

## New Experiences with the Use of Salt in Winter Road Maintenance in Germany

Dr.-Ing. H. Hanke

Road Authority of the County Hessen,  
Wilhelmstraße 10, 65191 Wiesbaden, Germany

In Germany the most used spreading material is salt. Prompted by the intensive debate about the environmental effects of salt abrasives were more and more used since about 15 years, especially on rural roads with low traffic and in urban areas. In the last years in Germany several research projects were carried out concerning the effects of spreading less salt and more abrasives regarding to traffic flow, traffic safety, maintenance costs, environment, dust bother and recycling. The conclusion of these experiences is to minimize the use of abrasive matters in winter maintenance. On roads with high and fast traffic or dangerous points the best method is spreading pre-wetted salt, on the other roads the renunciation of any spreading is mostly better than spreading abrasives. The new German winter maintenance guidelines give particular recommendations for this use of spreading materials.

### 1. INTRODUCTION

Since many years there is a great discussion about spreading materials in winter maintenance in Germany. Prompted by the intensive debate about the environmental effects of salt abrasives were more and more used since about 15 years, especially on rural roads with small traffic and in urban areas.

In several towns exists a 3-Step-Model for winter maintenance: Spreading of salt on the main roads, spreading of abrasives on the second-level-roads. On the streets of the third level there is only snow plowing, no spreading.

In average on about 40 percent of the urban streets is used salt, on about 30 percent abrasives and 30 percent are without spreading. This winter maintenance practice in towns leads to a great amount of abrasives spreaded in winter in Germany. Every year about 500.000 tons of abrasives are spreaded on urban streets.

Now after several years with this winter maintenance practice it is time to ask for the experiences with and the effects of the use of abrasives.

In the last years in Germany several research projects were carried out concerning the effects of abrasive spreading regarding to traffic flow, traffic safety, maintenance costs, environment, dust bother and recycling. Based on the results of this research projects and on the collected practical experiences with abrasive spreading are now new recommendations for winter maintenance and spreading materials possible.

### 2. NEW EXPERIENCES AND RESULTS

There are several new experiences and results of research projects which are important for the use of abrasives in winter maintenance:

#### 2.1. Expense for the abrasive spreading

When using abrasives there are needed strongly higher amounts of spreading material. To reach the abrasive effect You need at least 150 gramm per square-meter. When lying on the street the abrasives are thrown away by the vehicles so that after 300 or 400 vehicles passing the street the abrasive

spreading has no more effect. When spreading abrasive materials winter maintenance must control the streets periodical and must spread again when necessary. The result is much more amount of spreading material, personal-costs and vehicle-costs for the maintenance office.

After winter period the abrasive materials are still lying on the streets or beside the streets. It is necessary to clean the streets and collect the residual abrasives. The collected material is not suitable to spread again because it is pulverized by the traffic and it is soiled by several impurities like oil, rubber and dog droppings.

It is necessary to re-prepare the collected material or to deposit it. In Germany the new law situation does not allow to deposit the material without preparation. Therefore expensive treatments must be carried out to separate the abrasive materials from the other materials and to clean them. Because of the changed grain composition the resulting material is not suitable to be used in winter maintenance, it must be used for street building.

The greater amount of material, the necessity of spreading again and the expense for re-preparation of the material leads to a very great expense. Compared to salt spreading the whole maintenance costs per kilometer street are about 10 to 15 times higher when using abrasives.

Considering that German towns have more and more problems with financing public business it is very important to find ways to reduce winter maintenance costs. These high costs of abrasives require to reduce the abrasive spreading.

## 2.2. Environmental Effects

Abrasive spreading materials are not free of pollutants. Especially heavy metals are enclosed in abrasives and their portion is not low. Whether these metals go in solution and are harmful for the environment is not already clear. Answering this question needs more research about the influences of abrasives on ground and water.

Mainly precarious is the use of granulate and slag from blast-furnaces in winter maintenance because of the harmful pollutants, the use of gravel of natural stones is much better.

Another serious problem when using abrasives in winter maintenance is the dust problem. A research project carried out in Berlin has shown that the abrasive materials are pulverized by traffic. A part of the material crumbles into such minute dust that it

can go in the respiratory ducts and into the lungs. This can be very harmful for the lungs and lead to pneumoconiosis, the more so as pollutants like rubber and oil are combined with the dust. The greatest problem with dust is when the abrasive materials are lying for a long time on the streets and when sweeping the streets.

Also important for the environment are the problems with the re-preparation of the abrasive spreading material. All today known treatments for re-preparation need much energy and water, and residual materials must still be deposited; Air and water are bothered. An actual research project in Germany is working out a total ecological balance between abrasive and salt spreading; this balance is not positive.

## 2.3. Effects on Traffic Flow and Traffic Safety

The effect of abrasive spreading on the power transmission between tire and pavement is not very great. Salt spreading leads to a four or five times higher value of power transmission, abrasive spreading raises the value only by 20 percent.

In addition the abrasives are thrown away by the vehicles when lying on the street so that after 300 or 400 vehicles passing the street the abrasive spreading has no more effect.

A research project has analyzed driver behaviour, traffic flow and traffic safety in urban areas in winter. When using abrasives drivers are not able to recognize the effect of the abrasive spreading and the difference to salt spreading. They increase their speed after spreading, more than the effect of the abrasive raises the power transmission between tire and pavement. So after the abrasive spreading the stopping distance is longer than before. Accident analysis shows that the accident risk on streets with abrasive spreading is higher than on streets with salt spreading or no spreading. The greatest accident risk when abrasive spreading is not during the snowfall. Especially the days after snowfall show higher accident risks on these streets, because slipperiness is still there, the abrasive materials are thrown away and the drivers increase their speed.

The research project also showed that in comparison to the abrasive spreading the salt spreading leads to a much better traffic flow and increases traffic safety evident. On the residential streets in the third level of winter maintenance where no spreading took place the traffic safety was

also guaranteed because there is very low traffic and the drives are very careful.

Only in this areas where a great amount of snow falls in winter and where it is possible to have snow-covered road surfaces for a longer time it is advantageous to spread abrasive materials on the snow-covered streets. Here the abrasive spreading leads to a better power transmission and the drivers do not increase their speed because of the snow. Abrasive spreading is here also only possible on streets with low traffic where abrasives are not thrown away in short time.

#### 2.4. Implications of law and jurisdiction

In Germany the municipality is responsible for winter maintenance on the streets. The laws regulate that there must be spreading in winter on all roads with high traffic or dangerous points. A new court decision says that on these streets it is not sufficient to spread abrasive materials because they do not increase the power transmission for an adequate time.

Coincident the new waste law situation does not allow to deposit the abrasive material after collection without preparation. The law requires as highest maxim the total avoidance of any waste which leads to the avoidance of abrasive spreading in winter maintenance.

### 3. CONCLUSIONS FOR THE USE OF SPREADING MATERIALS

The described experiences and results concerning abrasive materials in winter maintenance lead to the following summary:

- The abrasive spreading leads to very high maintenance costs.
- The effect on traffic flow and traffic safety is very small, the accident risk increases.
- The environmental effects of abrasives are harmful, especially the dust bother in towns
- There is a great problem with recycling of the collected material after winter period
- New court decisions and laws lead to problems when using abrasives

This leads to the following recommendations for the use of abrasives in winter maintenance in Germany:

- The use of abrasives in winter maintenance must be minimized.
- On the streets where is a legal liability of spreading salt must be used. This means main roads, roads with high traffic, roads with special traffic like buses, streets to police-stations, fire-brigades or hospitals, roads with special dangerous points like bridges or gradients
- On the other streets in urban areas normally it is sufficient to spread nothing, only plowing.
- Only in areas with great amount of snowfalls and low temperature in winter abrasives should be used on snow-covered road surfaces on streets with low traffic. The climatic situation in Germany is so that these roads are only a very small part of the urban roads in Germany.

These new recommendations for the use of spreading materials in urban winter maintenance means not spreading more salt, but renunciation of abrasive materials and any spreading on a very great part of roads.

The new German winter maintenance guidelines from 1997 are based on these results and these recommendations.

This winter maintenance strategy leads to an optimal compromise between maintenance costs, traffic flow, traffic safety and environmental control.

### 4. RECOMMENDATIONS FOR SALT USING

Salt is the best and the only suitable spreading material and it must be used on most of the urban and rural roads. Nevertheless it is the aim of winter maintenance to minimize the amounts of salt spreaded. There are several measures to reach this aim.

The use of *Pre-wetted salt* has become normal standard in German Winter Maintenance meanwhile. This method leads to reduced amounts of salt and at the same time to a better and earlier effect of the winter maintenance. Therefore the use of pre-wetted salt was very helpful for the public discussion about the environmental problems of salting.

With pre-wetted salt and *good weather forecasts* (Street Weather Information Systems) today it is possible again to spread salt before it is getting icy



and to reduce a great number of heavy accidents in winter time.

When using *modern and good snowplows, especially combined with brushes*, it is possible to clean the street very good from snow and ice and to reduce the amount of salt, so that today an optimal compromise between maintenance costs, traffic flow, traffic safety and environmental control is possible when using salt in winter maintenance.

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