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# IMPROVING WINTER SERVICE ON BICYCLE PATHS

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## Summary

Numerous municipalities have started a transformation of the transport network in recent years and decades and have been able to achieve considerable changes in the modal split within a reasonable period of time. For example, the share of cycling in Karlsruhe could be increased from 16 % in 2002 to 25 % in 2012 to currently more than 30 %. But cyclists are much more exposed to weather conditions than public transport passengers and car users, especially in winter time. Latest studies show clearly the increase of bike accidents under wintry conditions.

The Federal Ministry for Digital and Transport (BMDV), represented by the Federal Highway Research Institute (BAST), has commissioned the Saarbrücken University of Applied Sciences (htw saar) and the Karlsruhe University of Applied Sciences (HKA) with a research project on the sustainable promotion of cycling in winter through optimised winter road maintenance.

The recommendations of this ongoing research project will be based on differentiated cost-benefit analysis of different measures, which may include not only the conception and implementation of appropriate winter service treatments but also aspects of planning and design of bicycle facilities. The realisation of the recommendations and requirements of this

project will open the possibility to encourage bicycle traffic as a whole year type of transport, an important step towards a climate friendly mobility.

### **Winter Service on bicycle paths**

According to the definitions of the Road and Transportation Research Association (FGSV) [1], winter road maintenance means "the totality of measures taken by the road authority to maintain and facilitate traffic and to ensure traffic safety in winter weather conditions". It is undisputed that the primary objective is to ensure traffic safety. In addition, maintaining the flow of traffic is of great importance. This is also reflected in the fact that mobility is nowadays an important location factor; smooth traffic is an essential prerequisite for the sustainable development of a functioning economy and society. In addition, there is an increasing demand for the roads to be operated according to the rules, but in an economic manner.

By increasing importance of the bicycle as a means of transport, it becomes more and more the focus of interest by public administration and on political level. Due to the increase in bicycle traffic, not only attention is being paid to winter road maintenance, but also to bicycle traffic infrastructure and their users. Cycling is becoming a part of everyday life in many cities, but it has become apparent that cycling is not promoted enough in winter due to various problems and influences.

There are two types of gritting materials that are used in winter maintenance on bike paths: abrasive materials or de-icing materials. In Germany in several municipalities, it is not allowed to spread de-icing materials on bike paths or walkways.

Abrasive materials mostly consist of natural materials such as sands, grits or foamed clay. With a snow layer, these materials can form a bond with the snow and ice, thus increasing the grip in winter conditions. But the disadvantages of this type of gritting is that they have little effect on icy and

slippery conditions and must be removed frequently after thawing. Cyclists are complaining the use of abrasive materials on bike paths because of the sharp edged materials, which can damage the tyre and the danger of slipping in curves or in case of harder breaking.

The use of de-icing materials like salt and brine prevent slippery conditions on bicycle paths and other traffic areas in winter conditions. Chlorides such as sodium chloride (NaCl), calcium chloride (CaCl<sub>2</sub>) and magnesium chloride (MgCl<sub>2</sub>) are particularly suitable for this purpose. The most common form of application for winter service in Germany is sodium chloride because of mild climate conditions.

Salt can theoretically also be spread in dry form. However, it should be applied pre-wetted or in a completely liquid form (brine) to avoid loss during spreading, to ensure a good spreading pattern, and to optimize effectiveness. The designation of the spreading material is based on the mass ratio of dry salt to salt solution (FS 30 corresponds to 30 % salt solution, 70 % dry salt). Compared to pre-wetted salt, brine (FS 100) offers a more uniform distribution and longer lying time. Brine spreading is useful when roadway temperatures are not too low (down to approx. -6°C) and large amounts of precipitation and temperature drops are not expected. Pre-Salting can prevent snow or ice from sticking to the surface during snowfall or freezing rain. Brine is normally spreaded by special nozzle constructions or spray bars. When spreading via a spreading disc, special attention must be paid to a uniform distribution.

The question is, what kind of treatment should be recommended on bike facilities (brine, pre-wetted salt or dry salt), because the circumstances on bike paths are different compared to road conditions with car traffic and higher driven velocities.

Along with the choice and use of gritting materials, the implementation of winter maintenance on bicycle paths represents the second important

component for bicycle-friendly use of bicycle facilities in winter and wintry conditions.

This winter maintenance consists of clearing the road surface and bike lanes in case of snowfall and spreading gritting materials, both preventively and immediately after clearing as an additional safety measure to avoid slippery conditions.

Due to different widths, changing surfaces, obstacles such as barriers and poles, problems often arise in the implementation of winter maintenance, especially on bike paths. For this reason, more and more so called narrow gauge vehicles are being used for winter maintenance on cycle paths. These are both smaller and more maneuverable and are therefore ideally suitable for smaller widths, narrow places and tight curves.

As a desired goal of proper winter road clearance on bicycle routes, snow removal, which mostly uncovers the trafficked area, has become



*Fig. 1 – Difficult conditions on bicycle path for winter service because of infrastructure installations [picture source Cypra, 2021]*

established in Germany. The aim is to remove all snow and ice from the surface of cycling routes permanently. The decisive factor for this objective is the minimization of the risk of accidents for cyclists, but also an economically, politically and environmentally justifiable clearing of these cycling routes. Due to the increasing number of cyclists and the change in mobility in many cities and municipalities, cycle paths and especially everyday cycle routes are becoming more and more important. The year-round use of bicycles is highly dependent on optimized winter road maintenance on important bicycle routes.

Depending on the height of snow, best results for snow removal is achieved by using a sweeping broom. Plows are required for significantly higher snow amounts and, in combination, can significantly improve the result of clearing a surface of snow and ice as the first clearing operation before clearing with a sweeping broom.



*Fig. 2 - Narrow gauge vehicle with front sweeping broom and spreader for pre-wetted salt treatment [picture source Cypra, 2021]*

Narrow gauge vehicles are more and more used nowadays in winter service on cycle paths in many cities. The vehicles differ depending on the manufacturer, brand and model in the dimensions, weight, steering or drive technology. All these small vehicles can be equipped with a front and a rear attachment. The front attachment can vary between a plow and a broom, for example, depending on the application and the amount of snow. The rear attachment is a spreader with appropriate spreading material and a distribution device such as a spreader disc, spray bar, etc.

The picture shows a narrow gauge vehicle in operation on a cycle path with a sweeper broom and a spreader for pre-wetted salt. The result of snow removal behind the winter maintenance vehicle is clearly visible. The objective of creating a cycling-friendly and generally cycling compatible surface on the cycle paths is fulfilled by the use of these narrow gauge vehicles.

### **Winter bicycle network in major German cities**

In many major German cities, there has been an increased focus on cycling and the expansion of cycling infrastructure in recent years. Climate protection, improved ecological balance and the promotion of personal health have led to a steady increase in the number of cyclists as a percentage of total traffic. This also affects the use of cycling routes in winter. Several large German cities are joining the trend and promoting cycling all year round. This is made possible by ensuring winter road maintenance on certain bike routes. The winter bicycle network is treated with a level of service like road network. One of the challenges is, how to communicate to cyclists, that a winter bicycle network exists and which parts of the cycling facilities belongs to the winter bicycle network. One of the best ways is a visualisation on a map [3], like in Karlsruhe published in internet.

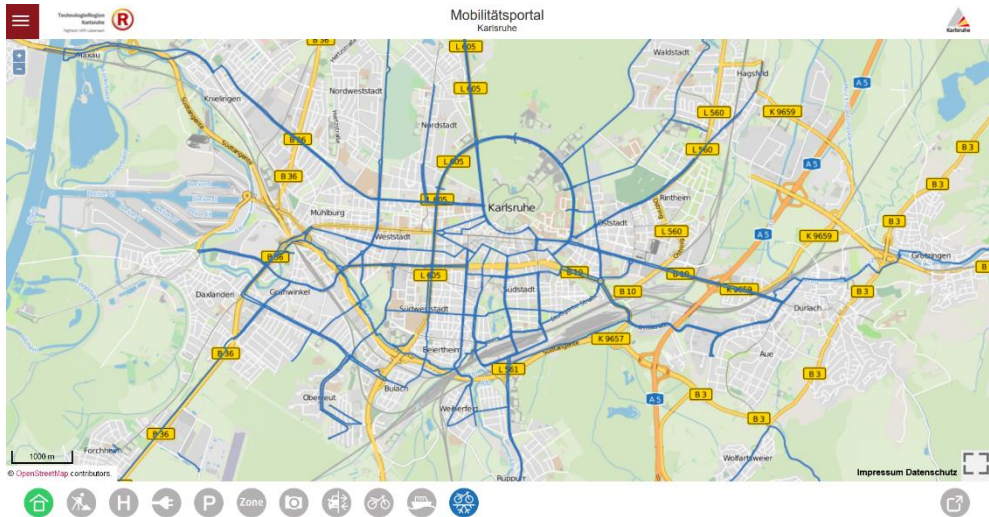


Fig. 3 - Winter bicycle network in city of Karlsruhe [3]

However, several cities and municipalities in Germany do not have a defined winter bicycle network or an appropriate communication is missing.

### **Studies of winter service in municipalities**

The winter road maintenance on cycle paths in the three municipalities of Karlsruhe, Cologne and Munich was examined as an example. In addition to winter service practice and the clearing and gritting technology used, the system of designated cycle routes was also examined.

In order to investigate the navigability of cycle path connections on site in winter weather, several routes were cycled in each municipality. The routes were modelled on typical everyday routes and led from the suburbs or outer city districts to the city centre, mostly on alternating bicycle facilities designs and sometimes across municipal boundaries. The routes were recorded with a camera and GPS-tracking. The classified trafficability could then be compared with the winter road maintenance data. It became clear where problems lie in practice and how this affects the possibility for cyclists (see Figure 4).





*Fig. 4 - Snow bulge at crossing section [picture source Wiesler, 2022]*

In addition, it was possible to determine how long good passability can be guaranteed with the clearing and gritting technology used, depending on the weather. In some cases, routes were travelled several times in one day.

To analyse the optimised winter road maintenance on cycle paths, several winter road maintenance operations in the municipalities were documented. For this purpose, winter service vehicles were equipped with cameras and their operations were filmed. These video recordings provide information about problem spots and areas as well as avoidable time losses due to obstacles such as poles or excessively narrow passage widths. Recommendations for improved and optimised winter road maintenance will be developed.

## **Survey of cyclists from the user perspective**

Within the framework of a survey with almost 3,000 participants, it was investigated, what experiences cyclists have had in winter and how they evaluate certain typically occurring road conditions of the cycling infrastructure in winter.

Especially for experienced cyclists, bad weather conditions are hardly an obstacle. On the other hand, unreliable or poorly executed winter maintenance on cycle routes can make cyclists feel considerably restricted. Particularly annoying and dangerous are snow bulges on bicycle paths.

Slippery ice is also often seen as a reason for preferring not to cycle. The majority is willing to do without a particularly large cycling network in winter as long as there are designated and reliably maintained routes that can be cycled safely in all weather conditions.

However, offers such as a dedicated winter cycle network or defect indicators are still often unknown even to experienced cyclists.

Furthermore, the aspect of route lighting plays a major role in many cyclists' sense of safety in winter.

## **Conclusions**

Due to the existing problems and difficulties in different areas, differentiated recommendations and requirements will be developed for an optimised winter service on bicycle routes in the future. These recommendations will be evaluated and finally assessed based on a cost-benefit analysis. Based on this analysis, cities and municipalities as well as states can decide which of the proposed recommendations and requirements should be implemented.

The realisation of the recommendations and requirements of this project opens the possibility to encourage bicycle traffic as a whole year type of transport, an important step towards a climate friendly mobility.

## References

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