Air Quality Assessment of the Canadian Pulp and Paper Industry

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Study Overview

• Health Canada is currently conducting a study of the effects on human health of air emissions from the Canadian Pulp and Paper Industry.

• This study is a first step in a larger program by Health Canada to examine the health effects of various industrial sectors in Canada under the federal Clean Air Regulatory Agenda.

• Pulp and Paper was chosen as the first industrial sector to be studied due to its relatively small size and the nearby communities generally being single industrial with limited population size.

• This trial study will serve to fine tune similar studies of other industrial sectors to be completed by Health Canada.

• The results of the industry studies will aide Health Canada in determining future policies and strategic directions.
The air quality assessment of the Canadian pulp and paper industry will consist of assessments of three representative mills as surrogates for the industry as a whole.

Site-specific concentrations and depositions of air contaminants emitted from each mill will be predicted in conjunction with other local emission sources.

The predicted concentrations and depositions will be used by Health Canada to assess air quality levels on the health of the residents living in the vicinity of each mill.
Study Methodology

- Assess ambient air quality conditions for chemicals of potential concern (CoPC) based on available sources of monitoring data.
- Estimate air contaminant emissions due to operation of each facility and other regional industrial and non-industrial emissions sources.
- Develop a meteorological dataset representative of each mill’s location for use in dispersion modelling.
- Conduct dispersion and deposition modeling of air contaminants emitted from all identified emission sources using the US EPA CALMET/CALPUFF models.
- Analysis of ambient data, emissions, and model results.
Ambient Air Quality

- Ambient air quality in the region surrounding each mill will be characterized based on historical monitoring data collected near each selected location over the five years considered in the assessment (2004-2008).

- Data from the following networks will be considered in the Crofton assessment:
  - The National Air Pollutant Surveillance (NAPS) program; and,
  - The British Columbia Ministry of Environment (MOE) monitoring network.

- This data will also be used to validate the dispersion model predictions and/or provide background concentration levels that might be used in the air quality assessment.
Emissions Inventory

• Emissions from the following sources will be considered in the air quality assessment:
  – Stationary emission sources (stacks and fugitives) from mill sources such as boilers, kilns, digesters, brown stock washers, bleach plant, paper machines, etc.
  – On-property fugitive emissions from mobile sources (roads, vehicles, and material handling, etc).
  – Emissions from other industrial sources in the study area.
  – Non-industrial emission sources such as commercial emissions, gas stations, residential emissions and vehicle traffic emissions.

• About 120 contaminants of potential concern (CoPCs) will be considered in the emissions inventory including CACs (PM, NO\textsubscript{x}, CO, etc), PAHs, VOCs, dioxins and furans, and sulphur based compounds)
Dispersion Modelling - Overview

• The US EPA CALPUFF model will be used to predict ground level concentrations over a 30-km x 30-km domain around the mill.
• The CALMET meteorological model is used to provide the meteorological data necessary to initialize the CALPUFF dispersion model.
• The CALMET model will be run over a 40-km x 40-km domain centered over the mill with a grid resolution of 250 m.
• Five years of meteorological data (2004 to 2008) will be considered for this assessment.
• Emissions for non-industrial sources will be apportioned to each grid cell in the modelling domain.
Dispersion Modelling - Study Area and CALMET/CALPUFF Grid Cells
CALMET Modelling

- To initialize the CALMET model the following data will be used:
  - Land use - British Columbia Thematic Mapping (BTM) data.
  - Surface data - measured (wind speed, wind direction, temperature, cloud cover, precipitation, etc) data from Nanaimo Airport, Vancouver Airport, Victoria Airport, and the Crofton met tower.
  - Upper air data - The NOAA Weather Research and Forecasting (WRF) model will be used to generate a 3-D meteorological dataset to initialize the wind and upper-level temperature fields in CALMET on a 4-km grid.
  - Ocean temperature data - Halibut Bank and Pat Bay buoys, NASA Group for High Resolution Sea Surface Temperature (GHRSSST)
Land Use Data

UTM Zone: 18
Hemisphere: N
Datum: WGS-84

- Land Use
- Snow/Ice
- Tundra
- Water
- Wetland
- Forest
- Range
- Agriculture
- Urban/Built-Up

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Met Stations
CALPUFF Modelling

- The US EPA CALPUFF model will be used to predict maximum short-term and annual average ground-level concentrations and deposition fluxes at grid cells as well as at specific sensitive receptor locations (schools, hospitals, daycares, nearby residences, recreational areas, etc).

- A receptor grid with variable spacing ranging from 10-m to 250-m will be used.

- Building wake effects will be considered for the mill emissions sources.

- The dispersion modelling will include special receptors that correspond to the locations of ambient monitoring stations. The measured ambient data will be compared to the model predictions for the same time period and location to validate the model predictions.
Population Exposure Assessment

- To estimate the exposure of individuals living in the study area to the CoPCs emitted from the mill, population and age group data from Statistics Canada will be obtained for the most recent census year (2006).
- The Stats Canada population data will be apportioned to each grid cell in the modelling domain.
- The model predictions in each grid cell will be used in conjunction with the processed population data to provide a population-weighted concentration exposure for each compound.
Crofton Area Population Data
Probabilistic Assessment

- In addition to the maximum ground-level concentrations due to the cumulative effect of all emission sources in each mill, the contribution of each emission source in the mill to the ambient concentrations will be assessed.
- These individual source contributions will be used in a probabilistic assessment to provide mean and percentile exposure levels in addition to the maximum predicted values.
- Representative distributions will be assigned to each variable and statistical assessments conducted using Monte-Carlo simulations.
Health Risk Assessment

- The results of the air quality assessment will be supplied to Health Canada who will conduct the human health risk assessment.
- The health assessment will be done using a multi-pathway/multi-contaminant approach.
- For the human health assessment, special consideration will be given to vulnerable populations such as young children, elderly and ill individuals.
Project Schedule

- The air quality assessment commenced in mid-May 2009. Data gathering and processing activities are currently underway.
- The air quality assessment is expected to be completed by October 2009.
- Initiation by Health Canada of the human health risk assessment of population exposed to specific industrial sectors is expected for this fiscal year.