National Pollutant Inventory

Emission Estimation Technique Manual

for

Timber and Wood Product Manufacturing

First published in July 1999

EMISSION ESTIMATION TECHNIQUES FOR

TIMBER AND WOOD PRODUCT MANUFACTURING

TABLE OF CONTENTS

TIMBER AND WOOD PRODUCT MANUFACTURING

LIST OF FIGURES, TABLES AND EXAMPLES

TIMBER AND WOOD PRODUCT MANUFACTURING

LIST OF FIGURES, TABLES AND EXAMPLES CONT'

1.0 Introduction

The purpose of all Emission Estimation Technique (EET) Manuals in this series is to assist Australian manufacturing, industrial and service facilities to report emissions of listed substances to the National Pollutant Inventory (NPI). This Manual describes the procedures and recommended approaches for estimating emissions from facilities engaged in timber and wood product manufacturing.

The wood product manufacturing activities covered in this Manual apply to facilities primarily engaged in any of the activities associated with the ANZSIC codes listed below.

EET MANUAL: Timber and Wood Product Manufacturing

HANDBOOK: Log Sawmilling, Timber Dressing, & Wood Product Manufacturing

ANZSIC CODES :   2321 - Plywood and Veneer Manufacturing

                        2322 - Fabricated Wood Product Manufacturing

                        2323 - Wooden Structural Component Manufacturing

                        2329 - Wood Product Manufacturing
                                (includes chemically preserved timber)

                        2311 - Log Sawmilling

                        2313 - Timber Resawing and Dressing

This Manual was drafted by the NPI Unit of the Queensland Department of Environment and Heritage on behalf of the Commonwealth Government. It has been developed through a process of national consultation involving State and Territory environmental authorities and key industry stakeholders.

2.0 Processes Description

The following section presents a brief description of the wood product manufacturing industry and identifies likely sources of emissions.

2.1 Sawmilling

In the sawmilling process, hardwood and softwood logs are debarked and cut into sections, which are sawn into timber. Bark from softwood logs may also be sold as horticultural mulch. Shavings, sawdust, and chips can be used in paper mills and reconstituted wood panel manufacturing plants, or used as fuel for boilers or for heat plants. The *Combustion in Boilers* EET Manual is available from your local Environment Protection Authority to assist in estimating emissions from fuel burning in boilers, stokers, and kilns.

Most timber is dried to a specific moisture content (conditioned) through air or kiln drying. Kiln drying is more efficient than air drying as it uses controlled air flow within a vented chamber to quickly dry the timber to a specific moisture content. Note that in the case of hardwood timber, it may be necessary to air dry for some time before kiln drying to avoid excessive checking of the timber.

Sawmills may also carry out preservative treatment operations to protect timber against sap-staining organisms, as well as against insect and fungal attack.
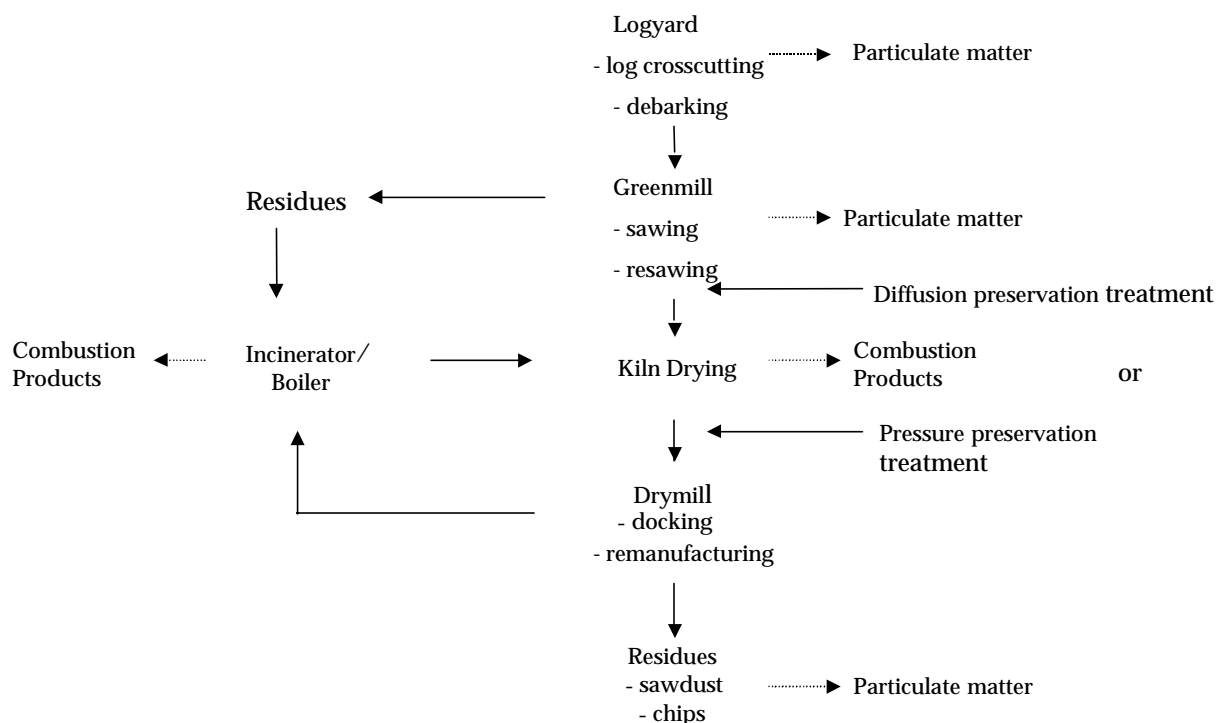
Figure 1 - **The Sawmilling Process**
Source: Department of Environment and Heritage, 1997

2.2   Particleboard (PB)

Particleboard is a panel product made from wood particles of various sizes that are bonded together with a synthetic resin such as urea-formaldehyde. The raw product for particleboard is wood residue. This is ground into particles of varying sizes using flakers, mechanical refiners, and hammermills. The material may be screened prior to refining.

The raw material is then dried to a low moisture content (two to six percent) to allow for moisture that will be gained by the adding of resins and other additives during blending. Pressure and heat are then applied to the mixture to form the board. The boards are sanded and trimmed, and a variety of product finishes may be added to complete the product. Figure 2 shows a typical particleboard manufacturing process.

Delivery	┄┄➤	Particulate Matter
Flaking	┄┄➤	Fugitive Dust Particles
Flake Drying	┄┄➤	Air emissions via stacks Water effluent
Flake Classifier	┄┄➤	Air emissions via stack
Blending	┄┄➤	Waste glue & other chemicals
Spreaders	┄┄➤	Fugitive dust particles
Hot Pressers	┄┄➤	Fugitive dust particles
Cooler		

Warehouse	┄┄➤	Fugitive dust particles
Laminating		
Saw	┄┄➤	Particulate matter
Grading Machine	┄┄➤	Fugitive dust particles
Sander	┄┄➤	Particulate matter
Stacking Bin	┄┄➤	Fugitive dust particles

Figure 2 - The Particleboard Manufacturing Process
Source: CSR Timbers, Gympie, 1998

2.3   Medium Density Fibreboard (MDF)

The raw products used to manufacture MDF consist of the same type of wood residues used to manufacture particleboard. First steam heating generates fibres and fibre bundles the wood, then passes it through a refiner. During this step, the wood changes both chemically and physically; becoming less susceptible to the influence of moisture and less brittle as the lignin in the wood softens. This semi-plastic wood is then "rubbed" apart into fibres and fibre bundles in a refiner rather than mechanically broken apart as in particleboard manufacturing.

The raw product is dried to a very low moisture content to allow for moisture to be gained by the addition of resins and other additives.

The blending process for MDF differs from that of particleboard in that it typically occurs before drying. After refining, urea formaldehyde resins are mixed with the wood fibre. In the blowline, the fibres are sprayed with a resin. Material is dried to an acceptable moisture content at low temperatures after the blowline.

MDF is formed using a dry process that uses air to distribute the raw materials in a random orientation onto a moving tray, belt or screen. The mats are then pressed, cooled and finished. Figure 3 shows the flow chart for an MDF plant.

```
┌──────────────────────┐            ┌──────────────────────┐
│      Debarker        │            │  Packaging and Sale  │
└──────────┬───────────┘            └──────────▲───────────┘
           ▼                                    │
┌──────────────────────┐            ┌──────────────────────┐
│      Chipper         │            │  Trimming/Laminating │
└──────────┬───────────┘            └──────────▲───────────┘
           ▼                                    │
┌──────────────────────┐            ┌──────────────────────┐
│     Screening        │            │      Cooling         │
└──────────┬───────────┘            └──────────▲───────────┘
           ▼                                    │
┌──────────────────────┐            ┌──────────────────────┐
│ Plugging and Heating │            │      Pressing        │
└──────────┬───────────┘            └──────────▲───────────┘
           ▼                                    │
┌──────────────────────┐            ┌──────────────────────┐
│     Defibrator       │            │      Cutting         │
└──────────┬───────────┘            └──────────▲───────────┘
           ▼                                    │
┌──────────────────────┐            ┌──────────────────────┐
│     Blowline         │            │    Fibre Bundle      │
└──────────┬───────────┘            └──────────▲───────────┘
           │                                    │
           └────────────────────────────────────┘
```
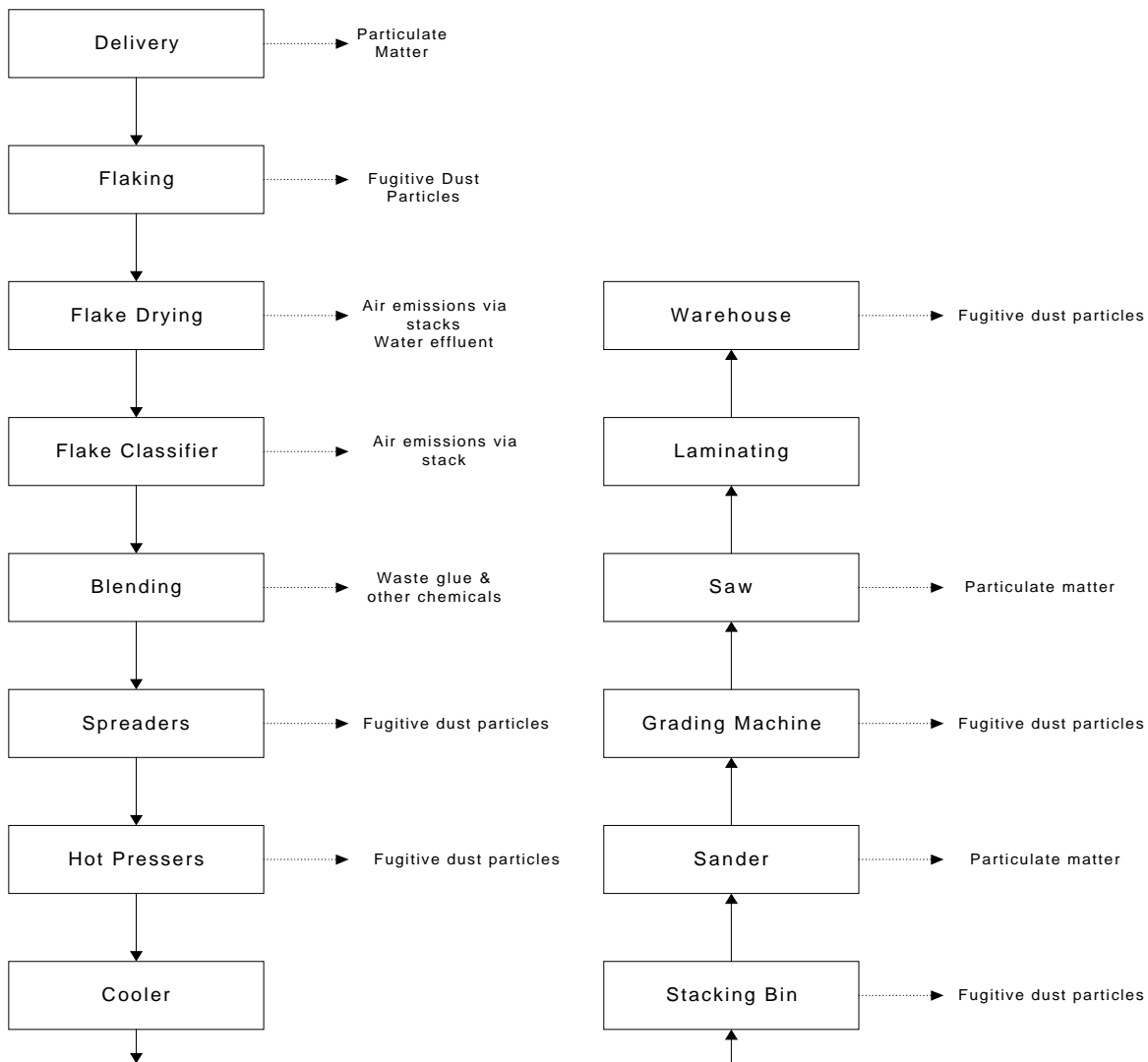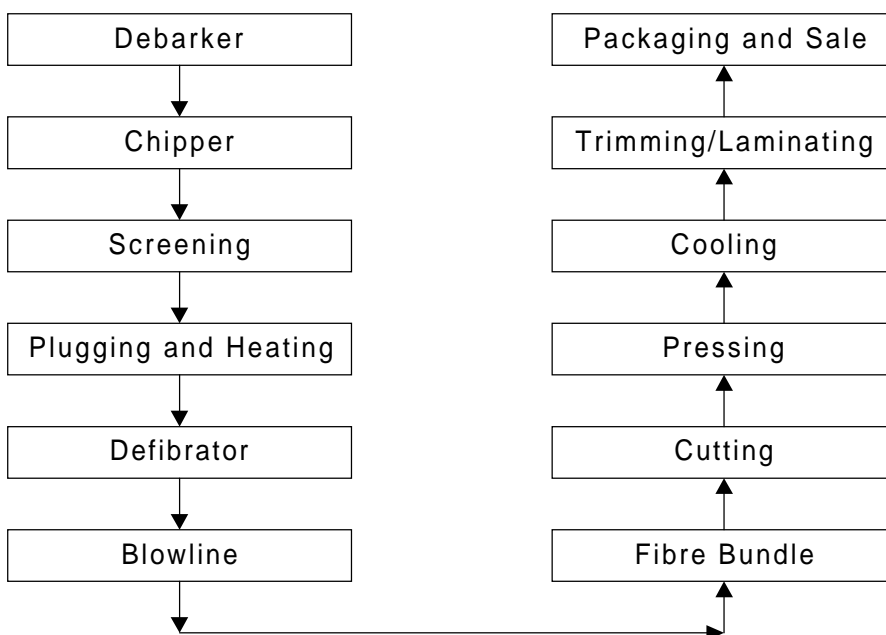
Figure 3 - **The Medium Density Fibreboard Manufacturing Process**
Source: Queensland Department of Environment and Heritage, 1998

2.4   Veneer and Plywood

A veneer is a thin sheet of wood peeled from logs or sliced from blocks of timber called flitches. Veneers are then glued together to form plywood.

After the sheets of veneer have been prepared, they are dried and glued. Narrow pieces of veneers are often joined with an adhesive and/or glue thread to maximise recovery. In the gluing process, adhesive is applied to individual sheets of veneer that are assembled into plywood.

Following the application of glue, the panels are pressed using a hot press to bring the veneers into close contact so that the glue layer is very thin. The resin is heated to the temperature required for the glue to set. Figure 4 illustrates the plywood manufacturing process:

```
          ┌──────────────────────┐
          │     Log Debarking    │
          └──────────────────────┘
                     │
          ┌──────────────────────┐
          │  Log Steaming and/or │
          │        Soaking       │
          └──────────────────────┘
                     │
          ┌──────────────────────┐
          │     Veneer Cutting   │
          └──────────────────────┘
                     │
          ┌──────────────────────┐
          │     Veneer Drying    │
          └──────────────────────┘
                     │
          ┌──────────────────────┐
          │  Veneer Preparation  │
          └──────────────────────┘
                     │
          ┌──────────────────────┐
          │    Glue Application  │
          └──────────────────────┘
                     │
          ┌──────────────────────┐
          │        Pressing      │
          └──────────────────────┘
                     │
          ┌──────────────────────┐
          │     Panel Trimming   │
          └──────────────────────┘
                     │
          ┌──────────────────────┐
          │     Panel Sanding    │
          └──────────────────────┘
```
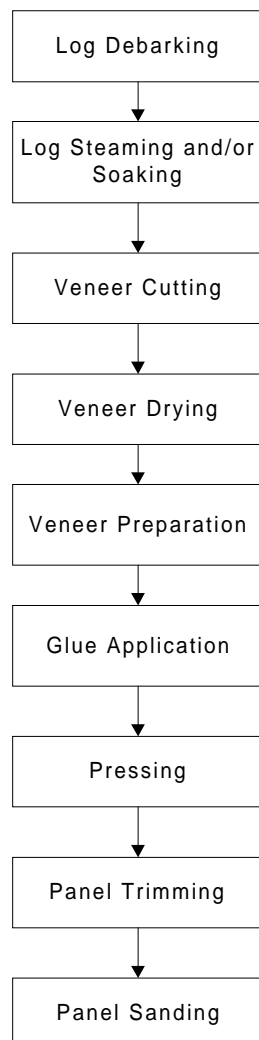
Figure 4 - **The Plywood Manufacturing Process**
Source: Queensland Department of Environment and Heritage, 1998

2.5   Wood Preserving

The most common timber preservatives currently used involve copper-chrome-arsenate (CCA) and boron compounds. New generation wood preservatives include Ammoniacal Copper Quaternary (ACQ) and Tanalith E (Tan E). In the case of Light Organic Solvent Preservative (LOSP) treatment, white spirit is used as a solvent. CCA, ACQ, and Tan E wood preservatives are applied by vacuum pressure impregnation processes (VPI) and boron compounds may be applied by VPI or soaking techniques.

The use of wood preservative chemicals allows timber to be used in situations where under normal conditions it would be destroyed by insect or fungal attack. Without such treatment, softwood and some hardwood timber species would deteriorate after a short period. Preservative treatment improves the useful life of timber, and thus makes it a more durable and practical resource. Figure 5 depicts a general CCA treatment process.

CCA wood preservatives are the most commonly used timber treatment in Australia and may be formulated a number of ways.
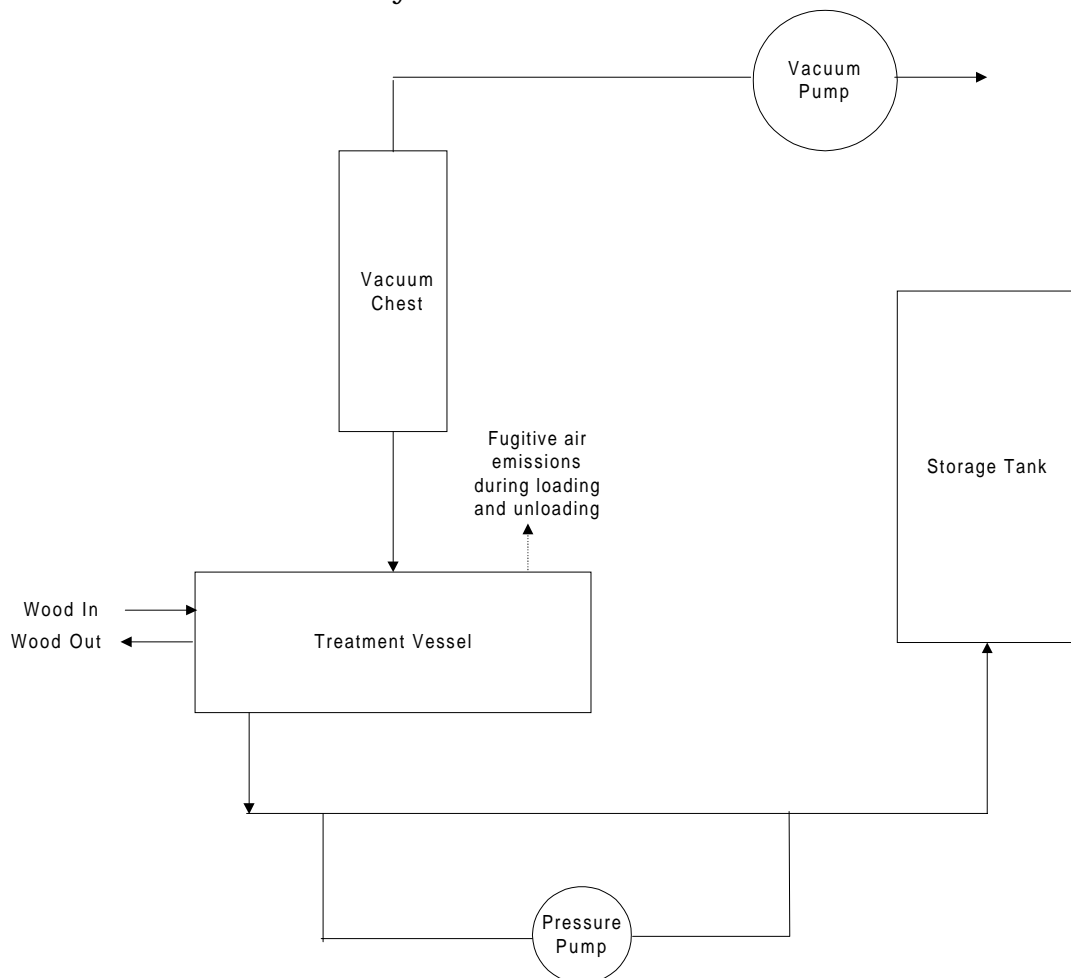

Figure 5 - **Schematic CCA Process for Timber Treatment**
Source: Queensland Department of Primary Industry, 1998

3.0 Emission Sources and Control Technologies

Considering the large variety of treatment processes available, and the associated range of chemicals used in wood preservation, it is essential to identify exactly which NPI-listed substances are used by your facility. Material Safety Data Sheets (MSDS) can be of assistance there.

It is also important to determine if any constituents of compounds used at your facility contain NPI-listed substances. For example, white spirit contains the NPI-listed substances toluene and xylene.

In many cases, emissions from on-site equipment will constitute a major emission source for timber/wood processing sites. Such emissions need to be estimated. Please refer to the *Combustion Engines* EET Manual, which may be useful for estimating emissions from forklifts or other equipment on-site.

Table 1 provides an overview of the typical material inputs, emission and waste outputs for different processes in the timber and wood product manufacturing industry.

Table 1 - **Typical Process Material Inputs, Emission and Waste Outputs**

Process	Inputs Containing NPI-Listed Substances	Air Emissions	Water Emissions	Land Emissions
Sawing		PM_{10}, VOCs, CO, NO_x		
Timber drying/ treating	Wood preserving chemicals and solvents	VOCs, CO, and NOx from the kiln, particulate matter	Kiln condensate and cooling water, containing preservative chemicals, nitrogen and phosphorus.	
Plywood and Veneer	Veneer, phenol-formaldehyde resins, urea-formaldehyde resins, melamine-formaldehyde resins, sodium hydroxide, ammonium sulfate, acids, ammonia	PM_{10}, VOCs, CO, NO_x, formaldehyde, phenol, condensable hydrocarbons, terpenes, methanol, acetic acid, ethanol	Not applicable	Adhesive residues
Reconstituted Wood Products	The same resins as plywood and veneer	PM_{10}, VOCs, CO, NO_x, formaldehyde, terpenes, phenol, methanol, acetic acid, ethanol	Not applicable	Adhesive residues
Wood Preserving	CCA, ACQ, TanE, borates, ammonium compounds, solvents	Ammonia, airborne arsenic compounds, VOCs	Dripped chemical formulations mixed with rainwater and washdown water, cooling water	Bottom sediment sludges, process residuals

Adapted from USEPA, Profile of the Lumber and Wood Products Industry, 1995.

For NPI reporting, it is important to consider the constituents of all materials used on-site to determine if they contain NPI-listed substances as well as emissions to air, land and water. Each of these areas is explained in more detail below.

Emissions to Air

Air emissions may be categorised as:

Fugitive Emissions

These are emissions that are not released through a vent or stack. Examples of fugitive emissions include organic compound releases from presses, volatilisation of vapour from vessels, or spills and materials handling. Emissions emanating from roof-vents, louvres, and open doors of a building as well as equipment leaks, and leaks from valves and flanges are also examples of fugitive emissions.

Point Source Emissions

These emissions are exhausted into a vent (excluding roof vents) or stack and emanate primarily from a single source from a piece of equipment, into the atmosphere.

Emissions to Water

Emissions of substances to water can be categorised as discharges to:

- Surface waters (eg. lakes, rivers, dams, and estuaries);
- Coastal or marine waters; and
- Stormwater.

Because of the significant environmental hazards posed by emitting toxic substances to water, most facilities emitting NPI-listed substances to waterways are required by their relevant State or Territory environment agency to closely monitor and measure these emissions. This existing sampling data can be used to calculate annual emissions.

If no wastewater monitoring data exists, emissions to water can be calculated based on a mass balance or using emission factors.

The discharge of listed substances to a sewer or tailings dam does not require you to report to the NPI. However leakage and other emissions (including dust) from a tailings storage facility are reportable. (See also Section Three of *The NPI Guide*).

Emissions to Land

Emissions of substances to land on-site include solid wastes, slurries, sediments, spills and leaks, storage and distribution of liquids and may contain listed substances. These emission sources can be broadly categorised as:

- surface impoundments of liquids and slurries; and
- unintentional leaks and spills.

3.1   Sawmilling

The main air emission from the sawmilling process is particulate matter. Particles which have an aerodynamic diameter equal to or less than 10 micrometers (ie. $\leq$ 10 microns, $\leq 10\mu m$) are referred to as PM_{10}; however, reporting emissions of particulate matter will occur only when the fuel burning threshold is triggered. Once this occurs, emissions from all sources of PM_{10} must be reported. Other substances associated with fuel burning may also be emitted. In general, substances that can be emitted from sawmilling are:

- Volatile organic compounds (VOCs);
- Oxides of Nitrogen;
- Carbon Monoxide;
- Sulfur Dioxide; and
- Particulate matter (PM_{10}).

The *Combustion in Boilers* EET Manual provides assistance with estimating emissions from fuel burning.

3.2   Panel Products

In this section, panel products refer to plywood, particleboard and medium density fibreboard.

In mills where chips or other furnish is generated on-site, operations such as debarking, sanding, chipping, grinding, and fibre separation generate particulate matter (PM_{10}) emissions in the form of sawdust and wood particulate matter. However, the majority of emissions from panel products come from the dryers and presses.

Dryers

Emissions from rotating drum wood chip dryers used in reconstituted wood panel facilities, are composed of wood dust, condensable hydrocarbons, fly ash, volatile organic compounds (VOCs) and products of combustion such as carbon monoxide and oxides of nitrogen if direct-fired units are used.

The organic portion of the emissions includes the listed substances:

- methanol;
- acetic acid;
- ethanol; and
- formaldehyde.

Quantities emitted are dependent on the wood species used, dryer temperature, and the fuel used.

Presses

Emissions from board presses are dependent on the type of resin used to bind the wood furnish together. Emissions from hot presses consist primarily of condensable organics. When the press opens, vapours that may include resin ingredients such as formaldehyde, phenol, and other organic compounds, are emitted to the atmosphere. Formaldehyde emitted through press vents during pressing and board cooling operations is dependent upon the amount of excess formaldehyde in the resin, application rates, the nature of the specific resin formulation, as well as press temperature and cycle time.

3.3   Wood Preserving

The emissions from wood preserving operations arise from process residuals and preservative drippage. Drips and spills of preservative chemicals may occur during chemical delivery, storage and mixing, and from freshly treated wood storage on bare ground. Aerosols and vapours may be emitted to ambient air during chemical storage and mixing, as well as solution storage.

During treatment, additional vapour emissions may occur. These may come from the work tank during the initial vacuum stage, the flooding under vacuum, pressure relief and blowback, and the final vacuum. Aerosols and vapour may also be emitted from the cylinder door area during pressure treating and door opening.

Some of the NPI-listed substances likely to be emitted from wood preserving include:

- Copper;
- Chromium III (extremely low or negligible emissions; it can reasonably be assumed that all the chromium is present as chromium VI.)
- Chromium VI;
- Arsenic;
- Ammonia;
- Toluene (a constituent of white spirit);
- Xylene (a constituent of white spirit); and
- Polycyclic aromatic compounds (if creosote is used).

3.4   Control Technologies

Air emission control technologies, such as cyclones, electrostatic precipitators, fabric filters or baghouses, and wet scrubbers, are commonly installed to reduce the concentration of particulates in process emissions. Where such emission abatement equipment has been installed, and where emission factors from uncontrolled sources have been used in emission estimation, the collection efficiency of the abatement equipment needs to be considered. Guidance on applying collection efficiencies to emission factor equations is provided in later sections.

With regards to emission controls for PM_{10} emissions in the absence of measured data, or knowledge of the collection efficiency for a particular piece of equipment, an efficiency of 90% should be used in the emission factor equation to calculate actual mass emissions. This default should only be used if there is no other available control efficiency.

4.0   Emission Estimation Techniques

Estimates of emissions of NPI-listed substances to air, water and land should be reported for each substance that triggers a threshold. The reporting list and detailed information on thresholds are contained in *The NPI Guide* at the front of this Handbook.

In general, there are four types of emission estimation techniques (EETs) that may be used to estimate emissions from your facility.

The four types described in *The NPI Guide* are:

- sampling or direct measurement;
- mass balance;
- fuel analysis or other engineering calculations; and
- emission factors.

Select the EET, (or mix of EETs), that is most appropriate for your purposes. For example, you might choose to use a mass balance to best estimate fugitive losses from pumps and vents, direct measurement for stack and pipe emissions, and emission factors when estimating losses from storage tanks and stockpiles.

If you estimate your emission by using any of these EETs, your data will be displayed on the NPI database as being of 'acceptable reliability'. Similarly, if your relevant environmental authority has approved the use of EETs that are not outlined in this handbook, your data will also be displayed as being of 'acceptable reliability'.

This Manual seeks to provide the most effective emission estimation techniques for the NPI substances relevant to this industry. However, the absence of an EET for a substance in this handbook does not necessarily imply that an emission should not be reported to the NPI. The obligation to report on all relevant emissions remains if reporting thresholds have been exceeded.

> **You are able to use emission estimation techniques that are not outlined in this document. You must, however, seek the consent of your relevant environmental authority. For example, if your company has developed site-specific emission factors, you may use these if approved by your relevant environmental authority.**

You should note that the EETs presented in this manual relate principally to average process emissions. Emissions resulting from non-routine events are rarely discussed in the literature, and there is a general lack of EETs for such events. However, it is important to recognise that emissions resulting from significant operating excursions and/or accidental situations (eg. spills) will also need to be estimated. Emissions to land, air and water from spills must be estimated and added to process emissions when calculating total emissions for reporting purposes. The emission resulting from a spill is the net emission, ie. the quantity of the NPI reportable substance spilled, less the quantity recovered or consumed during clean up operations.

> The **usage**[a] of each of the substances listed as Category 1 and 1a under the NPI must be estimated to determine whether the 10 tonnes (or 25 tonnes for VOCs) reporting threshold is exceeded. If the threshold is exceeded, **emissions** of these Category 1 and 1a substances must be reported for all operations/processes relating to the facility, even if the actual emissions of the substances are very low or zero.

[a] Usage is defined as meaning the handling, manufacture, import, processing, coincidental production or other uses of the substances.

Some of the factors that should be considered when estimating emissions that are process and facility- specific include:

* the range and mix of wood preservative and treatment technologies and practices in use;
* the use of drainage collection devices to keep rainwater away from wood preservatives process wastes;
* the wide range of timber species used and the condition of the timber before preservative treatment;
* the varying ratios of urea to formaldehyde used; and
* the efficiency of control equipment and emission abatement practices used

4.1 Direct Measurement

You may wish to undertake direct measurement in order to report to the NPI, particularly if you already do so in order to meet other regulatory requirements. However, the NPI does not require you to undertake additional sampling and measurement. For the sampling data to be adequate and able to be used for NPI reporting purposes, it would need to be collected over a period of time, and to be representative of operations for the whole year.

4.1.1 Sampling Data

Stack sampling test reports often provide emissions data in terms of kg/hr or g/m^3 (dry). Annual emissions for NPI reporting can be calculated from this data. Stack tests for NPI reporting should be performed under representative (ie. normal) operating conditions. You should be aware that some tests undertaken for a State or Territory licence condition may require the test be taken under maximum emissions rating, where emissions are likely to be higher than when operating under normal operating conditions.

For the timber and wood product manufacturing industry, sampling will be difficult in most instances due to the fact that the majority of emissions are fugitive, rather than from a point source. It may, however be possible to undertake sampling from dryers and from fuel burning activities.

4.2 Mass Balance

A mass balance identifies the quantity of substance going in and out of an entire facility, process, or piece of equipment. Emissions can be calculated as the difference between

---

input and output of each listed substance. Accumulation or depletion of the substance within the equipment should be accounted for in your calculation.

For the timber and wood product manufacturing industry, the mass balance approach can be used if enough information is available on the fate of the chemicals in various pathways. The following discussion refers primarily to the fibreboard manufacturing sector but can be adapted and applied to other wood production processes and activities in the industry. The aim of the discussion is to illustrate some of the 'traps' that may be encountered when performing a mass balance.

- Wood product facilities may recycle glue-equipment wash water in the preparation of new batches of glue. This event is not an emission and does not need to be considered in a mass balance. Only formaldehyde in wastewater and spent rinse water going to sewer or being emitted to land or a watercourse needs to be factored into a mass balance equation.

- Perforator test data on boards, which may be a good indicator of the free formaldehyde content in pressed panels, can be used to estimate the quantity of formaldehyde retained in the product and in the scrap wood.

- Quantities of free formaldehyde that react during board manufacture are generally not known, but most of the free formaldehyde is believed to be taken up during the cross-linking reaction.

- The press area is the largest contributor to the total plant formaldehyde emissions.

Processing parameters that are expected to have an impact on formaldehyde emission rates are:

- excess formaldehyde in the resin;
- press cycle time;
- press temperature; and
- amount of adhesive used.

The difficulty in estimating emissions of listed substances involved in the production of wood products via a mass balance, lies in determining what happens to these chemicals during pressing. Figure 6 may be of assistance:
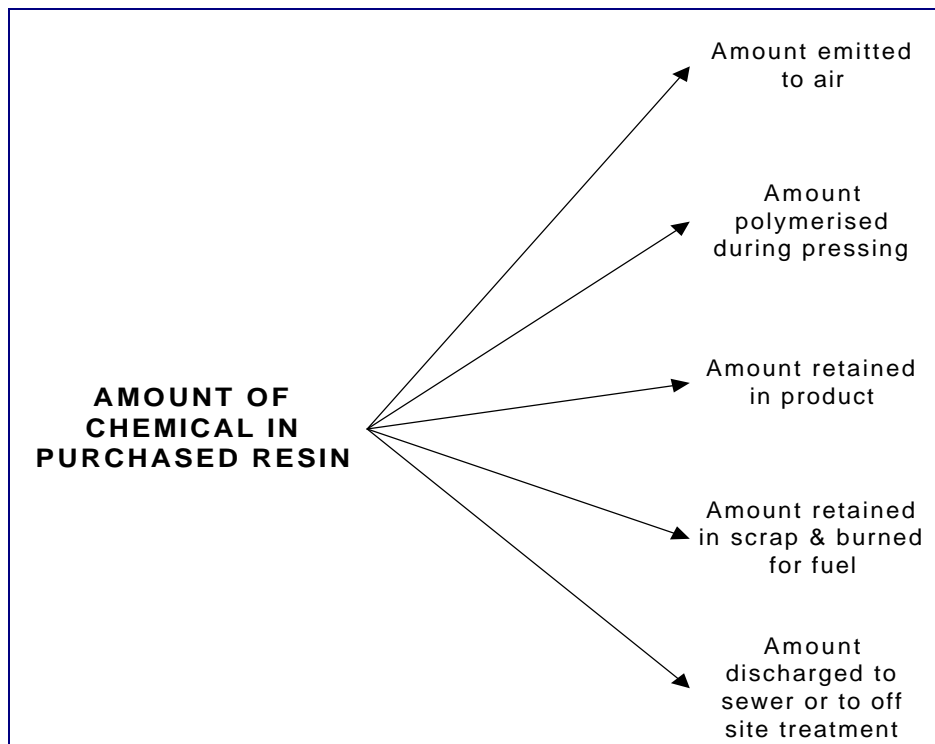
Figure 6 - **The Fate of Resins During Wood Pressing**
Source: USEPA, *Estimating Chemical Releases from Presswood and Laminated Wood Products Manufacturing,* 1988

Only the amount emitted directly to air and the amount retained in wood waste and burnt for fuel need to be reported as NPI air emissions. Additional emissions to water may also require reporting.

4.3   Engineering Calculations

An engineering calculation is an estimation method based on physical/chemical properties (eg. vapour pressure) of the substance and mathematical relationships (eg. ideal gas law).

4.3.1   Fuel Analysis

A fuel analysis may be useful for facilities burning fuel such as coal or gas. Fuel analysis is an example of an engineering calculation and can be used to predict SO_2, metals, and other emissions based on application of conservation laws, if fuel rate is measured. The presence of certain elements in fuels may be used to predict their presence in emission streams. This includes elements such as sulfur that may be converted into other compounds during the combustion process.

The basic equation used in fuel analysis emission calculations is the following:

Equation 1

$$E_{kpy,i} = Q_f * \text{pollutant concentration in fuel}/100 * (MW_p /EW_f) * OpHrs$$

where:

$E_{kpy,i}$ = annual emissions of pollutant i, kg/yr
Q_f = fuel use, kg/hr
OpHrs= operating hours, hr/yr
MW_p = molecular weight of pollutant emitted, kg/kg-mole
EW_f = Elemental weight of pollutant in fuel, kg/kg-mole
Concentration of pollutant i in fuel expressed as weight percent, %

For instance, SO_2 emissions from oil combustion can be calculated based on the concentration of sulfur in the oil. This approach assumes complete conversion of sulfur to SO_2. Therefore, for every kilogram of sulfur (EW = 32) burned, two kilograms of SO_2 (MW = 64) are emitted. The application of this EET is shown in Example 1.

Example 1 - **Using Fuel Analysis**

This example illustrates how SO_2 emissions can be calculated from oil combustion based on fuel analysis results and the fuel flow information. The facility is assumed to operate 1500 hours per year.

Sulfur dioxide (SO_2) emissions may be calculated using Equation 1:

Fuel flow (Q_f)   =   2 000 kg/hr
Weight percent sulfur in fuel   =   1.17%
Operating hours   =   1 500 hr/yr

$$E_{kpy,SO2} = Q_f * \text{pollutant concentration in fuel}/100 * (MW_p/EW_f) * OpHrs$$
$$= (2\ 000) * (1.17/100) * (64/32) * 1500$$
$$= 70\ 200 \text{ kg/yr}$$

4.4   Emission Factors

An emission factor is a tool that is used to estimate emissions to the environment. In this Manual, it relates the quantity of substances emitted from a source to some common activity associated with those emissions. Emission factors are obtained from US, European, and Australian sources and are usually expressed as the weight of a substance emitted divided by the unit weight, volume, distance, or duration of the activity emitting the substance (eg. kilograms of sulfur dioxide emitted per cubic metre of wood treated).

Emission factors are used to estimate a facility's emissions by the general equation:

Equation 2

$$E_{kpy,i} = [A_R * OpHrs] * EF_i * [1 - (CE_i/100)]$$

where :

$E_{kpy,i}$	=	annual emissions of pollutant i, kg/yr
A_R	=	activity rate, m^3/hr
OpHrs	=	operating hours, hr/yr
EF_i	=	uncontrolled emission factor of pollutant i, kg/m^3
CE_i	=	overall control efficiency for pollutant i, %.

Emission factors developed from measurements for a specific process can sometimes be used to estimate emissions at other sites. Should a company have several processes of similar operation and size, and emissions are measured from one process source, an emission factor can be developed and applied to similar sources. As previously mentioned, you are required to have the emission factor reviewed and approved by State or Territory environment agencies prior to its use for NPI estimations.

4.4.1   Industry Specific Emission Factors

Particleboard Manufacturing

Table 2 - **Particulate Matter (PM$_{10}$) Emission Factors for Particleboard Manufacturing**

Source	Particulate Matter ≤10 μm (PM$_{10}$)		
	Emission Factor (kg/tonne)[a]	Emission Factor (kg/m^3)[b]	Emission Factor Rating
Rotary dryer, direct unspecified pine[c]-fired:			
No emission control	0.35	-	D
Electrified filter bed	0.32	-	E
Batch hot press[e], UF resin[d]	-	$4.16 * 10^{-3}$	D
Board cooler[e], UF resin[d]	-	$8.84 * 10^{-4}$	E

USEPA, AP-42 Section 10.6.2, 1998. ND - no data. NA - not applicable.

[a] Units are kilograms of substance emitted per oven-dried tonne of wood material out of the dryer (kg/tonne).

[b] Units are kilograms of substance emitted per cubic meter of panel produced (kg/m^3).

[c] Unspecified pines = mixed pine species or the specific pine species processed were not reported.

[d] UF resin = urea-formaldehyde resins.

[e] Factors represent uncontrolled emissions.

Table 3 - **Emission Factors for Sulfur Dioxide (SO$_2$), Oxides of Nitrogen (NO$_x$) and Carbon Monoxide (CO) from Particleboard Manufacturing[a]**

Source	Sulfur Dioxide		Oxides of Nitrogen		Carbon Monoxide	
	Emission Factor (kg/tonne)	Rating	Emission Factor (kg/tonne)	Rating	Emission Factor (kg/tonne)[b]	Rating
Rotary dryer, direct wood-fired	0.001	E	0.55	B	0.8	C
Rotary dryer, direct natural gas-fired	ND	NA	0.155	D	0.06	D
Rotary predryer, direct wood-fired	ND	NA	1.05	D	0.47	D
Rotary final dryer, direct wood-fired	ND	NA	ND	NA	0.375	D
Batch hot press, UF resin[c] (kg/m^3)[b]	ND	NA	ND	NA	$2.34 * 10^{-2}$	D

USEPA, AP-42 Section 10.6.2, 1998. ND - no data. NA - not applicable.

[a] Units are kilograms of substance emitted per oven-dried tonne of wood material out of the dryer (kg/tonne).

[b] Units for batch hot press are kilograms of substance emitted per cubic meter of panel produced (kg/m^3).

[c] UF resin = urea-formaldehyde resins.

Table 4 - **Uncontrolled Emission Factors for Organic Compounds from Particleboard Dryers[a]**

Substance	Rotary dryer, direct wood fired, unspecified pines[c]		Rotary dryer, direct wood-fired, hardwood (kg/tonne)	Rotary dryer, direct natural gas-fired, unspecified pines[c] (kg/tonne)	Emission Factor Rating[b]
	<388°C inlet air (kg/tonne)	>482°C inlet air (kg/tonne)			
Volatile organic compounds (VOCs)[b]	0.475	4.1	0.175[d]	0.45	D
Methyl isobutyl ketone	$4.05 * 10^{-5}$	ND	ND	ND	E
Acetaldehyde	0.005	0.36	ND	ND	E
Acetone	$3.95 * 10^{-3}$	0.08	ND	ND	E
Acrylonitrile	$4.45 * 10^{-5}$	ND	ND	ND	E
Benzene	$1.1 * 10^{-4}$	ND	ND	ND	E
Biphenyl	$1.95 * 10^{-5}$	ND	ND	ND	E
Di-(2-Ethylhexyl) phthalate (DEHP)	$1.6 * 10^{-4}$	ND	ND	ND	E
Carbon disulfide	$1.8 * 10^{-5}$	ND	ND	ND	E
Chloroform	ND	$5 * 10^{-5}$	ND	ND	E
Cumene	$3.45 * 10^{-5}$	0.001	ND	ND	E
Dibutyl phthalate	$1.15 * 10^{-5}$	ND	ND	ND	E
Ethyl benzene	$1.9 * 10^{-6}$	ND	ND	ND	E
Formaldehyde	0.015	0.085	ND	ND	E
m,p-Xylene	$5.5 * 10^{-5}$	0.0038	ND	ND	E
o-Xylene	$7 * 10^{-6}$	$2.25 * 10^{-4}$	ND	ND	E
Methyl ethyl ketone	$6.5 * 10^{-4}$	0.0046	ND	ND	E
n-Hexane	$1.3 * 10^{-5}$	ND	ND	ND	E
Styrene	$6 * 10^{-5}$	$1.8 * 10^{-4}$	ND	ND	E
Toluene	$8.5 * 10^{-4}$	0.0105	ND	ND	E

USEPA, AP-42 Section 10.6.2, 1998. ND - no data. NA - not applicable.

[a] Units are kilograms of substance emitted per tonne of oven-dried wood material out of the dryer (kg/tonne).

[b] Volatile organic compound emissions as propane with emission factor rating D.

[c] Unspecified pines = mixed pine species or the specific pine species processed were not reported.

[d] Formaldehyde has not been added, but is suspected to be present, which would increase the VOC value given.

Table 5 - **Uncontrolled Emission Factors for Organic Compounds from Particleboard Presses and Board Coolers[a]**

Substance	Batch hot press, UF resin[c] (kg/m^3)	Veneer hot press, UF resin[c] (kg/m^3)	Board cooler, UF resin[c] (kg/m^3)	Emission Factor Rating
Volatile organic compounds (VOCs)[b]	0.244[d]	ND	0.0702[d]	D
Acetaldehyde	$3.64 * 10^{-3}$	$2.57 * 10^{-5}$	$3.38 * 10^{-4}$	E
Acetone	$3.38 * 10^{-3}$	ND	$5.2 * 10^{-4}$	E
Formaldehyde	0.0676[d]	$1.61 * 10^{-3}$	$7.02 * 10^{-3\ d}$	D/E
Methyl ethyl ketone	$3.64 * 10^{-4}$	$7.28 * 10^{-5}$	$2.86 * 10^{-5}$	E
Toluene	$1.22 * 10^{-4}$	ND	ND	E

USEPA, AP-42 Section 10.6.2, 1998. ND - no data. NA - not applicable.
[a] Units are kilograms of substance emitted per cubic metre of panel produced (kg/m^3).
[b] Volatile organic compound on a propane basis.
[c] UF = urea-formaldehyde resin.
[d] emission factor rating D

Medium Density Fibreboard (MDF) Manufacturing

Table 6 - **Uncontrolled Emission Factors for Particulate Matter (PM$_{10}$) from Fibreboard Manufacturing.**

Source	Particulate Matter (PM$_{10}$)		
	Emission Factor (kg/tonne)[a]	Emission Factor (kg/m^3)[b]	Emission Factor Rating
Tube dryer, direct wood-fired, unspecified pines[c]	0.8	-	D
Tube dryer, indirect heat, mixed species[d]	0.14	-	E
Batch hot press, UF resin[e]	-	$1.95 * 10^{-2}$	E
MDF board cooler, UF resin[e]	-	$9.88 * 10^{-4}$	E

USEPA, AP-42 Section 10.6.3, 1998. ND - no data. NA - not applicable.
[a] Units are kilograms of substance emitted per oven-dried tonne of wood material out of dryer (kg/tonne).
[b] Units are kilograms of substance emitted per cubic metre of panel produced (kg/m^3).
[c] Unspecified pines = mixed pine species or the specific pine species processed were not reported.
[d] Mixed species = 50 percent hardwood and 50 percent softwood.
[e] UF resin = urea-formaldehyde resin.

Table 7 - **Emission Factors for Sulfur Dioxide (SO_2), Oxides of Nitrogen (NO_x) and Carbon Monoxide (CO) from Particleboard Manufacturing[a]**

Source	Oxides of Nitrogen		Carbon Monoxide	
	Emission Factor (kg/m³)	Emission Factor Rating	Emission Factor (kg/m³)	Emission Factor Rating
Tube dryer, direct wood-fired[b]	ND	NA	2[b]	D
Batch hot press, UF resin[c]	$7.8 * 10^{-3}$	E	$8.84 * 10^{-3}$	E
Continuous hot press, UF resin, RTO controlled[c]	0.1326	E	0.0221	E

USEPA, AP-42 Section 10.6.3, 1998. ND - no data. NA - not applicable.

[a] Units for batch hot press are kilograms of substance emitted per cubic meter of panel produced (kg/m³) except where otherwise specified.

[b] Units are kilograms of substance emitted per oven-dried tonne of wood material out of the dryer (kg/tonne).

[c] UF resin = urea-formaldehyde resins. RTO = regenerative thermal oxidisers.

Table 8 - **Uncontrolled Emission Factors for Organic Compounds from Medium Density Fibreboard Dryers[a]**

Substance	Tube dyer, direct wood fired (kg/tonne)		Tube dryer, indirect heat (kg/tonne)		Emission Factor Rating[b]
	Unspecified pine[c]	Hardwoods	Hardwoods	Mixed species[d]	
Volatile organic compounds (VOCs)[e]	3.3	3.25[b]	2.35[b]	1.1	D/E
Acetaldehyde	ND	ND	$6.5 * 10^{-3}$	$6.5 * 10^{-3}$	E
Acetone	ND	ND	ND	$1.25 * 10^{-3}$	E
Di-(2-Ethylhexyl) phthalate (DEHP)	ND	ND	ND	$1.35 * 10^{-4}$	E
Dibutyl phthalate	ND	ND	ND	$9 * 10^{-5}$	E
Formaldehyde	ND	0.43	0.1	0.7	E
Methyl ethyl ketone	ND	ND	ND	$3.15 * 10^{-3}$	E
n-Hexane	ND	ND	ND	$7 * 10^{-4}$	E
Phenol	ND	ND	ND	$1 * 10^{-4}$	E

USEPA, AP-42 Section 10.6.3, 1998. ND - no data. NA - not applicable.

[a] Units are kilograms of substance emitted per tonne of oven-dried wood material out of the dryer (kg/tonne).

[b] EMISSION FACTOR RATING: D where specified by this footnote.

[c] Unspecified pines = mixed pine species or the specific pine species processed were not reported. For VOC emission factor, formaldehyde has not been added, but is suspected to be present, which would increase the VOC value given.

[d] Mixed species = 50 percent hardwood and 50 percent softwood.

[e] Volatile organic compounds as propane.

Table 9 - **Emission Factors for Organic Compounds from Medium Density Fibreboard Dryers[a]**

Substance	Batch Hot Press, UF Resin[d] (kg/m³)	Continuous hot press, UF resin[d]		MDF Board Cooler, UF Resin[d] (kg/m³)	Emission Factor Rating[b]
		Uncontrolled (kg/m³)	Controlled (kg/m³)		
Volatile organic compounds (VOCs)[c]	0.179[b]	0.364	$8.32 * 10^{-3}$	0.052	D/E
Acetaldehyde	$1.33 * 10^{-3}$	ND	ND	$2.6 * 10^{-4}$	E
Acetone	$8.06 * 10^{-4}$	ND	ND	$5.46 * 10^{-4}$	E
Formaldehyde	0.078[b]	0.286	$2.37 * 10^{-3}$	0.029	E
Methyl ethyl ketone	$1.53 * 10^{-4}$	ND	ND	$2.86 * 10^{-5}$	E

USEPA, AP-42 Section 10.6.3, 1998. ND - no data. NA - not applicable.
[a] Units are kilograms of substance emitted per cubic metre of panel produced (kg/m³).
[b] EMISSION FACTOR RATING: D where specified by this footnote.
[c] Volatile organic compounds as propane. For total VOC, add the appropriate formaldehyde emission factors.
[d] UF resin = urea-formaldehyde resins.

Plywood Manufacturing

Table 10 - **Emission Factors for Particulate Matter from Plywood Manufacturing[a]**

Source	Particulate Matter[b]	
	Emission Factor (kg/m³)	Emission Factor Rating
Plywood veneer dryer, direct natural gas-fired, unspecified pines[c]	$3.95 * 10^{-2}$	E
Plywood veneer dryer, indirect heat, unspecified pines[c]	0.175	D
Plywood veneer dryer, indirect heat, unspecified firs[d], wet electrostatic precipitator	0.017	E
Plywood veneer dryer, radio frequency heated, unspecified pines[c]	$2.5 * 10^{-3}$	E
Plywood press, phenol-formaldehyde resin	0.06	D

USEPA, AP-42 Section 10.6.3, 1998. ND - no data. NA - not applicable.
[a] Units are kilograms of substance emitted per cubic meter of veneer or panel produced (kg/m³). Factors uncontrolled unless otherwise specified.
[b] Factors represent total particulate emissions and will over-estimate emissions from the 10 microns or less (PM_{10}) size fraction. To determine PM_{10} emissions, facilities should conduct a size characterisation analysis of particulate matter from their site.
[c] Based on data on the drying of mixed pine species or the drying of veneers which are identified only as pines.
[d] Based on data on the drying of mixed fir species or the drying of veneers which are identified only as firs.

Table 11 - **Uncontrolled Emission Factors for Sulfur Dioxide (SO$_2$), Oxides of Nitrogen (NO$_x$) and Carbon Monoxide (CO) from Plywood Veneer Dryers[a]**

Source	Sulfur Dioxide Emission Factor (kg/m^3)	Rating	Oxides of Nitrogen Emission Factor (kg/m^3)	Rating	Carbon Monoxide Emission Factor (kg/m^3)	Rating
Direct wood-fired	0.029	D	0.12	D	2.55	D
Direct natural gas-fired	ND	NA	0.006	E	0.285	E

USEPA, AP-42 Section 10.6.2, 1998. ND - no data. NA - not applicable.
[a] Units are kilograms of substance emitted per cubic metre of veneer produced (kg/m^3).

Table 12 - **Emission Factors for Volatile Organic Compounds (VOCs) and Formaldehyde Substances from Plywood Manufacturing[a]**

Source	VOC[d] Emission Factor (kg/m^3)	Emission Factor Rating	Formaldehyde Emission Factor (kg/m^3)	Emission Factor Rating
Plywood veneer dryers, direct wood-fired:				
unspecified pines[b]	1.65[e]	E	ND	NA
unspecified firs[c], ionising wet scrubber controlled	0.305[e]	E	ND	NA
Plywood veneer dryers, direct natural gas-fired, unspecified pines[b]	1.05[e]	E	ND	NA
Plywood veneer dryers, indirect heated, unspecified pines[b]	1.35[e]	D	ND	NA
Plywood veneer dryers, radio-frequency heated, unspecified pines[b]	0.11[e]	E	ND	NA
Plywood press, phenol-formaldehyde resin	0.165[e]	D	ND	NA
Plywood press, urea-formaldehyde resin	$1.26 * 10^{-2}$	E	$2.1 * 10^{-3}$	E
Plywood press, urea-formaldehyde resin	$1.03 * 10^{-2}$	E	$1.25 * 10^{-3}$	E

USEPA, AP-42 Section 10.6.2, 1998. ND - no data. NA - not applicable.

[a] Units are kilograms of substance emitted per cubic metre of veneer or panel produced (kg/m^3). Emission factors uncontrolled unless otherwise specified.
[b] Based on data on the drying of mixed pine species or on the drying of veneers which are identified only as pines.
[c] Based on data on the drying of mixed fir species or on the drying of veneers which are identified only as firs.
[d] Volatile organic compounds as propane.
[e] Emission factors may not account for formaldehyde, which is suspected to be present; VOC factor indicated is likely to be biased low.

Wood Preservation

Table 13 - **Uncontrolled Emission Factors for Organic Substances from Creosote Wood Preserving Operations - Empty Cell Process[a]**

Substance	Emission Factor (kg/m^3)				Emission Factor Rating
	Conditioning (Boulton) Cycle	Final Vacuum Cycle	Working Tank Vent Blowback	Air Release	
Volatile organic compounds (VOC)	0.082	ND	0.0011	ND	E
Polychlorinated dioxins and furans	$5.3 * 10^{-4}$	$1.6 * 10^{-5}$	ND	$6.5 * 10^{-6}$	E
Total polycyclic aromatic hydrocarbons (PAH)[b]	$1.11 * 10^{-3}$	$5.9 * 10^{-5}$	ND	$1.38 * 10^{-5}$	E
Individual PAHs:					
Acenaphthene	$1.5 * 10^{-4}$	ND	ND	$2 * 10^{-6}$	E
Acenaphthylene	$4.1 * 10^{-4}$	$7.1 * 10^{-6}$	ND	ND	E
Anthracene	$1.7 * 10^{-6}$	$6.2 * 10^{-8}$	ND	$1.7 * 10^{-7}$	E
Benzo(a)-anthracene	ND	ND	ND	$6.2 * 10^{-8}$	E
Benzo(b)-fluoranthene	ND	ND	ND	$6 * 10^{-8}$	E
Benzo(k)-fluoranthene	ND	ND	ND	$2.3 * 10^{-8}$	E
Benzo(a)pyrene	ND	ND	ND	$3 * 10^{-8}$	E
Chrysene	$9.5 * 10^{-7}$	$5.5 * 10^{-8}$	ND	$6.6 * 10^{-8}$	E
Fluoranthene	ND	ND	ND	$3.3 * 10^{-7}$	E
Fluorene	$6.1 * 10^{-5}$	$3.6 * 10^{-7}$	ND	$7.9 * 10^{-8}$	E
Naphthalene	$4.9 * 10^{-4}$	$4.8 * 10^{-5}$	ND	$9.9 * 10^{-6}$	E
Phenanthrene	ND	$3.4 * 10^{-6}$	ND	$7.6 * 10^{-7}$	E
Pyrene	ND	ND	ND	$2.7 * 10^{-7}$	E

USEPA, AP-42 Section 10.8, 1999 (Draft). ND - no data.
[a] Units are kilograms of substance emitted per cubic meter of wood treated (kg/m^3).
[b] Total polycyclic aromatic hydrocarbons (PAHs) determined from the addition of all individual PAH emission factors for the process.

Table 14 - **Emission Factors to Air from CCA Treatment[a]**

Substance	Emission factor (kg/m³)	Emission Factor Rating
Arsenic[b]	$2.2 * 10^{-8}$	E
Chromium[c]	$2.2 * 10^{-8}$	E
Copper	$3.0 * 10^{-8}$	E

USEPA, AP-42 Section 10.8, 1999 (Draft).

[a] Units are kilograms of emissions per cubic metre of wood treated.

[b] Source for Arsenic emission factor: Timber Preservers Association of Australia, 1999.

[c] It can reasonably be assumed that all the chromium is present as chromium VI.

Example 2 - Calculating Emissions Using Emission Factors

This example shows how to calculate copper emissions for the vacuum treatment vessel at a wood preservation facility that treats 200 m³ of wood per hour, and operates for 1500 hours per year. In this plant there is no control technology in place, therefore the control efficiency (CE) % of pollutant i is zero. Using the emission factor presented in Table 14, and Equation 2 the following can be calculated:

A_R = 200 m³ of wood preserved per hour
OpHrs = 1500 hr/yr
EF_i = $3.0 * 10^{-8}$ kg/m³
CE_i = 0

$E_{kpy,Copper}$ = $[A_R * OpHrs] * EF_i * [1 - (CE_i/100)]$
$E_{kpy,Copper}$ = 200 m³/hr * 1500 hr/yr * $3.0 * 10^{-8}$ kg/m³ * [1-(0/100)]
= $9 * 10^{-3}$ kg/yr

Therefore, from the vacuum vessel, the emission of copper to the air is $9 * 10^{-3}$ kg per year.

4.4.2   Predictive Emission Monitoring (PEM)

Predictive emission monitoring is based on developing a correlation between pollutant emission rates and process parameters. A PEM allows facilities to develop site-specific emission factors, or emission factors more relevant to their particular process.

Based on test data, a mathematical correlation can be developed which predicts emissions using various parameters.

5.0 Determining if You Meet the Threshold for CCA Solutions

This section describes ways in which you can determine whether you exceed thresholds for copper compounds, chromium (VI) compounds and arsenic compounds, and hence need to report emissions of these to the NPI.

A simple threshold test would be to compare the total weight of CCA concentrate solution used in the reporting period with the Category 1 threshold of 10 tonnes. It is likely that you will trip thresholds for these compounds if you use much more than this quantity of CCA concentrate solution. However more accurate threshold tests are outlined below.

The following example illustrates how to determine if a facility trips the Category 1 threshold level for copper, chromium (VI) and arsenic, all of which are NPI Category 1 substances. (Note: all three are also Category 2b substances, so reporting is also required if the Category 2b energy use threshold is exceeded.)

Material Safety Data Sheets (MSDS) can be used to determine the exact constituents of the mixture. The fractions of copper, chromium (VI) and arsenic compounds in these mixtures will determine whether or not a threshold has been met, and therefore, whether it is necessary to report to the NPI.

Example 3 - **Determining if a Reporting Facility Needs to Report to the NPI for Copper, Chromium (VI), and/or Arsenic.**

The formulation is supplied as a concentrate that is formulated as follows: as either a CCA Salt Solution or a CCA Oxide Solution.

For CCA Salt Solution:

Copper Sulfate - 210.4 g $CuSO_4.5H_2O$/L
Sodium Dichromate - 241.6 g $Na_2Cr_2O_7$/L
Arsenic Acid - 160.8 g AsH_3O_4/L

The compounds add up to 612.8 g/L, which has an allowance for compound variations. Work on 600 g/L

For CCA Oxide Solution:

Copper Oxide - 195.6 g CuO/L
Chromic Acid - 516.9 g CrO_3/L
Arsenic Acid - 459.4 g AsH_3O_4/L

The compounds add up to 1171.9 g/L, which has an allowance for compound variations. Work on 1100 g/L

Note: For threshold calculation, the total metal compound weight should be used, ie. For Chromium VI, 10 tonnes refers to 10 tonnes of sodium dichromate ($Na_2Cr_2O_7$) in the salt solution and chromic acid (CrO_3) in the oxide solution, not just Cr.

Assume the site used 180 000 Litres of CCA Salt Solution concentrate and every litre of that concentrate contained 241.6 grams of chromium (VI) compounds (eg. $Na_2Cr_2O_7$).

Example 3 cont'

Then, the total amount of chromium (VI) compounds that the plant used:

$$= 180\ 000 * 241.6 \text{ grams } Na_2Cr_2O_7 \text{ per year}$$
$$= \frac{180\ 000 * 241.6}{1\ 000\ 000} \text{ tonnes } Na_2Cr_2O_7 \text{ per year}$$
$$= 43.49 \text{ tonnes } Na_2Cr_2O_7 \text{ per year}$$

Over the last 12 months, this plant has used more than the threshold level set for chromium (VI) compounds (10 tonnes), therefore plant management is required to submit a report on chromium (VI) emissions to the NPI. NB: The calculation needs to be performed for CCA Oxide Solution where this formulation is used.

Example 4 shows how copper compounds and arsenic compounds can also be assessed for Category 1 threshold exceedance in the same manner as Example 3.

Example 4 - **Determining if a Reporting Facility Needs to Report to the NPI for Copper, Chromium (VI), and/or Arsenic Using Volume of Concentrate.**

Another approach is to determine what volume of this type of preservative needs to be used, to trip the 10 tonne chromium (VI) compound threshold. Converting 10 tonnes to grams and then dividing by the concentration of chromium (VI) compounds in the appropriate formulation of concentrate does this.

CCA Salt Solution (concentrate):

$= 10 * 1\ 000\ 000\text{g of concentrate}/$
$(241.6\text{g of } Na_2Cr_2O_7/\text{L/yr})$
$= 10 * 1\ 000\ 000/241.6 \text{ L/yr}$
$= 41\ 390 \text{ L/yr}$

CCA Oxide Solution (concentrate):

$= 10 * 1\ 000\ 000\text{g of concentrate}/$
$(516.9\text{g of chromic acid/L/yr})$
$= 10 * 1\ 000\ 000/516.9 \text{ L/yr}$
$= 19\ 346 \text{ L/yr}$

Hence, if a CCA plant using this type of preservative uses more than 41 390 Litres of CCA Salts concentrate or more than 19 346 Litres of CCA Oxide concentrate, it will be required to submit an NPI report for chromium (VI) emissions.

Example 5 shows how to determine whether the facility trips the Category 1 threshold for copper compounds and arsenic compounds.

Example 5 - **Determining if a Reporting Facility Needs to Report to the NPI for Copper, Chromium (VI), and/or Arsenic Using 'Active Tonnes'.**

An alternative method is to relate the actual purchase of the preservatives as CCA sold to the treatment plants as 'active tonnes'.

The product is sold as Active Tonnes of CCA Salt Solution or a CCA Oxide Solution, ie. tonnes of the total whole metal compounds excluding water. The current 10 tonne threshold for compounds of each metal can be expressed as active tonnes of CCA solution as follows:

CCA Salt Solution
Product is sold as Active Tonnes, therefore:
10 Tonnes of Copper Compounds = 29.1 Active Tonnes CCA Salt Solution.
10 Tonnes of Chromium Compounds = 25.4 Active Tonnes CCA Salt Solution.
10 Tonnes of Arsenic Compounds = 38.1 Active Tonnes CCA Salt Solution.

CCA Oxide Solution.
Product is sold as Active Tonnes, therefore:

10 Tonnes of Copper Compounds = 59.9 Active Tonnes of CCA Oxide Solution.
10 Tonnes of Chromium Compounds = 22.7 Active Tonnes of CCA Oxide Solution.
10 Tonnes of Arsenic Compounds = 25.5 Active Tonnes of CCA Oxide Solution.

Therefore, you will trip the Category 1 threshold for Arsenic if your company purchases 25.5 Active Tonnes or more of CCA Oxide Solution.

Suitable ratios for working out usage can be devised from this information. The Salt and Oxide information noted above lists the trigger levels for reporting.

(Information supplied by Timber Preservers Association of Australia)

Note that **emissions** need to be **reported** as the parent **metal** (copper, chromium (VI) or arsenic) not the metal compound.

6.0 Emission Estimation Techniques: Acceptable Reliability and Uncertainty

This section is intended to give a general overview of some of the inaccuracies associated with each of the techniques. Although the National Pollutant Inventory does not favour one emission estimation technique over another, this section does attempt to evaluate the available emission estimation techniques with regards to accuracy.

Several techniques are available for calculating emissions from timber and wood product manufacturing facilities. The technique chosen is dependent on available data, available resources, and the degree of accuracy sought by the facility in undertaking the estimate. In general, site-specific data that is representative of normal operations is more accurate than industry-averaged data, such as the emission factors presented in Section 4.4.1. of this Manual.

6.1 Direct Measurement

Use of stack and/or workplace health and safety sampling data is likely to be a relatively accurate method of estimating air emissions from combustion processes in this industry. However, collection and analysis of samples from facilities can be very expensive and especially complicated where a variety of NPI-listed substances are emitted and where most of these emissions are fugitive in nature. Sampling data from a specific process may not be representative of the entire manufacturing operation and may provide only one example of the facility's emissions.

To be representative, sampling data used for NPI reporting purposes needs to be collected over a period of time, and to cover all aspects of production.

In the case of Continuous Emission Monitoring Systems (CEMS), instrument calibration drift can be problematic and uncaptured data can create long-term incomplete data sets. However, it may be misleading to assert that a snapshot (stack sampling) can better predict long-term emission characteristics. It is the responsibility of the facility operator to properly calibrate and maintain monitoring equipment and the corresponding emissions data.

6.2 Mass Balance

Calculating emissions from timber or wood product manufacturing facility using mass balance appears to be a straightforward approach to emission estimations. However, it is likely that few Australian facilities consistently track material usage and waste generation with the overall accuracy needed for application of this method. For example, during the pressing stage of board production, it is very difficult to quantify losses of formaldehyde or other resins.

Inaccuracies associated with individual material tracking, or other activities inherent in each material handling stage, can result in large deviations for total facility emissions. Because emissions from specific materials are typically below 2 percent of gross

consumption, an error of only ± 5 percent in any one step of the operation can significantly skew emission estimations.

6.3   Engineering Calculations

Theoretical and complex equations, or *models,* can be used for estimating emissions from timber and wood product manufacturing facilities.

Use of emission equations to estimate emissions from timber and wood product manufacturing facilities is a more complex and time-consuming process than the use of emission factors. Emission equations require more detailed inputs than the use of emission factors but they do provide an emission estimate that is based on facility-specific conditions.

6.4   Emission Factors

Every emission factor has an associated emission factor rating (EFR) code. This rating system is common to EETs for all industries and sectors and therefore, to all Industry Handbooks.   They are based on rating systems developed by the United States Environmental Protection Agency (USEPA), and by the European Environment Agency (EEA).   Consequently, the ratings may not be directly relevant to Australian industry. Sources for all emission factors cited can be found in Section 6.0 of this Manual.   The emission factor ratings will not form part of the public NPI database.

When using emission factors, you should be aware of the associated EFR code and what that rating implies. An A or B rating indicates a greater degree of certainty than a D or E rating. The less certainty, the more likely that a given emission factor for a specific source or category is not representative of the source type. These ratings notwithstanding, the main criterion affecting the uncertainty of an emission factor remains the degree of similarity between the equipment/process selected in applying the factor, and the target equipment/process from which the factor was derived.

The EFR system is as follows:

A   -   Excellent
B   -   Above Average
C   -   Average
D   -   Below Average
E   -   Poor
U   -   Unrated

7.0   References

ANZSIC: Australian and New Zealand Standard Industrial Classification
Australian Bureau of Statistics & NZ Dept of Statistics 1993
ABS Catalogue No 1292.0

Eastern Research Group. July 1997. *Introduction To Stationary Point Source Emission Inventory Development Volume II: Chapter 1.* Morrisville, NC, USA.

Personal Communication with Keith Riley, Timber Preservers Association of Australia, January and July 1999.

USEPA. March 1988. *Title III Section 313 Release Reporting Guidance, Estimating Chemical Releases From Presswood and Laminated Wood Products Manufacturing,* EPA 560/4-88-004f. Washington, DC, USA.

USEPA. September 1995. *EPA Office of Compliance Sector Notebook Project. Profile of the Lumber and Wood Products Industry.* United States Environmental Protection Agency, Office of Enforcement and Compliance Assurance. Washington, DC, USA.

USEPA. September 1996. *Emission Factor Documentation for AP-42, Section 10.8, Wood Preservation, Revised Draft Report.* United States Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, NC, USA.
http://www.epa.gov/ttn/chief/ap42.html

USEPA. 1997. *Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, fifth edition, AP-42. Section 10.0 Wood Products Industry.* United States Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, NC, USA.

The following EET Manuals referred to in this Manual are available at the NPI Homepage (http://www.environment.gov.au/epg/npi/home.html) and from your local Environmental Protection Authority:

Emission Estimation Technique Manual for Combustion in Boilers; and
Emission Estimation Technique Manual for Combustion Engines.