DEFENDING STREET TREES AGAINST ROAD SALT IN DENMARK[1]

by Niels Hvass

In Denmark, motoring developed strongly after 1950 and reached its climax in the late seventies. At the same time the level of public service went up immensely because of the growing prosperity. Prior to 1960 control of winter's slippery roads was entirely carried out by using sand, but then road salt was introduced. About 1980 the use reached its climax at the rate of 400,000 tons of salt applied per year. City and municipal gardeners, supported by private individuals concerned about the environment, protested against the immense salt pollution, but at first without results.

In Denmark, the urban forester, unfortunately, is placed under the city engineer. The task for the city and road engineer is to create a technically well-acting town, and road salt fits perfectly well into this plan. Salt is an excellent remedy against glaze and ice, and compared with sand, which lays alongside the road and stops up gutters, salt is efficient for melting snow. The greater the use of salt, the higher the level of motoring safety. But today most people realize that salt disappears into the gutters and pollutes the streams. The road shoulders became gradually more and more poisoned, leaving the trees in a hopeless situation.

Climate. The Danish mean winter temperature is near 0°C, which is the freezing point for water. The temperature typically changes within a few days from freezing to frost-free and the weather from rain to snow to sunny. There is constant risk for unexpected slippery roads. Days and nights with temporary frost vary from 30 to 90 per year, while days and nights with below freezing vary from 1 to 50. It is, therefore, understandable that our winter climate is rather unpredictable, and it is difficult to plan for control of slippery roads.

The quick changes in the weather demand a system that schedules lorries to turn out immediately to control the situation of ice on roads or roads that are slippery from snow fall. Road salt unfortunately fits well here; it is quick and efficient.

Side effects are recognized. Toward the end of the seventies there was, luckily, a realization in the state road department of the fact that the protests against the unwanted side effects from road salt were well founded. Two comprehensive reports on winter maintenance of roads were sent out, and protocols for spreading salt were established. New machines were developed for spreading salt. The new machines give the right dosage and limit the spread of salt. The reports called attention to the fact that less busy roads should not be treated with salt.

The authorities knew by then about the side effects on roadside trees: that they were killed. For the road engineer, another serious problem arose. The salt damaged nearly all types of road surfaces because the salt water penetrates everywhere and causes deep cracks and gaps. Concrete bridges that were scheduled to last for 50 years

Fig. 1. Winter situation in Denmark. It is seldom chaotic because of heavy snowfall. However, the fast changes between thaw and frost, rain and snow make it difficult to control the road against ice slipperiness.

1. Presented at the annual conference of the International Society of Arboriculture in Quebec City, Canada in August 1984.

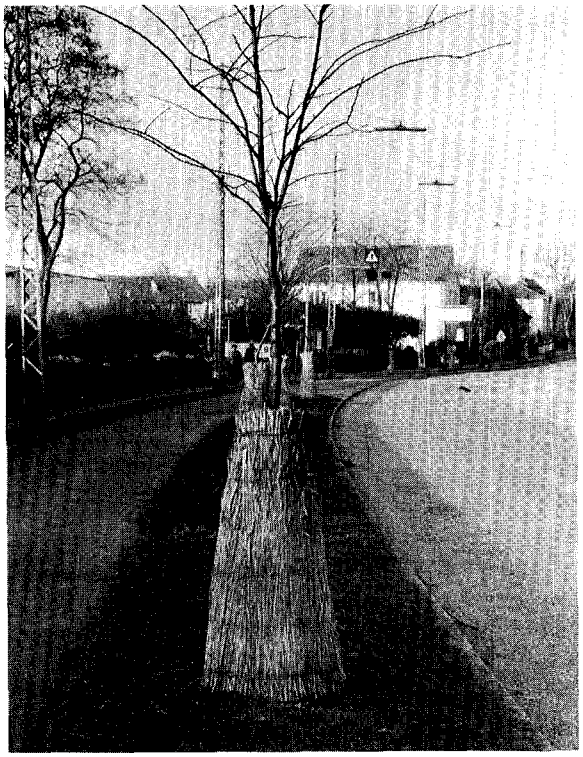

Fig. 2. This straw mat is useless. We call it a stem warmer.

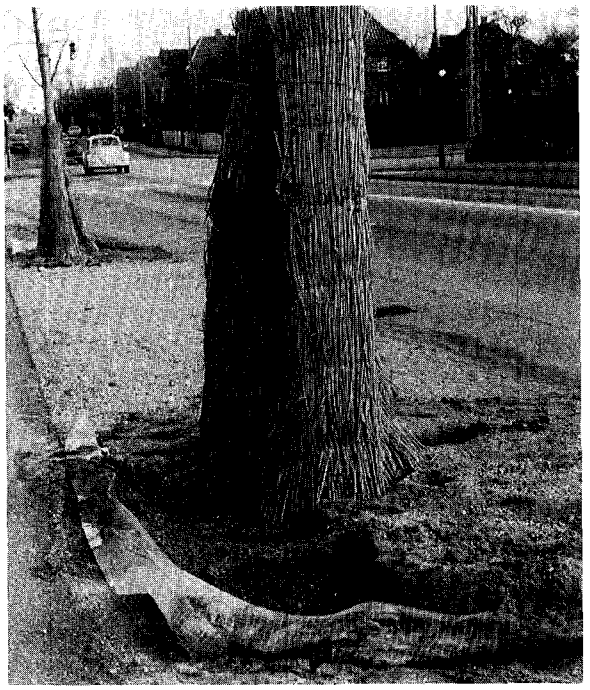

Fig. 3. Stem warmer again. The vertical sides of this planting hole are covered with a plastic sheet to avoid salt penetration from the polluted side (shoulder) into the clean planting soil.

Fig. 4. A typical situation on a major road. From right to left: road, curb with drain, growing site (shoulder), bicycle track, curb with drain, sidewalk. In this experiment a heavy plastic poncho is tied to the tree and nailed to the ground. This protection is meant to lead water away from the growing area.

Fig. 5. This is the same road as Fig. 4. So far, the system with straw mats is the one most recommended. It gives good protection against salt and it is reasonably aesthetic. New models will have a plastic liner which will lead the water over the curb into the gutter.

had to be replaced after 20 years. Repair of roads and bridges was carried out during the summer. Some roads were hardly passable during the summer because of the damages caused by salt used during the winter.

The economic recession started seriously in Denmark in 1981. Most people realized that the country as a whole had lived beyond its means. We simply could not allow ourselves to maintain the high level of public service by increasing foreign loans. The decrease in use of salt was caused not only by the severe side effects but also by economic considerations. We are now using 200,000 tons per year, down from the earlier 400,000 tons.

Traffic safety. There is a difference of opinion within the research community concerning the degree of traffic safety obtained from the use of salt. It would be natural to assume that safety was highest when the most salt was used, but the statistics do not prove this to be so. Road salting was never 100% efficient. Some parts of the roads were omitted. In other cases the glaze came tremendously fast. The spoiled and inattentive motorist fell into the trap and had an accident. The spoiled motorist overly trusted the efficiency of the road salt and therefore it gave him a false impression of safety. Currently, with the lower level of usage, it has been necessary to inform the motorists about the road situation through the radio news.

Today many people conclude that the high level of salt usage during the winter is less desirable as it causes an expensive level of road repairs during the summer. They would rather conform to nature, drive a little slower, and be a little more uncomfortable during the winter. Sand is again used more often. The clicks from the sand against metal are said constantly to remind the driver that the road might be slippery.

Protect the tree. The situation for road trees seems better now. Although many trees have

Fig. 6. A slightly elevated planting area. Nearly all the salt water is led to the drain.

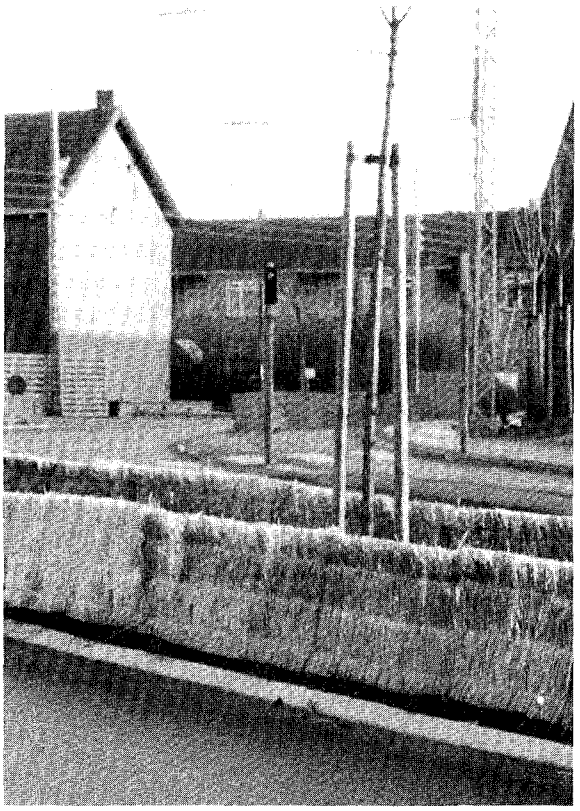

Fig. 7. Complete protection for trees and shrubs in an island in the street.

been killed, more trees have been planted or will be planted. It is not likely that we'll ever discontinue completely the use of road salt. Therefore, it is necessary to protect the newly planted trees to prevent road salt from getting to their roots. Some Danish city gardeners understand this problem and several more or less promising solutions have been introduced.

Old trees need protection as well, but this is difficult to rectify systematically as the trees are planted in various ways. Root feeding during the summer or watering through root ventilation systems together with screening during the winter is used to some extent. Treatments for new trees are especially important. Protection of these trees against road salt has a positive psychological effect on the city gardener's crew. Nothing else is as futile as having to replant trees over and over.

There are many ways of improving the conditions for street trees. Most important is planting them at an elevated level so that the poisoned surface water runs away from the planting site. Heightened plant beds (20-40 cm) with waterproof sides towards the road and sidewalk are recommended. It is even better if the trunks of the trees are protected with straw mats during the winter. These straw mats are today well accepted by the public aesthetically, even though many of them look rather "weary" at the end of the winter.

It is rather expensive to establish elevated plant beds containing approximately 2 cubic meters of clean planting soil. It would break the municipal budgets if all tree planting had to be carried out this way. However, it is often better to plant fewer trees with a safe future than more trees with hardly any future. It is possible to plant the road shoulders without using elevated plant beds if the curbs and drain are constructed to lead the salty water away from the trees. If these conditions cannot be attained, it would be better to refrain from planting.

The protective measures have two purposes: to keep the salt from accumulating on the plant bed, and to lead salty slush from vehicles and sweepers into the drain. Copenhagen city authorities are right now in a testing phase, and the photos show some of the tests. The ideas are tested both for efficiency and to estimate the aesthetic impression as well. Straw mats approximately 60 cm high with a plastic liner sewn on seem at present most promising. The plastic liner is inside the mat and is meant to ensure that water runs to the outside of the curbstone.

Experiment with salt. Private funds have been used for research on the newly planted trees' reaction to the chemicals applied for melting snow. In one test, a typical Danish soil (sandy loam; approximately 2 hectares) has been planted with *Betula, Quercus, Tilia,* and *Ulmus* 2 to 4 meters tall. Two areas are treated with NaCl, one area is treated with $Ca(NO_3)_2$, and one control area is untreated. Each of these four areas includes two levels of watering and a control (no watering). The area will be salted for three winters and watered for three summers. The experiment will end in 1984.

Salt-resistant trees. Several have said that gardeners ought to "invent" a salt-resistant tree since road salt apparently is here to stay. Salt-resistant trees already grow on salt steppes and in mangrove forests. The idea is promising but probably Utopian because no tree in our climate is resistant. We know of problems with diseases and winter damage on trees that have been imported from other climatic zones.

Our experiment with salt and the experiments in other countries can probably lead to discovery of some trees that are more resistant than others in certain types of soil, but we should not expect to find trees that will grow well with a constant salt application.

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