1 Introduction

The year-round use of the highway system is both expected by the public and essential to the national economy, causing many highway agencies to use large amounts of deicing chemicals to keep roadways free of winter snow and ice. The most widely used deicing chemical is sodium chloride, or common road salt,[1] which, because of its low price, easy application, and reliable ice-melting performance, has been a primary element of snow- and ice-control programs for many years.

Deicing chemicals can facilitate plowing, reduce the need for sanding and subsequent cleanup, and prevent the bonding of packed snow and ice to the pavement. These properties reduce the time, manpower, and equipment necessary for snow and ice control. Moreover, deicing chemicals provide levels of service that are seldom attainable by plowing and sanding alone, resulting in increased public mobility, fewer disruptions in trucking and other commercial traffic, and less hazardous driving conditions.

Over the years, however, evidence has grown that the most popular deicing chemical, sodium chloride, has many negative side effects. Damage attributable to salt includes accelerated corrosion of metals in bridges and automobiles, increased sodium levels in drinking water, and injury to roadside vegetation. Whereas the direct cost of purchasing and applying salt is low, the total cost may be much higher.

The last major studies quantifying the cost of salting were conducted more than a decade ago. The most comprehensive study, sponsored by the Environmental Protection Agency in 1976, indi-

cated that the total cost of highway deicing by salt exceeded $3 billion per year, or about 15 times the amount spent purchasing and applying salt each winter (Murray and Ernst 1976). During the 1970s, the publicity generated by these studies motivated highway agencies to seek ways to curtail salt use, for example, by developing more efficient spreading techniques and exploring alternative deicing chemicals.

In 1980 these efforts led to the discovery of calcium magnesium acetate (CMA) as a possible replacement for salt. Since its discovery, CMA has been subjected to many laboratory and field studies to determine its deicing effectiveness and environmental acceptability. Test results indicate that CMA has fewer adverse side effects than salt; however, a major deterrent to its use has been its price, which is more than 20 times that of salt by weight.

STUDY ORIGIN AND SCOPE

The commercial availability of CMA, as well as continued concerns about the adverse effects of salting, has underscored the need for information on the true cost of road salt. Because it has been many years since road salt's costs were last quantified, many earlier cost estimates are no longer applicable, especially given recent advances in corrosion protection and increased knowledge about the environmental and health effects of salt. Recognizing this deficiency, in 1988 Congress requested a study of "the full economic costs of using rock salt and calcium magnesium acetate for highway deicing" (U.S. Congress. Senate. 1988).

To carry out the study, which involved a diverse range of subject matters, the Transportation Research Board convened a special committee of experts in chemistry, materials science, economics, environmental science, and highway operations and maintenance. The committee interpreted its charge as an examination of the major cost and use issues associated with the use of road salt and CMA.

REPORT ORGANIZATION

The results of the study are presented in the following chapters. Chapter 2 provides a general overview of road salt use in the United States, including historical trends in salt use, salt application and storage practices, salt use by jurisdictional level and geographic region, and annual spending on salting activity. The discussion relies in part

on findings from a survey of state highway agencies conducted for the study (see Appendix A).

The major side effects of salting are discussed in Chapters 3, 4, and 5. Motor vehicle and infrastructure impacts, which are covered in Chapter 3, are salt's best-known and most quantifiable costs. The effects of salt on the environment and drinking water are reviewed in Chapters 4 and 5, respectively. Both subjects are difficult to quantify, especially in monetary terms. Instead, the discussion covers the likely extent and severity of each impact.

What is known about CMA, including its field performance, compatibility with automotive and highway materials, environmental and health acceptability, and current and prospective production technologies and price, is reviewed in Chapter 6. Chapter 7 is a summary of the principal findings from the previous chapters and contains a discussion of important cost and use issues that must be considered before using CMA.

NOTE

1. The terms "road salt" and "salt" are used interchangeably in this report to refer to sodium chloride (NaCl), unless otherwise specified. The more common term "rock salt," which is used in the appropriating legislation for this study, technically refers to mined salt; however, both mined and solar salt (usually derived from seawater) are used for highway deicing. Other highway deicing salts, such as calcium chloride, are referred to specifically by name or chemical abbreviation.

REFERENCES

Murray, D., and U. Ernst. 1976. *An Economic Analysis of the Environmental Impact of Highway Deicing*. Report EPA-600/2-76-105. Office of Research and Development, Municipal Environmental Research Laboratory, Environmental Protection Agency, Cincinnati, Ohio.

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