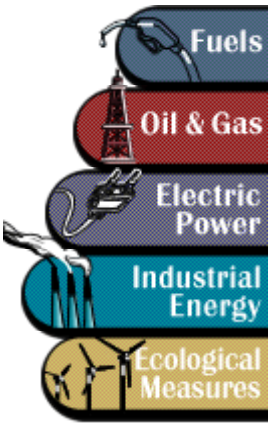

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National Emission Guidelines for Cement Kilns

Preface

In May 1991, the Canadian Council of Ministers of the Environment (CCME) issued Phase I of the Management Plan for Nitrogen Oxides (NO_x) and Volatile Organic Compounds (VOCs). The aim of the Plan is consistent attainment of the Canadian maximum acceptable one-hour air quality objective for ozone of 82 parts per billion by the year 2005. This Guideline responds to initiative N306 of the Plan, one of a series of initiatives aimed at preventing future increases in emissions through emission limits for new sources. The Guideline addresses emission limits for new high-temperature kilns in the cement manufacturing industry, and makes recommendations for emission reductions from existing plants that are being modified or upgraded. While this Guideline establishes maximum broad national emission limits, it is acknowledged that federal, provincial or regional environmental authorities may impose more stringent limits in response to regional or local problems.

Principles considered to be important in developing the Guideline were pollution prevention, energy efficiency, cost effectiveness and a comprehensive approach to minimizing various emissions. While the Guideline NO_x emission targets are aimed at new kilns, certain emission reduction strategies applied to modified existing kilns could also be beneficial. Where there are opportunities to improve the environmental performance and energy efficiency of kilns for which 'major modifications are planned, emission rates and control methods should be evaluated in close consultation with the appropriate regulatory authorities.

For the overall benefit of the environment, the Guideline encourages the use of substitutes for cement materials and for fossil fuels, where it can be demonstrated by the proponent that NO_x emissions would not be increased. It also encourages the implementation of energy efficiency measures in cement production.

The Guideline was developed through a multistakeholder consultation process, by a working group consisting of representatives from the cement and lime industry, equipment manufacturers, environmental groups, and provincial, regional and federal governments. The contributions of all participants who assisted in the establishment of this Guideline are gratefully acknowledged.

Introduction

The National Emission Guideline for Cement Kilns was developed to provide a consistent national basis for restricting emissions of nitrogen oxides (NO_x) and other pollutants, while encouraging greater energy efficiency in the industry. A Technical Background Document was also prepared, through the consultation

process, to describe the Canadian cement industries and available NO_x reduction methods. A summary of this document is presented in Appendix B to aid in the assessment of reduction strategies for new, existing and modified kilns.

In this National Emission Guideline, NO_x limits for cement kilns are expressed as weight of allowable emissions per unit of clinker production (kg/tonne). In determining allowable emission levels for cement kilns where major modifications are planned, consideration should be given to the offset of clinker production through the use of additives to clinker to produce cement, and the increase in energy efficiency available by the recovery of waste heat energy from cement kiln stack gases. The Guideline also addresses issues related to other common air pollutants, as well as monitoring of emissions.

The cement industry is based on the conversion of a mixture of limestone ($CACO_3$) and clay, into clinker material consisting of compounds of calcium oxide (CaO), by the addition of large quantities of heat in a coal- or gas-fired rotary kiln. NO_x formation results mainly from this high-temperature pyroprocessing stage which sinters the material into a cement clinker, as well as during initial limestone calcination. Carbon dioxide (CO_2) is also liberated in this calcination process. Clinker production can take place in a wet-process long kiln with a slurry raw material feed, with a dry-process feed in a long kiln, or with a dry feed in more modem and efficient preheater and precalciner kilns.

Several methods of NO_x reduction were assessed during the development of the Guideline, although only some of these have been proven commercially. These include both combustion technologies which reduce or prevent emissions at their point of generation, and post-combustion methods which reduce emissions already generated, as indicated below and explained in detail in the Technical Background Document:

- combustion operation modifications
- low-NO_x burners
- staged air combustion
- selective non-catalytic reduction
- selective catalytic reduction.

Process optimization through combustion modifications is one of the first options to be considered for improving process efficiency and for reducing emissions. The use of low-NO_x burners is being studied internationally, with a wide variety of results on installed systems. These burners usually require an indirect-fired system, whereby most combustion air is provided independently of the burner. Selective non-catalytic reduction using injection of ammonia compounds is also being investigated as a feasible post-combustion technology. There has been very limited experience on flue gas control methods such as selective catalytic reduction, or on technologies such as staged air combustion for precalciner kilns. Experience has shown that NO_x emissions from coal-burning kilns are often lower than from natural gas-burning kilns.

This Guideline recognizes that optimized and energy-efficient kiln processes, such as preheater and precalciner kilns with modem process and particulate controls, are the most effective means of minimizing the majority of emissions from cement kilns. These methods focus on cost-effective pollution prevention measures, and also address a variety of emissions including greenhouse gases.

NO_x emissions can also be minimized through reductions in the clinker/cement ratio, and tests with waste-derived fuels have in some cases shown a positive impact on reducing emissions. Regulatory authorities should consider the overall environmental impacts of incorporating flyash or slag mixed into the finished cement product to reduce the need for clinker, and of using substitute waste fuels such as solvents, tires and landfill gases to supplement traditional fuels. For technical guidance on operating and performance standards, reference is made to a separate CCME publication entitled National Guidelines for the Use of Hazardous and Non-Hazardous Wastes as Supplementary Fuels in Cement Kilns.

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