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IMPLICATIONS FOR HUMAN HEALTH

Acid Deposition and Transregional Pollution

Summary of the Problem

Transregional transportation of pollution, as with acid deposition and the long-range transport of air toxic, may threaten human health directly (particularly in the respect to respiratory disorders), and indirectly through effects on terrestrial ecosystems, forests, and agriculture.

Canadian Recommendations[1]

- Reduction of wet deposition level of sulphate to below 20 kilograms per hectare per year (kg/ha/yr) in the sensitive areas of the Canadian environment, in cooperation with the U.S.;
- Implementation of a national system of trading, tracking, compiling and recording sulphate emissions;
- Sufficient support for research into the effects of acidification on human health, terrestrial ecosystems, forests, agriculture, and clean transportation;
- Adoption of fuel efficiency and emission standards for mobile sources.

Acid Deposition

The burning of fossil fuels and increased production of acidifying emission from industrial sources increase the release of sulfates and nitrates into the atmosphere.[2-7] In the atmosphere, sulfur dioxide may convert, with promotion by metals enriched in airborne particles, to sulfuric acid and related species. Similar effects occur with nitrogen oxides. Fine acidic particulates are composed of or carry on their surface a variety of acidic species, such as the strongly acidic sulfate form of sulfuric acid, moderately acidic ammonium bisulfate, weakly acidic ammonium, nitrogen dioxide, and nitric acid. Seasonal variation of acidic species has been observed in the most sensitive areas.[8-10]

The acidic particulates can be transported long distances in the air and subsequently reach the earth in rain.[11] In recent years, surveys of acid precipitation and acidification of soil and water in the Northern Hemisphere have shown increased acidity (or, more accurately, reduced acid neutralizing capacity) and presumably irreversible changes in pH and in metal mobilization in soils.[12] The result has been extensive changes in vegetation and small lake biota, such as forest decline and fish loss.[6-7,12]

Acid precipitation has more obvious effects on delicate aquatic ecosystems, marine biota, and some terrestrial species of plants and trees.[8,13] The effects of acidifying chemicals, i.e., oxides of sulphur and ozone, chlorine and nitrogen oxides, are at least additive and effective control requires attention to all sources of emissions capable of distant transport.[14]

Indirectly, acid precipitation may adversely affect human health if essential food chains are disrupted due to killing of aquatic life and impaired crop growth and the economic consequences are severe. Some authors have speculated that if metals are leached into groundwater at excessive concentrations, there may be toxicological implications.[15-18] Distant migration of acid precipitation has been well documented within Canada.[19-21]

Although the effects of acid precipitation were once thought to be exclusively ecological and indirect rather than toxicologically significant to humans directly,[22-23] newly accumulating evidence has suggested that some adverse human health effects, particularly respiratory diseases, are related to exposure acid aerosols.[24-27] There is preliminary evidence in animal experiments to suggest lung injury at environmentally relevant concentrations of acidifying agents.[28-30] The impact of air pollution on human health has been demonstrated.[15,31-32] The associations of daily mortality or hospital visit/admissions or pulmonary function or aggravation of asthma and air pollution (acid haze) have been extensively studied.[33-53] Although the findings from these epidemiological studies vary somewhat, the evidence suggests that acid haze plays an important role in adverse health consequences. Acid haze and certain varieties of cancer has also been investigated.[55] Work by Canadian, American, and Italian investigators suggests possible direct effects of industrial exposure to acidifying agents that may have counterparts in environmental exposures to acid precipitates.[55] Acidification of water may alter the bioavailability, retention and excretion of trace elements in human body.[56]

Loading Capacity

The data from air and precipitation monitoring programs in North America have showed that wet sulphate deposition loadings exceeded 20 kg/ha/yr in eastern North America.[8] The acid rain control programs in eastern Canada, under the Long Range Transport of Air Pollutants Program, have been underway for more than ten years.

The economics of controlling acid emissions are complicated and relate primarily in North America to the American and Canadian energy sectors.[57-58] A major technical problem is considering control strategies for acid precipitation is the absence of a clear understanding of loading capacities, the maximum emissions an ecosystem or, in this case, an airshed can absorb before its capacity to neutralize, transform, or dilute the pollutant is exceeded. Critical loading capacities are being studied for Europe.[59] Under the UN Economic Commission for Europe Convention on Long Range Transboundary Air Pollution in an effort to set targets for reducing emissions.[60]

There is no such process at work in North America. The target load (20 kg/ha/yr) of sulphate in precipitation in Canada is based on aquatic effects when established in the early 1980s. The loading capacity of North American ecosystems has not received this degree of attention, at least at official levels. There is no visible program to establish

targets for reduction of acid deposition based on established loading capacity. There is a area that requires attention urgently.

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