previously, smaller-scale operations that manufacture composite structural products are not usually scheduled under the POEO Act and so do not require an environment protection licence.

For a non-scheduled facility, the council is the appropriate regulatory authority (ARA) and can direct the operators to ensure the facility is operating in compliance with consent conditions and in accordance with best practice.

Existing problems can be addressed using 2 sets of regulatory tools:

- compliance with any relevant consent conditions under the *Environmental Planning and Assessment Act 1979* (the EP&A Act)
- the notice provisions of the POEO Act (see Local Government Air Quality Toolkit – Module 2, *Legislative and policy framework for air quality management* and Module 4, *Practical regulation of air pollution*), including:
  - a prevention notice or series of notices, where the ARA suspects the activity is being carried out in an environmentally unsatisfactory manner
  - a clean-up notice, where there is a pollution incident within the meaning of the POEO Act
  - both a prevention notice and clean-up notice.

If issues are identified, the following tools are available in the Local Government Air Quality Toolkit – *Resource pack*:

- Chapter 2 – checklist for inspecting spray painting and surface coating activities
- Chapter 3 – checklists for investigating odour, fallout or other complaints
- Chapter 6 – checklists for reviewing air quality assessments and dispersion modelling

> Under the POEO notice provisions, local councils are empowered to call for studies to be carried out by the operation's management. Time spent making sure the brief for any investigation is thorough, and covers all the relevant aspects raised in this guideline, is time well spent – for the management, for council and for the neighbours and wider community.

4.2 Compliance testing

The need for compliance testing should be considered in each situation, balancing the potential expense incurred by the operator against likely sensitivity and the extent of likely impact.

Typical compliance testing conditions are included in Chapter 7 of the Local Government Air Quality Toolkit – *Resource pack*.

4.3 Assessment and dispersion modelling

There are a few important aspects for local government to consider when reviewing external consultants' air quality assessment and dispersion modelling studies, to ensure the best outcome is achieved. These are included in Chapter 6 of the Local Government Air Quality Toolkit – *Resource pack*.

4.4 Planning and development

The level of control of emissions will also depend on the location of the premises in terms of the separation distance from sensitive land uses or potential complainants.

The technical assessment described in the *Approved methods for the modelling and assessment of air pollutants in New South Wales* (EPA 2022a) will generally require specialist input.

Each of the following criteria is important at development planning and approval stages:

- location of FRP manufacturing premises
- expected level of emissions
- planned level of emission control or management.

An important option, which may only be available on one or 2 occasions, is managing the premises' location in relation to surrounding land uses, and making sure the separation distance to the nearest receptor is appropriate for effective dispersion of residual emissions after good-practice control technology has been applied.

An unsuitable location or unsympathetic development close to a sensitive receptor (such as housing or a school) can create a risk to human health and may be difficult to manage and control in the future. Residential encroachment can also be a problem. The separation distance required will depend on the size of the premises, the local topography and meteorology, and the control technology employed.

More information can be found in the Local Government Air Quality Toolkit – *Land-use planning guidance note*.

4.5 Operational and control recommendations

Consideration should be given to appropriate operational procedures to control and limit air emissions. Chapter 7 of the Local Government Air Quality Toolkit – *Resource pack* lists several operational measures that are helpful in reducing emissions and impacts from composite structural products.

The council may be required to conduct a site inspection to investigate current management practices. Chapter 2 of the Local Government Air Quality Toolkit – *Resource pack* provides helpful information for council officers prior to these inspections, including a checklist.

Before going on site for an inspection, council officers should be aware of the facility's status (scheduled or non-scheduled) and review any previous reports (including diagrams, photographs and maps).

5. References and other resources

All documents and webpages that are part of the Local Government Air Quality Toolkit are available from the EPA website.

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