10.6.2 Particleboard Manufacturing

Particleboard is defined as a panel product manufactured from lignocellulosic materials, primarily in the form of discrete particles, combined with a synthetic resin or other suitable binder and bonded together under heat and pressure. The primary difference between particleboard and other reconstituted wood products, such as waferboard, oriented strandboard, medium density fiberboard, and hardboard, is the material or particles used in its production. The major types of particles used to manufacture particleboard include wood shavings, flakes, wafers, chips, sawdust, strands, slivers, and wood wool. The term particleboard sometimes is used generically to include waferboard and oriented strandboard, which are manufactured primarily with wood flakes and wafers. However, for the purposes of this report, particleboard pertains only to panels manufactured from a mixture of wood particles or otherwise from wood particles other than wafers and flakes. Particleboard manufacturing falls under Standard Industrial Classification (SIC) Code 2493, reconstituted wood products, which includes hardboard, insulation board, medium density fiberboard, waferboard and oriented strandboard in addition to particleboard. The six-digit Source Classification Code (SCC) for particleboard manufacturing is 3-07-006.

10.6.2.1 Process Description[1-6]

Particleboard is produced in a wide range of densities. Particleboard with a density of less than 590 kilograms per cubic meter (kg/m^3) (37 pounds per cubic foot [lb/ft^3]), 590 to 800 kg/m^3 (37 to 50 lb/ft^3), and greater than 800 kg/m^3 (50 lb/ft^3) is classified as low-density, medium density, and high density particleboard, respectively. However, this report does not distinguish between particleboard densities relative to emissions from manufacturing operations.

Although some single-layer particleboard is produced, particleboard generally is manufactured in three or five layers. The outer layers are referred to as the surface or face layers, and the inner layers are termed the core layers. Face material generally is finer than core material. By altering the relative properties of the face and core layers, the bending strength and stiffness of the board can be increased.

The general steps used to produce particleboard include raw material procurement or generation, classifying by size, drying, blending with resin and sometimes wax, forming the resinated material into a mat, hot pressing, and finishing. Figure 10.6.2-1 presents a process flow diagram for a typical particleboard plant.

The furnish or raw material for particleboard normally consists of wood particles, primarily wood chips, sawdust, and planer shavings. This material may be shipped to the facility or generated onsite and stored until needed. In mills where chips are generated onsite, logs are debarked, sawn to proper length, and chipped. After shipping to the site or generation onsite, the furnish may be further reduced in size by means of hammermills, flakers, or refiners. After milling, the material is either screened using vibrating or gyratory screens, or the particles are air-classified. The purpose of this step is to remove the fines and to separate the core material from the surface material. The screened or classified material then is transported to storage bins. From the storage bins, the core and surface material are conveyed to dryers. Rotary dryers are the most commonly used dryer type in the particleboard industry. Both single and triple-pass dryers are used. In addition, some facilities use tube dryers to dry the furnish. Wood-fired dryers are used at most facilities. However, gas- and oil-fired dryers also are used. The moisture content of the particles entering the dryers may be as high as 50 percent on a wet basis. Drying reduces the moisture content to 2 to 8 percent. Dryer inlet temperatures may be as high as 871°C (1600°F) if the furnish is wet; for dry furnish, inlet temperatures generally are no higher than 260°C (500°F). Core dryers generally operate at

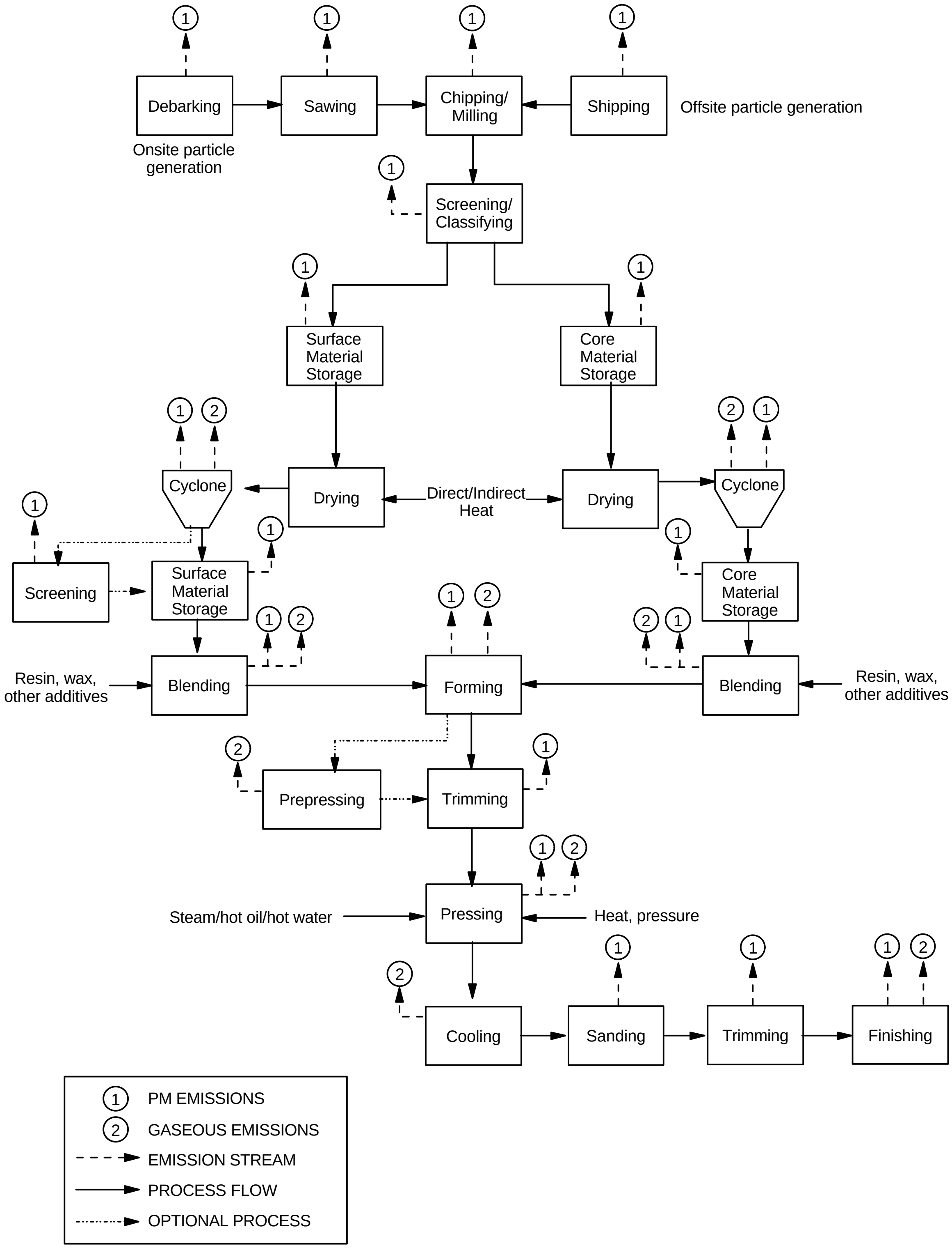

Figure 10.6.2-1. Process flow diagram for particleboard manufacturing.

higher temperatures than surface dryers operate due to differences in core and surface particle characteristics and because a lower moisture content is more desirable for core material.

A two-stage drying arrangement can be used when the moisture content of the incoming furnish is highly variable. The first stage (predryer) equalizes the moisture content in the furnish; the second stage (final dryer) is the main dryer. With this arrangement, tube dryers, rotary dryers, or a combination of dryer types (for example, a tube predryer followed by a rotary final dryer) may be used.

After drying, the particles pass through a primary cyclone for product recovery and then are transferred to holding bins. Face material sometimes is screened to remove the fines, which tend to absorb too much of the resin, prior to storage in the holding bins. From the holding bins, the core and surface materials are transferred to blenders, in which the particles are mixed with resin, wax, and other additives by means of spray nozzles, tubes, or atomizers. The most commonly used resins are phenol-formaldehyde and urea-formaldehyde. Generally, urea-formaldehyde resins are used in panels intended for interior applications and phenol-formaldehyde resins are used to manufacture particleboard for exterior applications.

Waxes are added to impart water resistance, increase the stability of the finished product under wet conditions, and to reduce the tendency for equipment plugging. For furnishes that are low in acidity, catalysts also may be blended with the particles to accelerate the resin cure and to reduce the press time. Formaldehyde scavengers also may be added in the blending step to reduce formaldehyde emissions from the process.

Blenders generally are designed to discharge the resinated particles into a plenum over a belt conveyor that feeds the blended material to the forming machine, which deposits the resinated material in the form of a continuous mat. Formers use air to convey the material, which is dropped or thrown into an air chamber above a moving caul, belt, or screen and floats down into position. To produce multilayer particleboard, several forming heads can be used in series, or air currents can produce a gradation of particle sizes from face to core.

As it leaves the former, the mat may be prepressed prior to trimming and pressing. The mats then are cut into desired lengths and conveyed to the press. The press applies heat and pressure to activate the resin and bond the fibers into a solid panel. Although some single-opening presses are used, most domestic particleboard plants are equipped with multi-opening presses, which generally have 14 to 18 openings and platens that range in size from 1.2 meter (m) by 2.4 m to 2.4 m by 8.5 m (4 ft by 8 ft to 8 ft by 28 ft). Total press time is generally 2.5 minutes (min) for single-opening presses and 4.2 to 5.8 min for multi-opening presses. Typical production capacities are 260 to 325 megagrams per day (Mg/d) (286 to 358 ton/d) for single-opening presses and 520 to 1,180 Mg/d (572 to 1,300 ton/d) for multi-opening presses. Presses generally are steam-heated using steam generated by a boiler that burns wood residue. However, hot oil and hot water also are used to heat the press. The operating temperature for particleboard presses generally ranges from 149° to 182°C (300° to 360°F).

After pressing, the boards generally are cooled prior to stacking. The particleboard panels then are sanded and trimmed to final dimensions, any other finishing operations (including edge painting and laminate or veneer application) are done, and the finished product is packaged for shipment.

10.6.2.2 Emissions And Controls[1-6,11-14]

The primary emission sources at particleboard mills are particle dryers and hot press vents. Other emission sources may include boilers, particle generation, blending, forming, board cooling, and finishing operations such as sanding, trimming, edge painting, and laminate or veneer application. Other potential emissions sources ancillary to the manufacturing process may include wood chip storage piles and bins (including wood fuel), chip handling systems, and resin storage and handling systems.

Although most particleboard mills have chips delivered from offsite locations, in mills where chips are generated onsite, operations such as log debarking and sawing, in addition to particle mills, screens, and classifiers generate particulate matter (PM) and PM less than 10 micrometers in aerodynamic diameter (PM-10) emissions in the form of sawdust and wood particles. In addition, these processes may be sources of PM less than 2.5 micrometers in aerodynamic diameter (PM-2.5) emissions.

Emissions from dryers that are exhausted from the primary recovery cyclone include wood dust and other solid PM, volatile organic compounds (VOCs), condensible PM, and products of combustion such as carbon monoxide (CO), carbon dioxide (CO_2), and nitrogen oxides (NO_x), if direct-fired units are used. The condensible PM and a portion of the VOCs leave the dryer stack as vapor but condense at normal atmospheric temperatures to form liquid particles or mist that creates a visible blue haze. Both the VOCs and condensible PM are primarily compounds evaporated from the wood, with a minor constituent being combustion products. Quantities emitted are dependent on wood species, dryer temperature, fuel used, and other factors including season of the year, time between logging and processing, and chip storage time.

Emissions from board hot presses are dependent on the type and amount of resin used to bind the wood fibers together, as well as wood species, wood moisture content, wax and catalyst application rates, and press conditions. When the press opens, vapors that may include resin ingredients such as formaldehyde, phenol, and other VOCs are released. The rate at which formaldehyde is emitted during pressing and board cooling operations is a function of the amount of excess formaldehyde in the resin, board thickness, press temperature, press cycle time, and catalyst application rates.

Emissions from finishing operations for particleboard are dependent on the type of products being finished. For most particleboard products, finishing involves trimming to size and, in some cases, painting or coating the edges. Other products may require sanding or the application of laminate surfaces or veneers with adhesives. Trimming and sanding operations are sources of PM and PM-10 emissions. In addition, these processes may be sources of PM less than 2.5 micrometers in aerodynamic diameter (PM-2.5) emissions. No data specific to particleboard trimming or sawing are available. However, emissions factors for general sawing operations may provide an order of magnitude estimate for similar particleboard sawing and trimming operations, bearing in mind that the sawing of dry particleboard panels may result in greater PM, PM-10, and PM-2.5 emissions than the sawing of green lumber. No data specific to particleboard panel sanding are available. It is expected that water-based coatings are used to paint particleboard edges, and the resultant VOC emissions are relatively small. Emissions from adhesives used in the application of laminate surfaces or veneers are likely to include VOCs.

In particleboard mills where particles are generated onsite, PM, PM-10, and PM-2.5 emissions from log debarking, sawing, and grinding operations can be controlled through capture in an exhaust system connected to a sized cyclone and/or fabric filter collection system. Emissions of PM, PM-10, and PM-2.5 from sanding and final trimming operations can be controlled using similar methods. These wood dust capture and collection systems are used not only to control atmospheric emissions, but also to collect the dust as a by-product fuel for a boiler or dryer.

Methods of controlling PM emissions from the particle dryer include multiclones, packed bed absorbers (PBAs), fabric filters, electrified filter beds (EFBs), wet electrostatic precipitators (WESPs), and incinerators. Emissions are generally controlled with multiclones, EFBs, or WESPs. The EFB uses electrostatic forces to attract pollutants to an electrically charged gravel bed. The WESP uses electrostatic forces to attract pollutants to either a charged metal plate or a charged metal tube. The collecting surfaces are continually rinsed with water to wash away the pollutants. Wet PM controls, such as PBA and WESP systems also may reduce VOC emissions from particle dryers, but to a lesser extent than PM emissions are reduced by such systems.

A VOC control technology gaining popularity in the wood products industry for controlling both dryer and press exhaust gases is regenerative thermal oxidation. Thermal oxidizers destroy VOCs, CO, and condensible organics by burning them at high temperatures. Regenerative thermal oxidizers (RTOs) are designed to preheat the inlet emission stream with heat recovered from the incineration exhaust gases. Up to 98 percent heat recovery is possible, although 95 percent is typically specified. Gases entering an RTO are heated by passing through pre-heated beds packed with a ceramic media. A gas burner brings the preheated emissions up to an incineration temperature between 788° and 871°C (1450° and 1600°F) in a combustion chamber with sufficient gas residence time to complete the combustion. Combustion gases then pass through a cooled ceramic bed where heat is extracted. By reversing the flow through the beds, the heat transferred from the combustion exhaust air preheats the gases to be treated, thereby reducing auxiliary fuel requirements.

Vendor literature indicates that an RTO can achieve a VOC destruction efficiency of 99 percent. The literature further indicates that with a particulate prefilter to remove inorganic PM, an RTO system can achieve a PM control efficiency of 95 percent. Industry experience has shown that RTOs typically achieve 95 percent reduction for VOC (except at inlet concentrations below 20 parts per million by volume as carbon [ppmvC]), and 70 to 80 percent reduction for CO. However, RTOs typically increase emissions of NO_x.

Biofiltration systems can be used effectively for control of a variety of pollutants including organic compounds (including formaldehyde and benzene), NO_x, CO, and PM from both dryer and press exhaust streams. Data from pilot plant studies in U.S. oriented strandboard mills indicate that biofilters can achieve VOC control efficiencies of 70 to 90 percent, formaldehyde control efficiencies of 85 to 98 percent, CO control efficiencies of 30 to 50 percent, NO_x control efficiencies of 80 to 95 percent, and resin/fatty acid control efficiencies of 83 to 99 percent.

Other potential control technologies for particleboard dryers and presses include exhaust gas recycle, regenerative catalytic oxidation (RCO), absorption systems (scrubbers), and adsorption systems.

Fugitive emissions from road dust and uncovered bark and dust storage piles may be controlled in a number of different ways. These methods include enclosure, wet suppression systems, and chemical stabilization. Control techniques for these sources are discussed more fully in AP-42 Chapter 13, Miscellaneous Sources.

Table 10.6.2-1 summarizes the emission factors for PM emissions from particleboard dryers. Factors for emissions of SO_2, NO_x, CO, and CO_2 from particleboard dryers are presented in Table 10.6.2-2, and factors for emissions of organics from particleboard dryers are summarized in Table 10.6.2-3. The factors for dryer emissions are presented in units of pounds of pollutant per oven-dried ton of wood material out of the dryer (lb/ODT). Factors for PM emissions from particleboard presses and board coolers are presented in Table 10.6.2-4; the factor for press emissions of CO is presented in Table 10.6.2-5; and factors for press and board cooler emissions of organics are presented in Table 10.6.2-6. The units for the press and board cooler factors are pounds of pollutant per thousand square feet of 3/4-inch thick panel produced (lb/MSF-3/4).

Emission factors for mixed hardwood and softwood species are not reported in this section. Emission factors for specific mixes of wood species may be calculated by combining emission factors for individual wood species in the ratio specific to a given application, as emission data for those species become available. For example, a VOC emission factor for a direct wood-fired rotary dryer processing 60 percent pines and 40 percent hardwoods (and operating at an inlet temperature below 730°F) may be calculated using the VOC emission factors for unspecified pines (0.95 lb/ODT for dryers with an inlet air temperature of less than 730°F) and hardwoods (0.35 lb/ODT), and the ratio of 60 percent to 40 percent. The resultant emission factor, rounded to two significant figures, would be 0.71 lb/ODT.

Table 10.6.2-1. EMISSION FACTORS FOR PARTICLEBOARD DRYERS--PARTICULATE MATTER[a]

Source	Emission Control	Filterable[b]				Condensible[c]	EMISSION FACTOR RATING
		PM	EMISSION FACTOR RATING	PM-10	EMISSION FACTOR RATING		
Rotary dryer, direct wood fired							
Southern yellow pine (SCC 3-07-006-06)	None	8.0	D	0.90	D	0.43	D
Unspecified pines[h] (SCC 3-07-006-02, -04)	None	3.9	D	0.69	D	0.30[d]	D
	Multiclone	2.5	E	ND		ND	
	EFB	0.85[e]	D	0.64	E	1.3[f]	D
	Fabric filter	1.4[g]	E	ND		0.97[g]	D
Hardwoods (SCC 3-07-006-10)	None	2.5	D	ND		0.13	E
	Multiclone	2.1	D	ND		0.13	D
	EFB	0.19	D	ND		0.087	D
	Packed bed absorber	0.93	D	ND		0.024	D
Rotary dryer, direct natural gas-fired							
Unspecified pines[h] (SCC 3-07-006-11)	None	1.3	E	ND		ND	
	EFB	0.14	E	ND		0.064	E
Tube final dryer, direct wood-fired							
Douglas fir (SCC 3-07-006-29)	Incineration[j]	0.22	E	ND		0.015	E
Rotary predryer, direct wood-fired							
Douglas Fir (SCC 3-07-006-28)	Multiclone	0.74	D	ND		ND	
	WESP	0.11	D	ND		0.15	D

[a] Emission factor units are pounds of pollutant per oven-dried ton of wood material out of the dryer (lb/ODT). One lb/ODT = 0.5 kg/Mg (oven dried). SCC = source classification code. Reference 6 except where noted otherwise. ND = no data available. EFB = electrified filter bed. WESP = wet electrostatic precipitator.

[b] Filterable PM is that PM collected on or prior to the filter of an EPA Method 5 (or equivalent) sampling train.

[c] Condensible PM is that PM collected in the impinger portion of a PM sampling train.

[d] Consists of 62 percent organic material and 38 percent inorganic material based on EPA Method 202 results.

[e] References 6,7.

[f] Consists of 29 percent organic material and 71 percent inorganic material based on Method 202 results.

[g] Reference 7.

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

[j] Dryer exhaust used as cooling air and as inlet air for COEN burner.

Table 10.6.2-2. EMISSION FACTORS FOR PARTICLEBOARD DRYERS--SO_2, NO_x, CO, AND CO_2[a]

Source	SO_2[b]	EMISSION FACTOR RATING	NO_x[b]	EMISSION FACTOR RATING	CO[b]	EMISSION FACTOR RATING	CO_2[b]	EMISSION FACTOR RATING
Rotary dryer, direct wood-fired (SCC 3-07-006-02, -04, -06, -10)	0.0020	E	1.1[c]	B	1.6	C	570[d]	D
Rotary dryer, direct natural gas-fired (SCC 3-07-006-11)	ND		0.31	D	0.12	D	ND	
Rotary predryer, direct wood-fired (SCC 3-07-006-28)	ND		2.1	D	0.94	D	ND	
Rotary final dryer, direct wood-fired (SCC 3-07-006-21)	ND		ND		0.75	D	ND	

[a] Factors represent uncontrolled emissions unless noted. SCC = Source Classification Code. ND = no data available. All emission factors in units of pounds of pollutant per oven-dried ton of wood material out of the dryer (lb/ODT). One lb/ODT = 0.5 kg/Mg (oven dried). Reference 6 except where noted.

[b] Average of all available data.

[c] References 6,9,10.

[d] References 7-10.

Table 10.6.2-3. EMISSION FACTORS FOR PARTICLEBOARD DRYERS--ORGANICS[a]

Source	CASRN[b]	Pollutant	Emission Factor	EMISSION FACTOR RATING
Rotary dryer, direct wood fired Southern yellow pine (SCC 3-07-006-06)		VOC[c]	1.1[e]	D
	50-00-0	Formaldehyde*	0.021	E
Rotary dryer, direct wood-fired, uspecified pines,[d] <730°F inlet air (SCC 3-07-006-02)		VOC[c]	0.95[f]	D
	77-55-6	1,1,1-Trichloroethane*	1.2E-05	E
	95-63-6	1,2,4-Trimethyl benzene	9.0E-05	E
	5779-94-2	2,5-Dimethyl benzaldehyde	3.3E-05	E
	108-10-1	4-Methyl-2-pentanone*	8.1E-05	E
	101-77-9	4,4-Methylene dianiline*	3.3E-05	E
	80-56-8	Alpha pinene	0.46	E
	10482-56-1	Alpha terpeneol	0.066	E
	75-07-0	Acetaldehyde*	0.010	E
	67-64-1	Acetone	0.0079	E
	98-86-2	Acetophenone*	6.4E-05	E
	107-02-8	Acrolein*	0.0033	E
	107-13-1	Acrylonitrile*	8.9E-05	E
	127-91-3	Beta pinene	0.16	E
	100-52-7	Benzaldehyde	0.0026	E
	71-43-2	Benzene*	0.00022	E
	92-52-4	Biphenyl*	3.9E-05	E
	117-81-7	Bis-(2-ethylhexyl phthalate)*	0.00032	E
	74-83-9	Bromomethane*	2.8E-05	E
		Butylbenzyl phthalate	1.4E-05	E
		Butylaldehyde	0.0031	E
	75-15-0	Carbon disulfide*	1.8E-05	E
	56-23-5	Carbon tetrachloride*	1.2E-05	E
	74-87-3	Chloromethane*	0.00011	E
	98-82-8	Cumene*	6.9E-05	E
	84-74-2	Di-n-butyl phthalate*	2.3E-05	E
		Dimethyl sulfide	1.4E-05	E
	100-41-4	Ethyl benzene*	3.8E-06	E
	50-00-0	Formaldehyde*	0.030	E
	66-25-1	Hexaldehyde	0.016	E
	123-31-9	Hydroquinone*	6.0E-05	E
	590-86-3	Isovaleraldehyde	0.00052	E
	108-38-3, 106-42-3	m,p-Xylene*	0.00011	E
		m-Tolualdehyde	0.00035	E
	78-93-3	Methyl ethyl ketone*	0.0013	E

Table 10.6.2-3. (cont.).

Source	CASRN[b]	Pollutant	Emission Factor	EMISSION FACTOR RATING
Rotary dryer, direct wood-fired, unspecified pines,[d] <730°F inlet air (SCC 3-07-006-02) (cont.).	75-09-2	Methylene chloride*	0.00066	E
	110-54-3	n-Hexane*	2.6E-05	E
	98-95-3	Nitrobenzene*	1.7E-05	E
	95-47-6	o-Xylene*	1.4E-05	E
	99-87-6	p-Cymene	0.0062	E
	100-42-5	Styrene*	0.00012	E
		Trans 1,4 dichlorobutene	2.4E-05	E
	108-88-3	Toluene*	0.0017	E
	110-64-3	Valeraldehyde	0.0045	E
	108-05-4	Vinyl acetate*	2.9E-05	E
Rotary dryer, direct wood-fired, unspecified pines,[d] >900°F inlet air (SCC 3-07-006-04)		VOC[c]	8.2[f]	D
	5779-94-2	2,5 Dimethyl benzaldehyde	0.0053	E
	80-56-8	Alpha pinene	1.9	E
	10482-56-1	Alpha terpeneol	0.17	E
	75-07-0	Acetaldehyde*	0.072	E
	67-64-1	Acetone	0.16	E
	107-02-8	Acrolein*	0.023	E
	127-91-3	Beta pinene	0.82	E
	100-52-7	Benzaldehyde	0.12	E
		Butyl aldehyde	0.029	E
	67-66-3	Chloroform*	0.00010	E
	123-73-9	Crotonaldehyde	0.010	E
	98-82-8	Cumene*	0.0020	E
	50-00-0	Formaldehyde*	0.17	E
	66-25-1	Hexaldehyde	0.022	E
	590-86-3	Isovaleraldehyde	0.018	E
	108-38-3, 106-42-3	m-, p-Xylene*	0.0076	E
	78-93-3	Methyl ethyl ketone*	0.0092	E
	75-09-2	Methylene chloride*	0.0022	E
		n-Butyraldehyde	0.030	E
	529-20-4	o-Tolualdehyde	0.011	E
	95-47-6	o-Xylene*	0.00045	E
	99-87-6	p-Cymene	0.011	E
	104-87-0	p-Tolualdehyde	0.026	E
	123-38-6	Propionaldehyde*	0.011	E

Table 10.6.2-3. (cont.).

Source	CASRN[b]	Pollutant	Emission Factor	EMISSION FACTOR RATING
Rotary dryer, direct wood-fired, unspecified pines,[d] >900°F inlet air (SCC 3-07-006-04) (cont.).	100-42-5	Styrene*	0.00036	E
	108-88-3	Toluene*	0.021	E
	110-64-3	Valeraldehyde	0.014	E
Rotary dryer, direct wood-fired Hardwoods (SCC 3-07-006-10)		VOC[c]	0.35[g]	D
Rotary dryer, direct natural gas-fired Unspecified pines[d] (SCC 3-07-006-11)		VOC[c]	0.90[h]	D
		Methane	0.27	E

[a] Factors represent uncontrolled emissions. Emission factor units are pounds of pollutant per oven-dried ton of wood material out of the dryer (lb/ODT). One lb/ODT = 0.5 kg/Mg (oven-dried). Reference 6. SCC = Source Classification Code. * = hazardous air pollutant.

[b] CASRN = Chemistry Abstracts Service Registry Number.

[c] Volatile organic compounds as propane. Based on results of EPA Method 25A.

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

[e] Formaldehyde has been added.

[f] Formaldehyde has been added; acetone and methylene chloride have been subtracted.

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

[h] Formaldehyde has been added; methane has been subtracted.

Table 10.6.2-4. EMISSION FACTORS FOR PARTICLEBOARD PRESSES AND BOARD COOLERS--PARTICULATE MATTER[a]

Source	Filterable[b]				Condensible[c]	EMISSION FACTOR RATING
	PM	EMISSION FACTOR RATING	PM-10	EMISSION FACTOR RATING		
Batch hot press, UF resin (SCC 3-07-006-51)	0.030	E	0.016	D	0.061	D
Board cooler, UF resin (SCC 3-07-006-61)	0.014	E	0.0034	E	0.0092	E

[a] Reference 6 unless noted otherwise. Emission factor units are pounds of pollutant per thousand square feet of 3/4-inch thick panel produced (lb/MSF-3/4). One lb/MSF-3/4 = 0.26 kg/m^3. SCC = Source Classification Code. Factors represent uncontrolled emissions. All data for mills using urea-formaldehyde resins.

[b] Filterable PM is that PM collected on or prior to the filter of an EPA Method 5 (or equivalent) sampling train.

[c] Condensible PM is that PM collected in the impinger portion of a PM sampling train.

Table 10.6.2-5. EMISSION FACTORS FOR PARTICLEBOARD PRESSES AND BOARD COOLERS--CO[a]

Source	CO	EMISSION FACTOR RATING
Batch hot press, UF resin (SCC 3-07-006-51)	0.090[b]	D

[a] Factors represent uncontrolled emissions. SCC = Source Classification Code. Reference 6 unless otherwise noted. ND = no data available. Emission factor units are pounds of pollutant per thousand square feet of 3/4-inch thick panel produced (lb/MSF-3/4). One lb/MSF-3/4 = 0.26 kg/m^3. All data for mills using urea-formaldehyde resins.

[b] References 3,6.

Table 10.6.2-6. EMISSION FACTORS FOR PARTICLEBOARD PRESSES AND BOARD COOLERS--ORGANICS[a]

Source	CASRN[d]	Pollutant	Emission Factor	EMISSION FACTOR RATING
Batch hot press, UF resin		VOC[e]	0.94[b,f]	D
(SCC 3-07-006-51)	5779-94-2	2,5 Dimethyl benzaldehyde	0.00032	E
	75-07-0	Acetaldehyde*	0.014[b]	E
	67-64-1	Acetone	0.013	E
	107-02-8	Acrolein*	0.0019	E
	100-52-7	Benzaldehyde	0.0018[b]	E
		Butylaldehyde	0.0018[b]	E
	123-73-9	Crotonaldehyde	0.00050	E
	50-00-0	Formaldehyde*	0.26[b]	D
	66-25-1	Hexaldehyde	0.045[b]	E
	590-86-3	Isovaleraldehyde	0.0011	E
	78-93-3	Methyl ethyl ketone*	0.0014[b]	E
	80-56-8	a-Pinene	0.00054[c]	E
	127-91-3	b-Pinene	0.00011[c]	E
	123-38-6	Propionaldehyde*	7.2E-05	E
	108-88-3	Toluene*	0.00047[c]	E
	110-64-3	Valeraldehyde	0.0039	E
Veneer hot press, UF resin (SCC 3-07-020-21)	71-55-6	1,1,1-Trichloroethane*	0.00022[c]	E
	75-07-0	Acetaldehyde*	9.9E-05[c]	E
		Butylaldehyde	0.00014[c]	E
	50-00-0	Formaldehyde*	0.0062[c]	E
	66-25-1	Hexaldehyde	0.11[c]	E
	78-93-3	Methyl ethyl ketone*	0.00028[c]	E
Board cooler, UF resin		VOC[e]	0.27[f]	D
(SCC 3-07-006-61)	50-00-0	Formaldehyde*	0.027	D
	75-07-0	Acetaldehyde*	0.0013[b]	E
	67-64-1	Acetone	0.0020	E
	107-02-8	Acrolein*	0.00036	E
	100-52-7	Benzaldehyde	0.00042[b]	E
		Butylaldehyde	0.00060[b]	E
	123-73-9	Crotonaldehyde	0.00029	E
	66-25-1	Hexaldehyde	0.0011[b]	E
	590-86-3	Isovaleraldehyde	0.00040	E
	78-93-3	Methyl ethyl ketone*	0.00011	E
	110-62-3	Valeraldehyde	0.0015	E

[a] Emission factor units are pounds of pollutant per thousand square feet of 3/4-inch thick panel produced (lb/MSF-3/4). One lb/MSF-3/4 = 0.26 kg/m^3. Factors represent uncontrolled emissions. Reference 6 unless otherwise noted. SCC = Source Classification Code. All data for mills using urea-formaldehyde resins. * = hazardous air pollutant.
[b] References 3,6.
[c] Reference 3.
[d] CASRN = Chemistry Abstracts Service Registry Number.
[e] Volatile organic compounds on a propane basis. Factors are based on Method 25A.
[f] Formaldehyde has been added; acetone has been subtracted.

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