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Fact Sheet

NITEP
Modernization and Assessment of the Mass-Burning Incinerator in Quebec City

The Communauté urbaine de Québec (CUQ) Municipal Solid Waste Incinerator in Quebec City, which was built in 1974, is the largest incinerator in Canada. It offered a unique opportunity to the National Incinerator Testing and Evaluation Program (NITEP) to both modernize and improve mass-burning incineration technology.

The Garbage Problem and NITEP

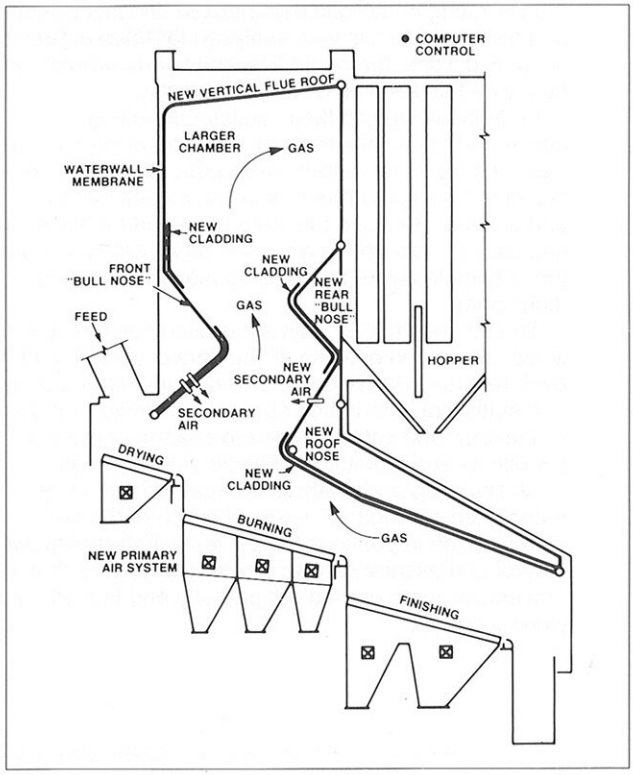
Canadian municipalities are constantly searching for ways to reduce municipal garbage disposal problems. A hierarchy of effective waste reduction options has been developed that includes reduction, re-use, recycling and, where applicable, recovery of energy through incineration. The priorities of these options are to reduce the overall garbage disposal problems by treating garbage as a resource.

Incineration can effectively reduce the volume of waste to be disposed in landfills by over 90 per cent while producing useable energy. This is called energy-from-waste technology. Unfortunately, if not properly controlled, incinerators can release harmful emissions into the atmosphere. These emissions can include toxic chemicals such as lead, mercury, and other heavy metals; dioxins, furans, and other harmful organic chemicals; and acid gases that contribute to acid rain.

The National Incinerator Testing and Evaluation Program (NITEP) has been charged with the task of studying and finding ways of reducing incinerator emissions. Through NITEP, Environment Canada has worked with industry, municipal governments, provincial governments, and international organizations to study energy-from-waste incineration technology and emission control systems.

The Incinerator at Quebec City

Much has changed in incineration technology since the CUQ municipal solid waste incinerator facility started burning garbage and producing energy in Quebec City. The CUQ facility was constructed to burn garbage collected from the city of Quebec and several nearby municipalities. The facility consists of four mass-burning incinerators, and produces steam that is sold to a local paper company (Reed Paper Ltée.). Ash is disposed of at a nearby landfill site and flue gases are treated in an electrostatic precipitator before being discharged into the environment.



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The Modernization Program

In May 1985, a comprehensive study was completed to transform the design of one of the incinerators at Quebec into a state-of-the-art design that would improve energy recovery and reduce emissions. Modifications were made to improve air distribution, reshape the furnace to allow for maximum mixing of air combustion gases, and to increase the amount of time that the gases were in the furnace. All of these modifications enhanced combustion of the garbage. A computerized control and monitoring system was added to display and control all of the process conditions in the incinerator. This control system provided a great deal of information to the NITEP data acquisition system.

Testing the Technology

Once the modernization was completed, a comprehensive testing program was started to evaluate the performance of the new design, and to identify optimum operating parameters. Two levels of testing were carried out. First, characterization testing was performed. This involved running the incinerator under different operating conditions and monitoring operating parameters to develop an understanding of the incinerator operating range. A total of 22 tests were run under 18 different operating conditions. After a thorough assessment of these tests, five representative test conditions were selected for more detailed performance testing. These represented a wide range of operating conditions for the incinerator. A total of 13 performance tests were run.

During the performance test runs, operating data was collected from points throughout the incinerator to define the operating conditions being tested. Incoming refuse and the resulting ash was analysed for trace organics such as dioxins, furans, PCBs, and hydrocarbons, and heavy metals such as lead and mercury.

Flue gases leaving the pollution-controlling electrostatic precipitator were analysed using continuous sampling trains for carbon monoxide, carbon dioxide, sulphur dioxide, hydrogen chloride, oxides of nitrogen, and oxygen. Because trace organics and metals in the flue gases could not be analysed on a continuous basis, these samples were taken using manual sampling techniques.

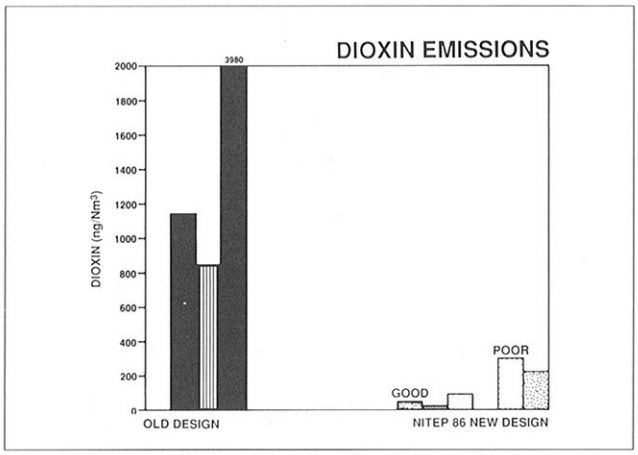
The microcomputer data acquisition network was used to log, store, and analyse all the data collected during each test run. This network provided real-time graphics and statistical information about the conditions in the incinerator, and could be used to change operating conditions and monitor the effects of the change.

All sampling and analysis was carried out using recognized procedures, many of which had been standardized in previous NITEP tests. External quality control and assurance was provided to ensure that all procedures were carried out properly and that all results were accurate.

Reduced Emissions

The test results demonstrated that the modernization of the incinerator resulted in a dramatic reduction in the amounts of pollutants discharged into the atmosphere. The most important results observed were:

- Major reductions in the emission of trace organics, especially dioxins and furans, under all operating conditions.



- Reductions in the emission of heavy metals.
- Major reductions in particulate (fine dust) emissions. The amount of particulates released has a direct effect on the amount of metals released, and correlates with dioxin emissions.
- Carbon monoxide concentration in the flue gas was found to be a good indication on incinerator operation. Low levels of carbon monoxide indicated that the incinerator was operating efficiently. At carbon monoxide levels below 50 parts per million, the lowest amounts of dioxins and other trace organics were emitted.
- Reductions in the amounts of ash produced, and the amounts of organics in the ash.

Understanding the Results With Models

Perhaps the most important result of this study is the development of relationships between trace organic emissions with both process operating conditions and continuous emission data. These relationships, called prediction and control models, can be used to give the operators of an incinerator a means of reducing the amounts of pollutants discharged into the environment. For instance, a model was developed for this incinerator that predicts the amounts of hard-to-measure pollutants in the incinerator emissions, based on the levels of substances that can be easily monitored on a continuous basis. This makes it possible for the operator to minimize the amounts of pollutants being emitted from the incinerator using a control model that identifies which operating conditions are required to reduce emissions.

A number of models were created using a technique called multiple linear regression analysis. Through these models, it was determined that:

- Trace organic emissions such as dioxins and furans can be controlled by adjusting total air flow into the incinerator, the ratio of primary air to secondary combustion air, and the refuse feed rate.
- Trace organics can be predicted by monitoring for carbon monoxide, oxides of nitrogen, and water in the flue gas.
- The level of carbon monoxide can be useful for predicting the amounts of most trace organics.

The models developed in this study indicate that the design and operation of an incinerator has an important effect on the emissions that it will produce. By putting models that have been developed into actual practice, the incinerator can then be operated in an environmentally-sound manner. The results of this study provide a basis for developing similar models for other incinerators, using the same general approach.

NITEP Results Put Into Action

Through this study of the CUQ Mass-burning incinerator, Environment Canada has been able to provide municipalities all over Canada with useful information on controlling pollution from incinerators. The results of the study also indicate that modernization of older incinerators can greatly improve the efficiency of the incinerator and at the same time reduce emissions. This will affect how other Canadian mass-burning incinerators are designed, operated, and monitored.

This and the other NITEP studies have contributed a great deal to Environment Canada's initiatives in the area of pollution control. They have also made Environment Canada a world leader in incineration control technology evaluation. Incineration is an important part of the disposal stage in the "life cycle" of toxic substances. The life-cycle approach is integral to the Canadian Environmental Protection Act (CEPA). NITEP results will be used in setting future environmental standards under CEPA and with other legislation that regulates incineration.

NITEP Data Available to the Public

Environment Canada has published complete results of this study in the summary report: National Incinerator Testing and Evaluation Program: Environmental Characterization of Mass Burning Incinerator Technology at Quebec City. Six additional detailed reports on this study are also available.

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