

Residential Wood Heating

SUMMARY OF RESULTS FROM 1999 TO 2002

OBJECTIVES OF THE STUDY

A study conducted in 1998 by the *Regroupement montréalais pour la qualité de l'air (RMQA)* identified residential wood heating as one of the main sources of air pollution in the Greater Montreal area. Several medical studies indicate that wood combustion may have a negative impact on human health.

During the winter of 1999, samples taken from a monitoring station located in Rivière-des-Prairies showed that the concentrations of several pollutants were greater in this residential area than in downtown Montreal. Furthermore, a survey conducted by the *Direction de la santé publique de Montréal-centre* in 2000 confirmed that this residential district, located northeast of Montreal, is among the sectors of the island where most homes are heated by wood by a primary or secondary heating system.

This brochure summarizes the results obtained between December 1998 and May 2002, by comparing values obtained in downtown Montreal with values measured in winter and summer in a residential area where residential wood combustion is popular. It also assesses the impact of residential wood combustion on the concentrations of various products found in the air and the influence of meteorological conditions. Polycyclic aromatic hydrocarbons (PAHs), dioxins and furans (D/F), volatile organic compounds (VOCs), fine particulate matter (PM_{2.5}), and metals are among the pollutants measured in the course of the project.



Illustration: Alain Reno



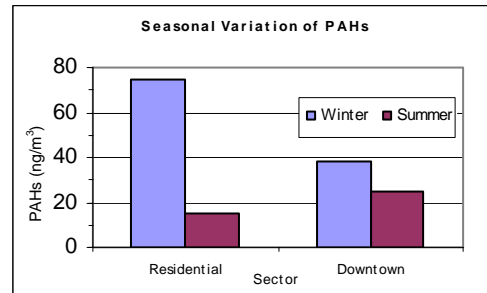
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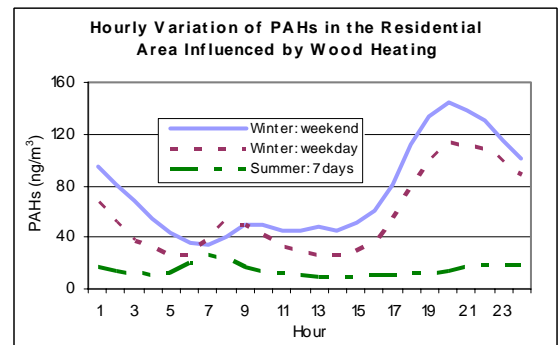
Montréal 

POLYCYCLIC AROMATIC HYDROCARBONS



During the four winters, the mean daily concentration of polycyclic aromatic hydrocarbons (PAHs) measured in the area influenced by residential wood combustion was 74.6 ng/m³. This concentration is five times greater than the concentration measured in summer, and twice the concentration measured in the downtown area in winter. At the residential area, the highest monthly values occurred from November to February, reaching a peak in January.

PAHs were also measured using a continuous analyzer in the residential sector influenced by wood combustion. The highest mean hourly value (144 ng/m³) occurred during the evening on weekends in winter. This value was 30% higher than on weekday evenings in winter, and 10 times higher than during the evening in summer.



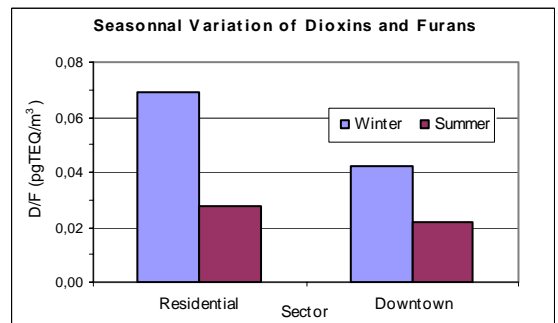
PAHs ARE TWICE HIGHER THAN DOWNTOWN

- 5 times higher than in summer
- Concentrations are higher during the night and the weekend in winter

DIOXINS AND FURANS

Among the dioxins and furans (D/F) emitted during wood combustion, 17 compounds are of particular concern as regards to their impact on human health. Their concentrations are expressed in terms of toxicity equivalent (TEQ) as compared to the most toxic product of the group. In the residential area,

the mean concentration in toxicity equivalent was 2.5 times greater in winter (0.069 pg TEQ/m³) than in summer (0.028 pg TEQ/m³) and 1.7 times greater than in downtown Montreal in winter (0.041 pg TEQ/m³).



1.7 TIMES AS MUCH D/F THAN DOWNTOWN

- 2.5 times more than in summer

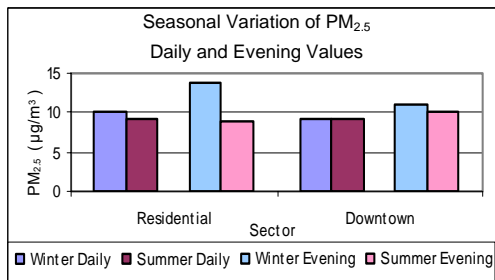
The mean concentration in 2001 was 0.049 pg TEQ/m³ in the residential area and 0.031 pg TEQ/m³ in the downtown area. In both cases, the concentrations stood below the annual criteria established at 0.060 pg TEQ/m³ by the ministère de l'Environnement du Québec.

VOLATILE ORGANIC COMPOUNDS

Contrary to the winter of 1999, we did not find any significant differences in the concentrations of volatile organic compounds (VOCs) measured in the residential area and in downtown Montreal. However, the presence of certain VOCs at levels similar to those measured downtown is probably caused by wood combustion in the residential area, since motor vehicle traffic, also known as a source of VOCs, is not important in this sector.

SIMILAR VOC VALUES BUT FROM DIFFERENT SOURCES

FINE PARTICULATES



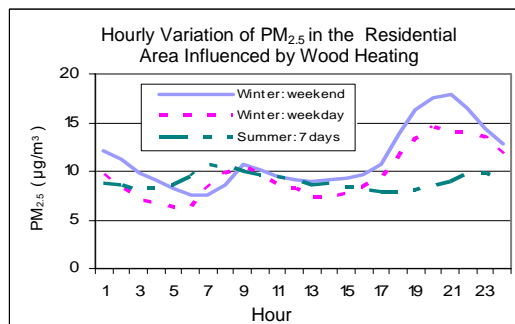
In winter, daily concentrations of particulate matter (PM_{2.5}) were 10% greater in the residential area (10.1 µg/m³) than in downtown Montreal (9.2 µg/m³), and were also 10% greater than in summer in the residential area. When only the evening levels of PM_{2.5} are taken into account (from 6 p.m. to

midnight), the difference between concentrations measured in the residential area (13.9 µg/m³) and in downtown Montreal (11.0 µg/m³) reached 25% in winter. Lastly, PM_{2.5} concentrations measured in the residential area in winter were 60% greater than the concentrations measured on summer evenings.

10% INCREASE AND MORE OF PM_{2.5} COMPARED TO DOWNTOWN

- At night, 60% increase compared to summer values

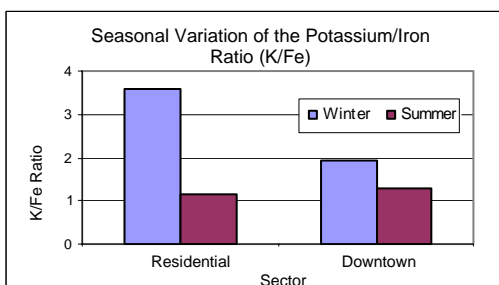
As for PAHs, PM_{2.5} concentrations are greater on winter weekend evenings. Hourly average concentrations reached 17.9 µg/m³, while they were only 14.6 µg/m³ during weekdays which represents a difference of about 20%. No such discrepancy was noted in summer, either during the day or at night.



- Maximum values observed around 9 pm during winter weekends

METALS

Among all the metals measured, the presence of potassium, and its relation with iron are recognized as tracers for wood combustion. The concentrations of potassium measured in the residential sector in winter (0.13 µg/m³) were 150%



greater than in the summer, and 40% greater than concentrations measured downtown in winter. High potassium to iron ratio (K/Fe) provides an indicator for wood combustion. In the residential sector, this ratio was 200% higher in winter than in summer, and 80% higher than in the downtown area in winter.

THE K/FE RATIO IS A WOOD COMBUSTION INDICATOR

- 80% increase compared to downtown

- 200% increase compared to summer

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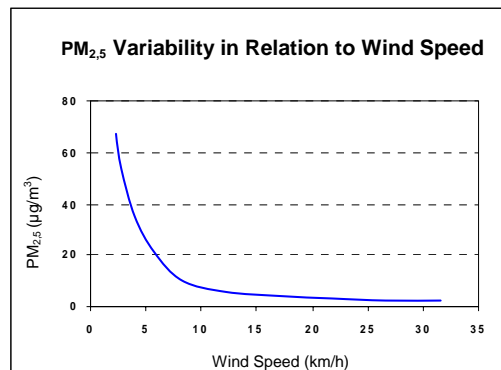
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METEOROLOGY

Meteorological conditions influence pollutant concentrations present in ambient air in winter. For instance, the wind can disperse pollutants emitted by local sources such as wood combustion. During the evening, when wind speed is above 15 km/h in the residential area, PM_{2.5} concentrations are generally below 5 µg/m³. However, concentrations can increase to 60 µg/m³ when wind speeds are below 2 km/h. Calm winds allow for the accumulation of pollutants near local emissions.



Meteorological conditions such as wind speed, relative humidity, temperature and air stability can explain up to 60% of the variability of PM_{2.5} concentrations measured during the winter evenings. This suggests that in winter, the contribution of local sources to PM_{2.5} concentrations is important in the residential area.

CONCLUSION

Results obtained between the winter of 1999 and the summer of 2002 in the residential area of Montreal where wood heating is significant, indicate that wood combustion contributes to the deterioration of ambient air quality. Concentrations of certain pollutants can be five times higher in winter than in summer. When the residential area influenced by wood combustion is compared to the downtown area, winter concentrations can be twice as important. Results obtained after the winter of 1999, notably for the continuous measurements of PM_{2.5} and PAHs, confirm the results of the first sampling program.

To know when to avoid burning wood, consult the winter INFO-SMOG Web site which provides daily air quality forecasts from December to April:

<http://lavoieverte.qc.ec.gc.ca/atmos/smog/>

The INFO-SMOG program partners also provide additional information on their respective Web sites:

<http://www.menv.gouv.qc.ca/air/info-smog>

<http://www.rsqa.qc.ca> (available in French only)

<http://www.santepub-mtl.qc.ca/environnement/> (available in French only)