Residential Wood Combustion

SUMMARIZED RESULTS OF THE 1998-1999 SAMPLING PROGRAM

STUDY OBJECTIVES

In 1998, the Regroupement Montréalais pour la qualité de l'air (RMQA) led a study to assess the health and environmental impacts of air pollution in the Greater Montreal area. Wood combustion was identified as a major source of air pollution. In order to partly respond to the issue, the Communauté urbaine de Montréal (CUM), Environment Canada and the Direction de la santé publique de Montréal Centre (DSP Montréal-Centre) jointly conducted a field measurement study during the winter of 1998-1999 aiming at the assessment of the impacts of wood burning. The sampling site chosen for the project was located at Rivière-des-Prairies, in an area considered to be mostly influenced by residential wood combustion. Data obtained at the site were compared to those measured at other reference sites located in semi-urban area and downtown Montreal.

Illustration: Alain Reno

The main goal of the winter sampling program consisted into the environmental impact assessment of wood combustion units used in many residences. Several air pollutants emitted through wood combustion have been measured such as polycyclic aromatic hydrocarbons (PAH), volatile organic compounds (VOC), fine particulate matter (PM) and some metals. Meteorological data were also acquired in order to verify linkages between emissions and pollutant concentrations present in the air. Within the context of the study, hourly and daily PAH and PM variations were also examined. Lastly, the contribution of residential wood burning on the levels of different air pollutants has been evaluated. Eventually, data obtained during the project should allow for the prediction of adverse air quality situations that could have an impact on the health of affected population and also the elaboration of further work on the health impacts of residential wood combustion.

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Direction de la santé publique

COMMUNAUTÉ URBAINE DE MONTRÉAL

POLYCYCLIC AROMATIC HYDROCARBONS

Increase of 45% in PAH

- Higher levels during the evenings.
- Higher levels on week-ends.
- Higher levels on Christmas evening.

For PAH, mean levels measured during a full day at the site influenced by residential wood combustion (76,8 ng/m^3) were higher than those measured in downtown Montreal (40 ng/m^3), mostly influenced by vehicle emissions (Figure 1). On evenings and week-ends, more PAH are observed in area affected by residential wood combustion, either using the standard technique (87,8 ng/m^3) or from a continuous analyzer. The latter shows that there is twice more PAH during the evening (4 pm to 10 pm) than during the day (10 am to 3 pm). Noteworthy is the fact that samples measured during Christmas evening contained twice more PAH than those obtained during the entire day on December 25th.

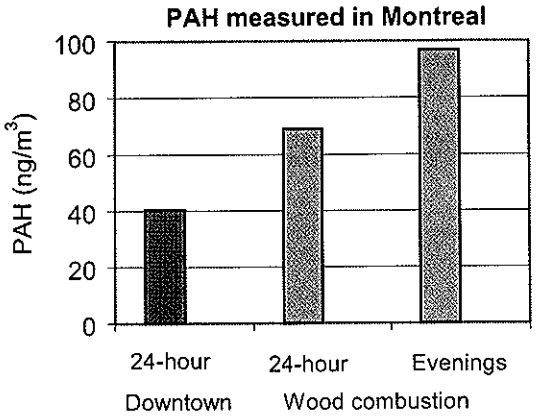

Figure 1 : Comparison of PAH measured in downtown Montreal (full day) and at a site influenced by wood combustion (entire day and evenings only) in Montreal.

VOLATILE ORGANIC COMPOUNDS

Increase of VOC up to 200%

- Acrolein is typically found in wood burning emissions.

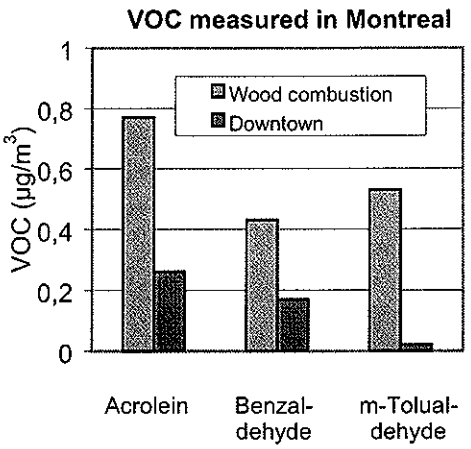

Figure 2 : Comparison of some VOC measured in downtown Montreal and at a site influenced by wood combustion in Montreal.

Some VOC are found in greater concentrations at the site influenced by residential wood combustion than in downtown Montreal (Figure 2). Literature review indicates that wood burning is a major source of these compounds. Car transportation, well known as a VOC emission source, is not as important in the residential area chosen for the study.

FINE PARTICULATE MATTER AND METALS

During the winter of 1998-1999 (Figure 3), levels of fine particulate matter have been higher in a sector influenced by wood combustion (12,9 $\mu g/m^3$) than in semi-urban area (7,4 $\mu g/m^3$) or in downtown Montreal (10,4 $\mu g/m^3$). PM generally behave the same way from one site to the other in Montreal. However, the site " wood burning " greatly differs with numerous periods of high PM concentrations observed only at this site.

From the range of metals measured in Montreal, potassium and iron might help identifying sources of pollution. Their ratio can be used to single out wood combustion as the main source of pollution in the residential area considered during the study.

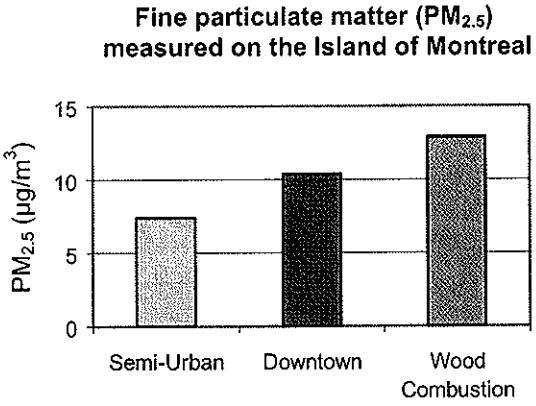

Figure 3 : Levels of fine particulate matter ($PM_{2,5}$) measured in various sectors on the Island of Montreal.

Increase of 40 to 100% in fine particulate matter (PM)

- Higher levels during the evening.
- Higher levels on week-ends.

40% increase in some metals

- The potassium/iron ratio is an indicator of wood combustion.

DAILY CYCLES

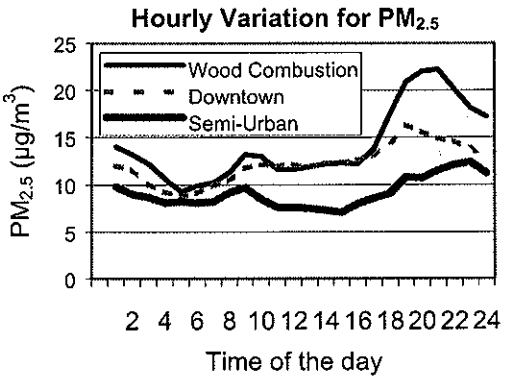

Figure 4 : Hourly variation of fine particulate matter levels ($PM_{2,5}$) measured on week-ends in the Island of Montreal.

In an attempt to characterize the use of wood combustion units, $PM_{2,5}$ and PAH data measured with continuous sampling instruments have been examined. Hourly values indicate that they were higher during the evening than during the day, either for $PM_{2,5}$ (Figure 4) than for PAH (Figure 5). Similarly, levels measured on week-ends are higher than those observed on week-days. In fact, differences between week-days and week-ends can be as high as 34% for $PM_{2,5}$ and 92% for PAH. Also, PM and PAH levels tend to increase later through the week-end.

Daily cycles

- Hourly lag in the levels during week-days compared to week-ends.
- Higher levels on week-ends and during the evening.

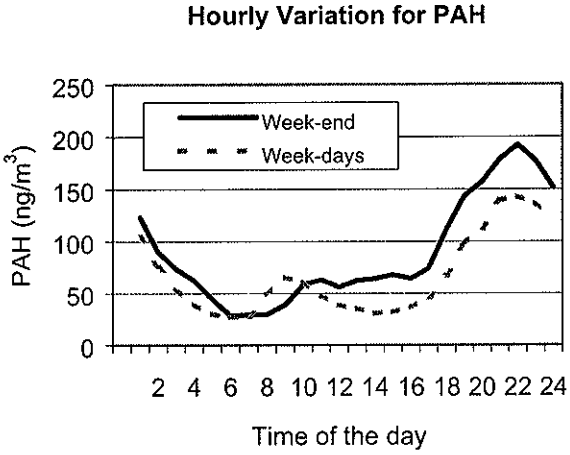

Figure 5 : Hourly variation of PAH levels measured on week-days compared to week-ends.

CONCLUSION

Results tend to demonstrate that wood combustion contributes to the deterioration of ambient air quality in an area mostly influenced by wood burning. As a matter of fact, many of the measured compounds experienced an increase of 40% or more in their observed concentrations. Complementary studies should be pursued to confirm if the impact of wood combustion are as significant as indicated by the results of this study. Additional field studies during the summer and winter seasons have therefore been conducted to validate the results of 1998-1999 winter field study.

HEALTH

With respect to the health and the exposure of people to contaminants originating from wood combustion, this wintertime study raises a series of questions. That is why the DSP Montreal-Centre, in partnership with the Communauté urbaine de Montréal, Environment Canada and the ministère de l'Environnement du Québec, has conducted a survey not only to understand the spatial distribution of wood burning units over the Island of Montreal, but also to identify sectors of weak and intensive use of wood burning units. That information has enabled the DSP Montreal-Centre to do a pilot-project to characterize and to quantify indoor and outdoor exposure for residents.

The technical report is available through the following Internet sites:
www.cum.qc.ca/rsqa (See section *Documents*)
www.santepub-mtl.qc.ca/Environnement/environnement.html
www.qc.ec.gc.ca/envcan/atmospheree.html

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