

Review of Health Effects from Cement Plant Operations

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- **Limited information was found about health effects related to community exposures to cement plant operations and similar industries.**
- **In the studies reviewed, a causal relationship between the proximity to a cement plant and an excess risk of cancer and other health effects could not be established. However, health impacts were identified in the surrounding communities, including specific cancers (i.e., lung cancer, colon-rectum and NHL) and respiratory diseases.**
- **The health impacts found in these studies may not be generalizable to the community in L'Orignal as emissions from cement plants vary significantly based on inputs, meteorology, and pollution controls.**

Issue

Colacem Canada Inc. (Colacem) has proposed the development of a cement plant in L'Orignal, Ontario, in the vicinity of an existing quarry, and steel plant.¹ Residents in this community have expressed concerns about adverse health effects resulting from the proposed cement plant, and associated cumulative exposures from industry air emissions in this area. The following has been prepared at the

request of the Eastern Ontario Health Unit (EOHU) to assist with their understanding of the possible adverse health effects of living near a cement plant.

Methods

A literature search from the past 20 years on the health effects of living near a cement plant was conducted through the Ovid Medline, Embase, Environment Complete and Scopus databases using a combination of the terms such as: cement, concrete, clinker, hearing, vibrations, disease, illness, air pollution. A total of 930 abstracts were reviewed, and 15 articles were retained for response. Articles pertaining to occupational exposures, asbestos-related health effects, and studies conducted outside of North America and Europe, were screened out of the review, as they were considered outside of the scope of this request. A general Google search was also done with these search terms to identify grey literature on the topic. Relevant references from these sources were also reviewed.

Background

Colacem has submitted an application for an Environmental Compliance Approval to the Ministry of the Environment and Climate Change (MOECC) for the development of the cement plant in L'Orignal.¹ The proposed cement plant may be operational continuously (i.e., 24 hours per day, 7 days per week, 52 weeks per year), and is expected to produce 1.16 million tonnes of cement annually.¹ The proposed cement plant will be located approximately 1000 m from residences, and approximately 5 km from an existing quarry owned by Colacem. The existing quarry will be used to supply the raw materials for the production of cement.¹

As part of the approvals process, Colacem has undertaken air quality and noise assessments, and developed a stormwater management plan, and a best management plan for dust control.¹ The air quality assessment for the proposed cement plant has identified the following as “significant” contaminants: suspended particulate matter, nitrogen oxides, sulphur dioxide, ferric oxide, crystalline silica, manganese and calcium oxide.³ The air quality assessment concluded that emissions from the proposed cement plant and cumulative emissions from industry in the area would meet the regulatory requirements in Ontario, and were below limits protective of human health.¹ The noise assessment predicted sound levels impacts from the operations would be below the MOECC sound limits. The studies completed under the approvals process are awaiting technical review by the MOECC, and are within the public comment period.¹

Health effects and cement plants

According to the United States Environmental Protection Agency (US EPA), “cement plants are a significant source of sulphur dioxide (SO₂), nitrogen oxide (NO_x) and carbon monoxide (CO)”.² A 2014 Air Quality Report in Ontario by the MOECC states that cement and concrete industry account for 4% of NO_x emissions. In addition, 29% of SO₂ emissions are attributable to electrical utilities and industrial processes including cement and concrete manufacturing. The report highlights that air quality in Ontario has been improving from 2005 to 2014, and ambient air concentrations and air emissions of NO₂, SO₂, CO and PM_{2.5} have decreased in this time period.²⁰

In general, the results from a single health study will not be generalizable to all cement plants because of differences in pollution controls, meteorology and operations⁴. The air quality assessment has not identified that asbestos will be used in the proposed cement production; therefore, health effects related to asbestos exposure in cement production and emissions were not included.

Of the studies found where cement plants were studied in relation to community health effects most of the results were for individuals who were exposed to occupational cement dust^{5,6}. These studies found both respiratory effects and increased mortality in occupationally exposed workers.

Biomonitoring

A biomonitoring study was conducted by Dong et al., (2015) in Ravena, Albany County, New York on 185 participants living within 0.7 to 9.9 km from a cement plant. The study was conducted to address community concerns about the possible health impact from the metal emissions of the cement plant. Concentrations of aluminium, arsenic, cadmium, lead, mercury and selenium were measured in blood and mercury in hair samples of the participants. The results were comparable to the general US population and regional population. The authors concluded that metal exposures to the surrounding community were minimal, and it was unlikely that residents in the vicinity of the cement plant had elevated health risks as a result of exposure to metals.⁷

Cancer

An ecological study was designed by Garcia-Perez et al., to examine mortality from 33 various cancers from the period of 1997 to 2006, in towns in Spain near the production of cement, lime, plaster, and magnesium oxide facilities. An excess risk of dying from cancer, and specifically in colon-rectum was observed for those living within 5 km of these industries. The authors note that the use of distance as a proxy of exposure was a limitation, as actual exposures to industrial operations may depend on prevailing winds and geographic landforms; in addition, they lacked information on smoking and occupational exposures.⁹

Lopez-Cima et al., conducted a hospital-based case-control study in Spain to determine if living within 3 km of industrial facilities was linked to an excess risk of lung cancer. 700 lung-cancer patients were matched with control cases and categorized based on demographics, residential history, tobacco use, family history of cancer and occupational history. The study concluded that living in the vicinity of industrial facilities, particularly metal industries, cement plants and shipyards was a risk factor for developing lung cancer.⁸

A case-control study in the State of Iowa, Los Angeles County, in the metropolitan areas of Detroit and Seattle was conducted by Pronk et al., to determine if there was an association between non-Hodgkin lymphoma (NHL) and residential proximity to industrial combustion facilities releasing dioxins and furans. Facilities in the study included secondary copper smelters, municipal solid waste incinerators, cement kilns, iron ore sintering plants, medical waste incinerators, coal-fired electric generating facilities, sewage sludge incinerators, hazardous waste incinerators and industrial boilers. The study was conducted between July 1998 and June 2000, and involved 1,321 patients and 1057 case-controls. After statistically accounting for potential confounding factors (including but not limited to lifestyle, nutrition,

occupational hazards, etc.), the researchers found an elevated risk of NHL for those residing <3 km and <5 km from cement kilns.¹⁰

Although these three studies observed an excess risk of cancer in communities in the vicinity of cement plants and other industrial facilities, a causal relationship between the proximity to a cement plant and an excess risk of cancer was not established.

Mortality

A study by Giordano et al., looking at mortality patterns of a local population in a town in Rome was conducted for two periods, between 1983 to 1992 and 1993 to 2002. The objective of the study was to examine the possible health effects of air pollution resulting from the cement plant located in the centre of the town. The study found there was no statistically significant increased risk of mortality for all causes of death in the exposed population in both periods; however, for the period between 1993 and 2002, a statistically significant risk was found in males for respiratory diseases including chronic bronchitis, and pneumoconiosis. This was the same time period where the cement plant expanded its production and employed exclusively men, and the authors suggest that this finding may be due to occupational exposure.⁶

Respiratory diseases

Bertoldi et al. , conducted a case-control study to evaluate acute health effects resulting from exposures to cement plant emissions in two highly industrialized and densely populated cities in Italy. The study used hospital admissions for acute cardiovascular and respiratory diseases over a four year period, and used modelled and direct measurements of nitrogen oxides (NO_x), as a proxy for cement plant emissions. Statistically significant risks were found for respiratory diseases among children and adults in the moderately, and highly exposed groups (NO_x concentrations of 111-150 µg/m³ and >150 µg/m³, respectively). The authors note that the health impacts are not exclusively attributable to the presence of the cement plant, but the facility remains a major source of NO_x in the local airshed.¹¹

A cross sectional study conducted by Legator et al., with 58 participants was conducted in Midlothian, Texas. The study used a symptom survey on the study community and a reference community, and found that persons living near a cement kiln experienced increased respiratory effects.¹² The Texas National Resource Conservation Commission (TNRCC) published a critique of this study and identified numerous limitations including a small sample size, the inability to calculate a response rate, biases introduced during the interviews and confounding factors including not controlling for age, sex or socioeconomic status.¹³

Risk Assessments

Several environmental monitoring and risk assessment studies have been conducted in the vicinity of existing cement plants in Catalonia, Spain. The results of these environmental studies estimate that risks from contaminants emitted by cement plants are within acceptable limits.^{14,15,16,17}

Noise/Vibrations and health effects

Information about noise, and exposure to vibrations and health effects from cement plants or similar industries was not found. A study conducted in Italy looked at three years of seismic events and found that some events which were previously thought to be naturally occurring, may be due to huge cement factories across the country.¹⁸

Community particulate matter assessment

Public Health Ontario conducted a short-term community particulate matter assessment in a residential area near a concrete plant in Toronto. The objective of this work was to measure particulate matter exposures experienced by residents in the community and see how these exposures compared to a reference area in Toronto within the same time period. There was a strong correlation of particulate matter measured at the residential site near the concrete plant and the reference site; the assessment concluded that this may suggest hourly or daily variations in measurements are as a result of characteristics of the Toronto air shed rather than dust emissions from the concrete plant.¹⁹ This response is available if EOHU is interested in the results.

Summary

Limited information was found about health effects related to community exposures to cement plant operations and similar industries. In the studies reviewed, a causal relationship between the proximity to a cement plant and an excess risk of cancer and other health effects could not be established. However, health impacts were identified in the surrounding communities, including specific cancers (i.e., lung cancer, colon-rectum and NHL) and respiratory diseases.

The health impacts found in these studies may not be generalizable to the community in L'Original as emissions from cement plants vary significantly based on inputs, meteorology, and pollution controls.

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