Pollution Prevention Program
for
Other Wood Production Manufacturing & Wood Furniture and Related Manufacturing

Prepared for Toronto Public Health
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Contents

1.0 BACKGROUND INFORMATION

1.1 ChemTRAC Facilities

In the Metropolitan Toronto area, 304 facilities[1] have self-declared with NAICS codes 321 and 337, which correspond to Wood Product Manufacturing and Furniture and Related Product Manufacturing, respectively. In the 2013 reporting year, ninety four (94) unique facilities reported to ChemTRAC that met or are exceeding the reporting thresholds, representing approximately 30.9% of the facilities implicated in the sector.

1.2 Sector Releases to Air

In the 2013 reporting year, the sector reported releases of seven contaminants: Chromium, Dichloromethane, Formaldehyde, Manganese, Nitrogen Oxide, PM2.5, VOCs. Three (3) facilities reported meeting or exceeding the reporting thresholds of Chromium, three (3) for Hexavalent Chromium, two (2) for Dichloromethane, eight (8) for Manganese, eleven (11) for Nitrogen Oxide, thirty seven (37) for PM2.5 and forty nine (49) for VOCs. In total, fifty seven (57) facilities reported meeting or exceeding the thresholds for the contaminants mentioned above.

1.2.1 Chromium

Total chromium releases to air were reported at 6 kg in the 2013 reporting year. Based on ChemTRAC data, only one facility, Profile Industries Limited, had air emissions of chromium, as shown in Table 1. Releases of chromium are expected to be from metal working operations such as laser or plasma cutting, and welding.

1.2.2 Dichloromethane

Total dichloromethane releases to air were reported at 582 kg in the 2013 reporting year. Dichloromethane could be found in adhesives, where it is used to glue wood parts and veneers together. Wood stains, varnishes and finishes also contain dichloromethane and are often used as a decorative coating to make the wood product more appealing for consumers. Dichloromethane is also predominantly a solvent that is commonly used as a paint stripper, and wood floor and panel cleaners[2]. As shown in Table 1, only one facility showed releases of dichloromethane.

[1] Source: Composite of Scott's Directory, Industry Canada, and the 2013 ChemTRAC reporting year data set.
[2] Safer Chemicals, Healthy Families. *Congress Must Expand Protections against Widely Used Harmful Chemicals: Methylene Chloride*. http://saferchemicals.org/wp-content/uploads/sites/3/2013/08/methylene-chloride-fs.pdf

1.2.3 Formaldehyde

Total formaldehyde releases to air were reported at 121 kg in the 2013 reporting year. Formaldehyde is primarily used to produce chemical intermediates for adhesives[3], often used to bind the veneer and wood pieces together. Presence of formaldehyde releases could also be found in the press operations. Depending on the type of resin used to bind the wood components together, vapor released from the press may contain trances of formaldehyde[4]. A total of 2 facilities reported formaldehyde releases to ChemTRAC, as shown in Table 1. Teknion Limited, comprised 99% of the overall formaldehyde emission.

1.2.4 Manganese

Total manganese releases to air were reported at 35 kg in the 2013 reporting year. Similar to chromium, manganese is released from metal working operations from the cutting of metal. As shown in Table 1, five facilities have shown releases of manganese, with one facility, Knoll North America Corp, comprising 63% of the overall manganese emission in the sector. Manganese is a common alloyed element in cold-rolled steel, which the vast majority of painted metal office furniture is made from.

1.2.5 Nitrogen Oxide

Total nitrogen oxide releases to air were reported at 14,838 kg in the 2013 reporting year. Nitrogen oxide emissions are primarily from the oven/drying operations used to cure paints or coating.[5] As seen in Table 1, Knoll North America Corp consist of 60% of the overall Nitrogen Oxide emission from the sector, while each of the remaining facilities emit no more than 12% of the overall emission.

1.2.6 Particulate Matter (PM2.5)

Total PM2.5 releases to air were reported at 16,352 kg in the 2013 reporting year. Releases to air of PM2.5 are expected to be primarily from the cutting/sawing, sanding, and overspray form the painting operations. Secondary emissions from natural gas combustion are expected to be insignificant. Discharges to air from the facility are both controlled (via filter or dust collector), and direct (uncontrolled). Sawing and sanding are often done in enclosures with a dust collector, or equipped with a downdraft table to capture saw dust, while paint booths with internal filters are typically used to capture paint solids from the painting operations. The top three PM2.5 reporters from this sector comprise 55% of

[3] CAREX Canada. *Wood Product Manufacturing Sector*. http://www.carexcanada.ca/CAREX_WPM_Package%20July-16-2015.pdf
[4] U.S EPA. *10.9 Engineered Wood Products Manufacturing*. http://www3.epa.gov/ttnchie1/ap42/ch10/final/c10s09.pdf
[5] Discussions with E. Murphy. Knoll North America. 2015

the overall releases, while each of the remaining facilities emit no more than 7% of the overall release. From the ChemTRAC data, the top ten facilities with air releases of PM2.5 are provided in Table 1.

1.2.7 VOCs

Total VOC releases to air were reported at 161,791 kg in the 2013 reporting year. Releases to air from the sector are primarily from solvent-based paints, stains, and solvent based adhesives. Secondary releases from VOCs from natural gas combustion are considered to be insignificant. From the ChemTRAC data, the top ten facilities with VOC emission is shown in Table 1 below, with 37% of the overall emission being the highest for the biggest emitter.

Table 1. Top 10 Facilities with the Highest Air Releases and Contribution by Pollutant for the Wood Product Manufacturing Sector[6]

Pollutant	Air Release (kg/year)	Sector Contribution (%)
Chromium, Non-Hexavalent and its compounds	**6**	
Profile Industries Limited	6	100%
Dichloromethane (Methylene chloride) (75-09-2)	**582**	
Tayco Panelink Ltd	582	100%
Formaldehyde (50-00-0)	**121**	
Teknion Limited	120	99%
Times Kitchen And Bath	1	1%
Manganese and its compounds (7439-96-5)	**35**	
Knoll North America Corp	22	63%
Profile Industries Limited	6	17%
Teknion Limited	4	11%
Ergotech	2	6%
Jetco Manufacturing Limited	1	3%
Nitrogen Oxides (NOx) (11104-93-1)	**14838**	
Knoll North America Corp	8928	60%
Profile Industries Limited	1715	12%
Global Contract Inc	982	7%
Teknion Limited	925	6%
Spec Furniture Inc	655	4%
Tayco Panelink Ltd	612	4%
Tekwood a Division of Teknion Canada Ltd	448	3%
Jetco Manufacturing Limited	432	3%
Tekwood	141	1%
Particulate Matter 2.5 (PM2.5)	**16352**	
Knoll North America Corp	4313	26%

[6] Source: 2013 Reporting Year ChemTRAC Data.

Pollutant	Air Release (kg/year)	Sector Contribution (%)
Vintage Hardwood Flooring	3359	21%
Golden Summit Woodworking Inc	1280	8%
Tekwood a Division of Teknion Canada Ltd	1221	7%
Global Wood Concepts Ltd	777	5%
D&J Manufacturing Co Ltd	695	4%
Z & D's Finishes Ltd	451	3%
Marana Kitchens Home Design Inc	394	2%
Jetco Manufacturing Limited	390	2%
R&S Door Maker LTD	361	2%
Volatile Organic Compounds (VOCs) Total	**161791**	
Knoll North America Corp	59221	37%
Nienkamper Furniture & Accessories Inc.	12530	8%
Olympic Kitchens Inc	11287	7%
New Image Kitchens Inc	10944	7%
Tayco Panelink Ltd	9294	6%
Tekwood a Division of Teknion Canada Ltd	7927	5%
Teknion Limited	5914	4%
Global Upholstery	5500	3%
D&J Manufacturing Co Ltd	4862	3%
Vintage Hardwood Flooring	4793	3%
Grand Total	**193725**	

1.3 Description of Sector Processes and Operations

Within the Wood Products, Furniture and Related Products Manufacturing sector facilities receive lumber, particle board, and veneer as the main raw materials. Other raw materials include adhesives, paints and lacquers. The wood products undergo a series of manual or automatic woodworking operations including sawing, cutting and trimming to create the desired shape for the final product. Often times, a layer of veneer is glued on the work pieces, sometimes undergoing through a press to bind all the work pieces together. The pieces will then go through machining and sanding for final touch ups before assembling all the pieces together to create the final product. Once assembly is completed, the product is painted, stained and varnished to give the product a desirable look. In some cases, the product will go through a low temperature oven to cure the paint prior to storage and shipment. For each process, various pollutants are emitted into the air, as shown in Figure 1.

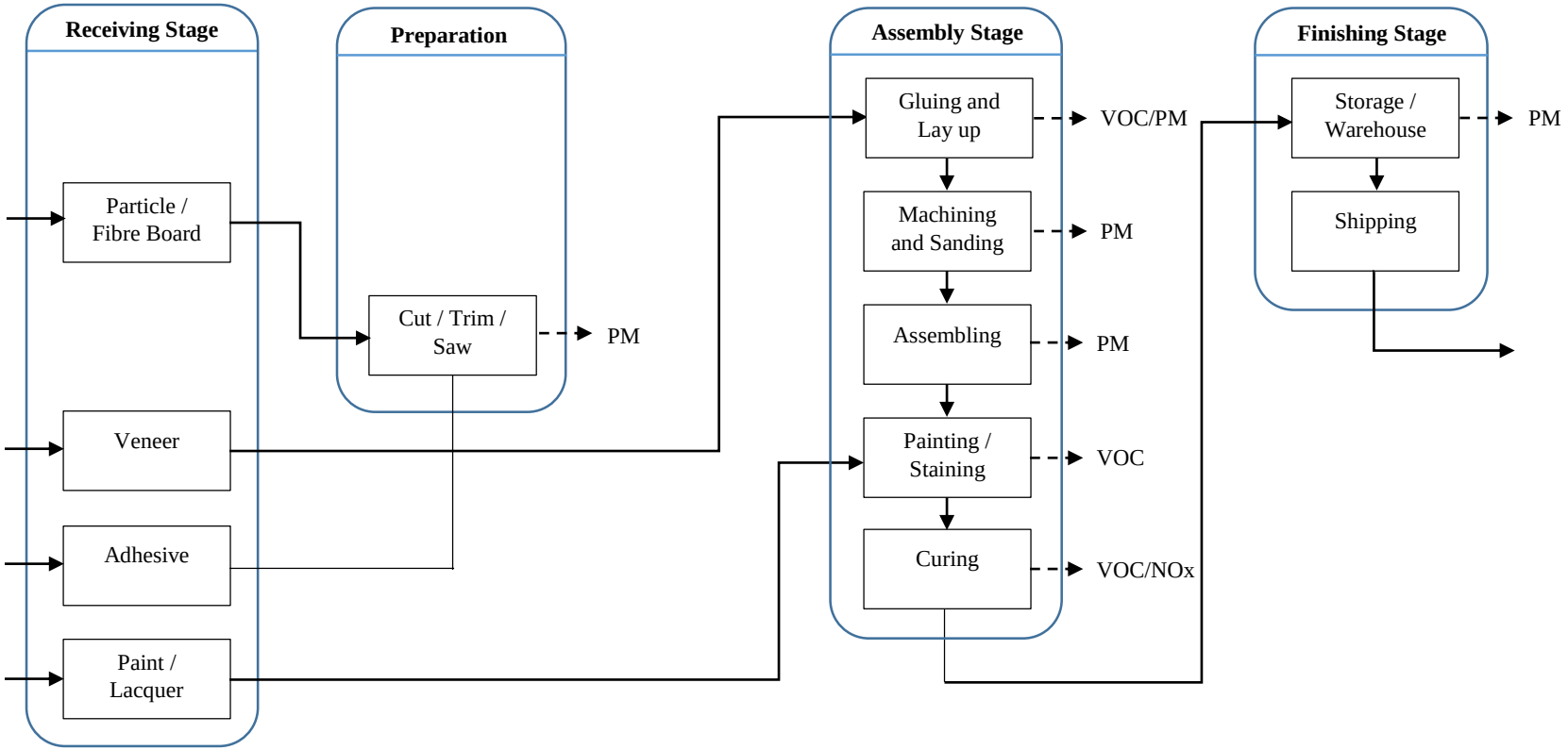

Figure 1. Process Flow Diagram of Wood Products, Furniture and Related Products Manufacturing Sector with Corresponding Process Emissions

2.0 BARRIERS IDENTIFIED

2.1 Sector Breakdown

The barriers to implement pollution prevention are dependent on the size of the facility. The distribution of facilities by employee size that reported to ChemTRAC in 2013 is shown below in Table 2.

Table 2. Employee Distribution of the Wood Product Manufacturing and Furniture and Related Product Manufacturing Sector[7]

# Employee	# Facility	Percent of Total
<5	15	16.0%
5 to 9	15	16.0%
10 to 14	14	14.9%
15 to 19	6	6.4%
20 to 29	12	12.8%
30 to 44	8	8.5%
45 to 99	6	6.4%
100+	18	19.1%
TOTAL	**94**	**100.0%**

Facilities employing less than 20 people are considered small facilities, and account for 53% of the facilities in Toronto. Facilities employing more than 20 people are considered large facilities in the sector, and account for 47% of the facilities in Toronto.

2.2 Motivation

Motivational barriers vary based on the size of facility and the layers of management required to enact change at the facility. For small facilities, owner/operators need to be motivated to use pollution prevention technologies in the absence of direct customer demand. For larger facilities, it is likely a chain of management that needs to be motivated to implement pollution prevention technologies. Often managers have competing priorities which they try to promote within the organization, in the absence of a P2 champion, P2 initiatives may often be overlooked.

Motivational barriers identified within this sector include:

- Multiple decision makers may have competing priorities, resulting in frustration with championing P2 initiatives
- Many small businesses are skeptical about the business benefits of environmental improvements[8]

[7] 2013 Reporting year ChemTRAC data set.
[8] Revell et al, 2010. Small businesses and the environment: turning over a new leaf? *Business Strategy and the Environment*, *19*(5), 273–288. doi:10.1002/bse.628

- Lack of financial incentives.
- Lack of pressure from customers[9]

2.3 Knowledge

With a limited number of staff, facilities are not positioned to employ specialists with an enhanced knowledge of P2 measures. Small facilities are likely to employ manual operations, and the skills of the workers are tied to the specific duties (carpentry, painting, etc). These facilities are more likely to learn from business-to-business discussion, suppliers, tradeshows or magazines, and from industry associations. Larger facilities are more likely to have adapted automation technology, and the skill of the works is related to operating equipment, or function as an assembly line worker. For facilities larger than 100 employees, basic knowledge of P2 can be expected as a result of industry specific product certification programs. The most common being the GreenGuard© program, which mandates the use of certain P2 initiatives such as low VOC coatings..

Within the sector, the following knowledge barriers have been identified:

- Limited or no technical resources in-house
- Business may not understand the necessary actions involved in implementation of a P2 technology or practice[10]
- Unsure how new technologies will impact business
- Desire external expertise to validate potential opportunities[11]
- Risk of failure of new technologies
- Benefits of new P2 technologies not understood

A major obstacle for the facilities is little or no knowledge about pollution prevention technologies. effectiveness, capital cost, annual savings, and payback period of technologies are all the key factors to deciding whether or not alternative technologies should be implemented.

2.4 Financial Resources

Financial investment is one of the major barriers identified that prevent facilities from implementing P2 initiatives. Within the sector, the smaller facilities are typically focussed on their day-to-day survival rather than research, and investing capital for retrofits, new equipment, or other supplies in order to prevent or reduce pollution.

[9] Hassanali, M. Pollution Prevention Practices in SMEs in the GTA. 2005.
[10] Heath & Heath, 2010. *How to change things when change is hard*. Crown Business.
[11] ChemTRAC Business Panel, 2012.

The following financial barriers that have been identified within the sector include:

- Lack of financial capital to invest
- Short return on investment (typically a return on investment must be complete within a year)[12]
- Capital tied up in other projects

2.5 Time/Human Resources

For small facilities employing less than 10 people, there is a considerable time demand placed on the owner, and employees resulting in a lack of resources to investigate P2 initiatives. It is not uncommon for the owner/operator to be involved in the managing of operations, customer service, sales, human resources, and accounting functions. For larger facilities, as a result of the cost competitiveness of the industry, the operations are expected to lean, with minimal available time for employees to explore P2 initiatives.

Time/Human Resources barriers include:

- Facilities with limited time and human resources cannot afford to release employees for training without affecting operations.
- Lack of available time to explore and research effectiveness of P2 opportunities

2.6 Organizational

In the smaller facilities, it is likely that the owner-operator is the decision maker, and may believe they are risking their financial security to implement pollution prevention, whether it be changes to the production line that may alter the quality of the product, or a capital investment in new equipment. The owner-operator is unlikely to have an environmental compliance/sustainability employee or a team to consult with on the decision, so pollution prevention may often be overlooked.

In larger facilities, it is likely that a chain of management must agree to implement pollution prevention. The motivation may come from maintenance workers that identify areas for improvement, or from more senior management indicating that pollution prevention must be implemented as part of company policy[13]. Internal competing priorities, or the lack of agreement on priority of initiatives can often stagnant P2 initiatives.

The following organizational barriers have been identified:

[12] Based on experience working on P2 projects within the sector.
[13] http://www.knoll.com/design-plan/resources/environment

- Environmental managers may not fully understand production processes and may doubt that P2 opportunities or technologist exist[14].
- Limited worker involvement / no reward for pollution prevention.

2.7 Market

As a result of increased concern over indoor air quality, certifications such as GreenGuard©, LEED©, and SMaRT© are influencing customer decisions for juvenile furniture, office furniture, and building products. Residential consumer demand for GreenGuard© certified products is considered low in the kitchen cabinet and bath sector.[15] Smaller manufacturers are likely not in a position to be able to afford, or administer green product certifications because of their considerable overhead.[16]

Market Barriers that were identified include:

- Undesirable to make process changes that change the quality of product
- Distributors may not demand sustainable production throughout their supply chain
- Although consumers are full of intent to purchase sustainability, studies have indicated that these preferences have not translated into a widespread uptake of more sustainable products[17]

2.8 Technological

Facilities in this sector generally do not have the specialized resources in-house to identify technical P2 opportunities. As a result of highly manual operations, smaller facilities have encountered difficulty in implementing change, which may require training or changing of habits.

Technological barriers identified include:

- Lack of specialized staff training to implement new technology
- Fear of results / misinformation within the industry[18]
- Reliant on suppliers to develop recommendations (smaller facilities)

[14] U.S Congress Office of Technology Assessment. (1994). *Industry, Technology, and the Environment – Competitive Challenges and Business Opportunities.*
[15] Discussions with D. Martin. Cranberry Hill Kitchens. 2015
[16] Ibid.
[17] Horne, R.E., 2009. Limits to labels: the role of eco-labels in the assessment of product sustainability and routes to sustainable consumption. *International Journal of Consumer Studies.* 33,175-182.
[18] Autobody Profitability Handbook – Appendix 2. HVLP Background Information. Hamilton District Autobody Repair Association.

2.9 Regulatory

The wood product manufacturing industry is not subject to any limiting regulations. As such, no regulatory barriers could be identified.

3.0 POLLUTION PREVENTION OPPORTUNITIES

The following have been identified as potential P2 options for facilities. As a general comment, implementation costs and payback periods were not available in the case studies reviewed. This would be a critical element to add into the P2 program.

- Waste Minimization
    - Ensuring that the moisture content of wood is in equilibrium with the conditions of the shop to allow for proper joining[19].
        - Can be achieved by measuring the environmental conditions such as humidity and temperature, and using these values to check that the moisture content of the wood is correct before attempting a joining operation. As each species of wood has difference requirements, commercially available moisture meters will take into consideration the types of woods being joined.
    - Purchase materials on a need basis to reduce spoiling and disposal of solvents.
- Best Management Practices
    - Tight seals on solvent and glue containers to prevent VOC's from flashing off or spoiling of product.
        - Can be achieved by implementing a maintenance schedule to check lids and seals
    - Calibrate glue applicators regularly for proper transfer and reduced glue losses.
        - Can be achieved by implementing a maintenance schedule to calibrate applicators.
    - Clean spray guns in enclosed cleaners rather than open buckets.
    - Solvent recycling[20]
        - Can reduce waste by 98%[21]
- Materials Substitution

  Materials that perform the same function but do not contain contaminants can be substituted over those that do contain contaminants. Opportunities within the materials substitution include:

[19] Missouri Department of Natural Resources. (2005). *Preventing Pollution in Wood Furniture Manufacturing.*
[20] United States Environmnetal Protection Agnecy. (2004). *Furniture Manufacturing and Refinishing*
[21] [21] United States Environmental Protection Agency. (1992). *Pollution Prevention Opportunities in Wood Furniture Manufacturing.*

  - Low VOC or no VOC, glues, adhesives, stains and coatings[22]
  - Heat treating, infrared, or aqueous curing glues, adhesives and coatings

- Dust Collection

  Dust collection is required in most facilities to comply with Ontario's air quality regulation (O. Reg 419/05). However, increased dust collection can be promoted to benefit working conditions, reduce liability, and reduce equipment wear greatly. Additionally, captured wood dust can be sold to create new sources of revenue[23]. Opportunities for dust collector include:

  - Baghouses
  - Cyclones

- Finishing Efficiency

  The finishing stage of the process is a significant source of emissions, including VOCs, metals, and particulate matter (PM). Increasing the transfer efficiency reduces material costs and pollutants. Opportunities to reduce emissions from the finishing stage include:

  - Spray operator training
    - Can result in finishing material savings of 10%[24]
    - High pressure, low volume guns[25]

[22] Wyoming Department of Environmental Quality. (n.d.). *Solvent - Furniture Refinishing Suggested Best Management Practices.* 2001.
[23] Missouri Department of Natural Resources. (2005). *Preventing Pollution in Wood Furniture Manufacutring.*
[24] United States Environmental Protection Agency. (1992). *Pollution Prevention Opportunities in Wood Furniture Manufacturing.*
[25] Utah Department of Environmental Quality. (1999). *Wood Products Manufacturing Pollution Prevention Fact Sheet.*