

STABILIZATION OF GRANULAR BASE MATERIALS
WITH ROCK SALT

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The Michigan Department of State Highways does not depend upon admixtures to obtain serviceable base course construction. However, from past experience, experimental projects, and observations of such construction by others, we are aware of the usefulness of additives in solving certain soil and aggregate problems. In recent years, we have been interested in the possibility of upgrading aggregates by the use of sodium chloride, as applied in the form of rock salt. Therefore, in answer to the question forming the theme of this ARBA workshop, "How would you stabilize this soil?" we are presenting results of three projects with which we are familiar, in which rock salt was used to improve the performance of base course aggregates. These include two county road base construction jobs and an experimental shoulder stabilization project conducted by the Michigan Department of State Highways. The materials stabilized fall in the A-1 category [A-1-a(0) and A-1-b(0)] and are generally suitable for base construction. However, for various reasons, it was considered necessary to upgrade these materials to improve their performance. Grain size distribution of the test aggregates is shown in Figure 1. The quantity of rock salt added varied with different projects, each of which will be described separately.

Steuben County, Indiana

The value of rock salt in this project has been ably described by Clyde J. McLeland in ARBA Technical Bulletin No. 254, "Sodium Chloride Stabilization Work In Steuben County, Indiana." This project was initiated to determine under controlled construction conditions whether an inferior aggregate, containing the high fines normal to this area, could be made acceptable by treatment with rock salt. The basic aggregate used for the project met Indiana Specifications for No. 53 size. Test sections of this material were placed untreated, and treated with 1.4-percent rock salt (28 lb per ton of aggregate). Another section was placed in which native fines were added to the basic aggregate increasing the minus-200 fraction to 13.2 percent, a value normally too high for satisfactory use in this area. This mixture was treated with 1.3-percent rock salt. The difference in gradation between the basic No. 53 and the adulterated aggregates is shown in Figure 1. The plasticity index of the high fines mixture determined by testing material from a salt-treated core was 2. The normal aggregate was non-plastic.

Results of this experiment have been very favorable to the use of rock salt, both to improve the basic aggregate and to upgrade the higher fines mixture. Among the more important conclusions derived were these:

1. Inferior aggregate mixtures can be upgraded by use of rock salt as an admixture. All of the salt-treated areas were more stable and weather-resistant than were the untreated.

2. Maintenance costs were reduced substantially by use of rock salt. Even spring freezing and thawing cycles had little effect on the salt-treated bases.

3. Construction costs were lower for the salt-treated areas. Although the salt-treated base cost about 5 cents per sq yd more than the untreated, the salt base was found to require a much less expensive surface, resulting in an overall saving of more than 80 cents per sq yd.

Monroe County, Michigan

The reason for stabilizing this project was need for stronger support for a county roadway in an area of high traffic, a large part of which consisted of heavy trucks hauling from a nearby stone quarry. Seasonal high water tables had further aggravated the problem. For this project, an 8-in. compacted crushed limestone subbase, constructed of material meeting Ohio Specification B-19, was treated with 1-percent rock salt (about 20 lb per ton of aggregate) and mixed in place with a Seaman Pulvimixer. The aggregate, tested from a treated core, had a plasticity index of 6 with a gradation as shown in Figure 1. The salt-treated subbase supported a 6-in. compacted base composed of crushed limestone meeting Michigan specifications for 23A material. The whole was covered by an asphalt surface. The cost of the rock salt treatment was approximately 2-1/2 percent of the total cost of construction.

Built in 1964, this project has given excellent service to date with no signs of former breakup problems. In this case, the original aggregate was not an inferior material, but because of the heavy traffic loads improved design procedures were found to be necessary. So far, addition of rock salt has proved to be an economical and satisfactory solution to the problem. The salt-treated area remains relatively unaffected by surrounding high moisture conditions.

Alpena County, Michigan

Rock salt was one of several admixtures used by the Michigan Department of State Highways on an experimental project to determine methods for improving open-surfaced shoulders that had been causing maintenance problems. The in-place material approximated Michigan's 23A gradation with about 13 percent passing the No. 200 sieve. This material was non-plastic.

Two sections each 2 miles long by 4 ft wide were treated, one with 6 lb and the other with 12 lb of rock salt per ton of aggregate, and compacted to a depth of 6 in. The admixture was incorporated into the aggregate by means of a Seaman Duo-Stabilizer and compacted by a Seaman Duo-Compactor, all in one operation. Three passes of the equipment were necessary to complete mixing and compaction of the salt, water, and aggregate.

This project was completed in 1962 and to date the salt sections (surfaced, as were the other test areas, with a single seal coat) have served remarkably well and our periodic roughometer testing has shown them to be the smoothest riding of all the test sections installed, which included sections treated with various asphalts and with portland cement. Also, the salt sections were the easiest and cheapest to construct. Throughout this project the 6-lb per ton salt section has performed as well as the 12-lb per ton section.

Summary Remarks

Based on these projects and observations of other salt stabilization jobs, we can summarize the more important findings as follows:

1. Rock salt has proved to be a beneficial and economical method for upgrading granular base course mixtures.
2. Rock salt treatments offer no particular construction problem when applied either by plant mixing or in-place mixing on the road. Both methods give satisfactory results.
3. Density can be easily obtained with salt-treated mixtures during compaction. Tests of completed projects show much higher densities in salt-treated areas than in corresponding untreated sections. Such increases do not diminish with time.
4. High compressive strength cores can be obtained from salt-treated bases whereas no cores can be obtained from the same untreated bases using normal coring methods.

5. Best compaction results are obtained when salt-treated aggregates are placed at moisture contents 1- to 2-percent below optimum.

6. Salt-treated bases appear to be unaffected by surrounding moisture fluctuations. Whether this is due to higher density or to the formation of a waterproofing gel in the voids is not known.

7. We are aware that rock salt has been used successfully to stabilize materials having gradations finer than those reported here. Based on our experience, however, we feel that rock salt can be best used with the granular-type materials discussed here.

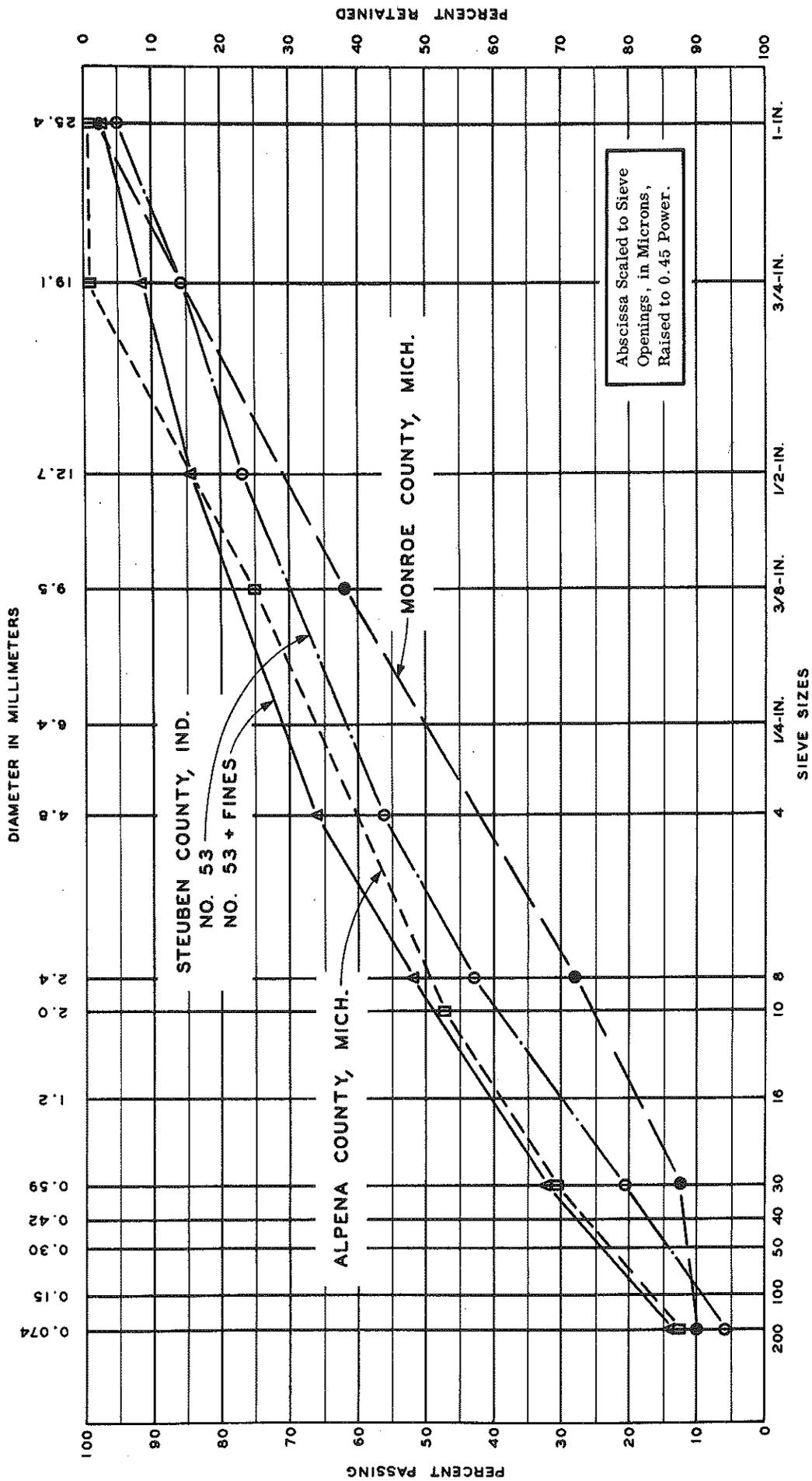


Figure 1. Aggregate grain size distribution.