SPREADING-AGENT-MANAGEMENT SYSTEM AS PART OF AN ALL-EMBRACING WINTER MAINTENANCE MANAGEMENT SYSTEM

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ABSTRACT

A modern Winter Maintenance Management System links all data and information needed for planning and executing winter maintenance operations. This is the basis for an effective preparation and controlling of the operations, but also for its documentation and analysis.

Parts of this all-embracing Winter Maintenance Management System are not only road network data, climatic data and road condition data but also a spreading agent management system (SAMS). This report describes the all-embracing and strategic spreading agent management system developed in the German state of Saarland. Specified are the parts of this system and its benefit in the practical use. The intensive implementation of this system gives great potentials for optimizing winter maintenance.

KEYWORDS

WINTER MAINTENANCE MANAGEMENT SYSTEM / SPREADING AGENT MANAGEMENT SYSTEM / SPREADING AGENT / SALT / SALT STORAGE / STOCKS

1. INTRODUCTION

Task of winter maintenance is to fight against snow and ice on the roads to ensure safe and liquid traffic. But also there is the need to fulfil economic and ecologic requirements.

To reach this aim a lot of things are needed: Winter Maintenance has to be planned early and good, the operation must be just-in-time and quickly, and the operation done must be effective. This is very complicated and many influences are to be considered.

A great support for the winter maintenance planning and operation can be a Winter Maintenance Management System (WMMS) using the possibilities of modern communication and data processing. This system links all data and information needed for planning and executing winter maintenance operations. This is the basis for an effective preparation and controlling of the operations, but also for its documentation and analysis.

In the German State of Saarland such a WMMS has been developed in the last years as an all-embracing system. Parts of this system are not only road network data, climatic data, road condition data and winter maintenance operation data but also a Spreading Agent Management System (SAMS).

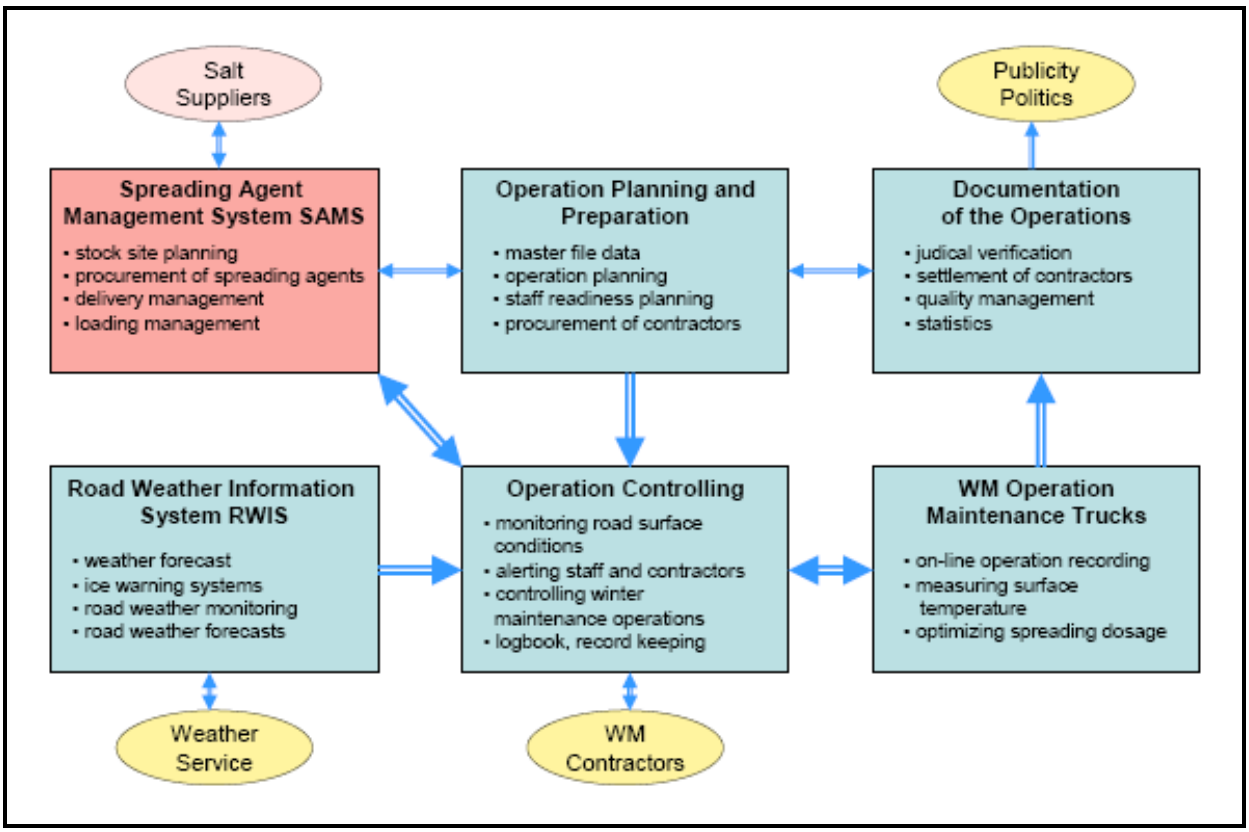

Figure 1 – Winter Maintenance Management System in Saarland

The spreading agent management covers the planning of the stock sites, the procurement of the spreading agents, the stocking, the delivery management and the loading techniques. The system allows digital billing and statistics.

2. STOCK SITE PLANNING

Maintenance in Germany is done centrally from Maintenance Units (MU) distributed over the whole network. Each MU is responsible for a network of approximately 80 km motorways or 300 km secondary roads (rural roads), depending on the density of the road network more or less. In the state of Saarland there were built units responsible at the same time for both types of roads motorways and rural roads in the year 2007. The sectioning of the whole network to the units is done by minimizing the distances from the units to its road sections.

For winter maintenance additional to the units there is a need for salt stocks in the network. These stocks are necessary for additional loading in operation when the truck has spread all its content. Also it is possible that some of the trucks, especially contractors, start their route from the stock site. Aim is to save travel costs and time for the trucks for re-loading and going in operation.

When planning a stock site or when checking the efficiency of existing sites it is necessary first to make a route planning for the whole network. On the basis of optimized winter maintenance routes it is possible to determine the optimal site of stocks or to evaluate existing stock sites by minimizing route lengths and re-loading distances for the trucks starting or loading in this area. Often these optimum sites are at the edge of the network

far from the central unit. So it is beneficial when the stock is used also for the neighbour units.

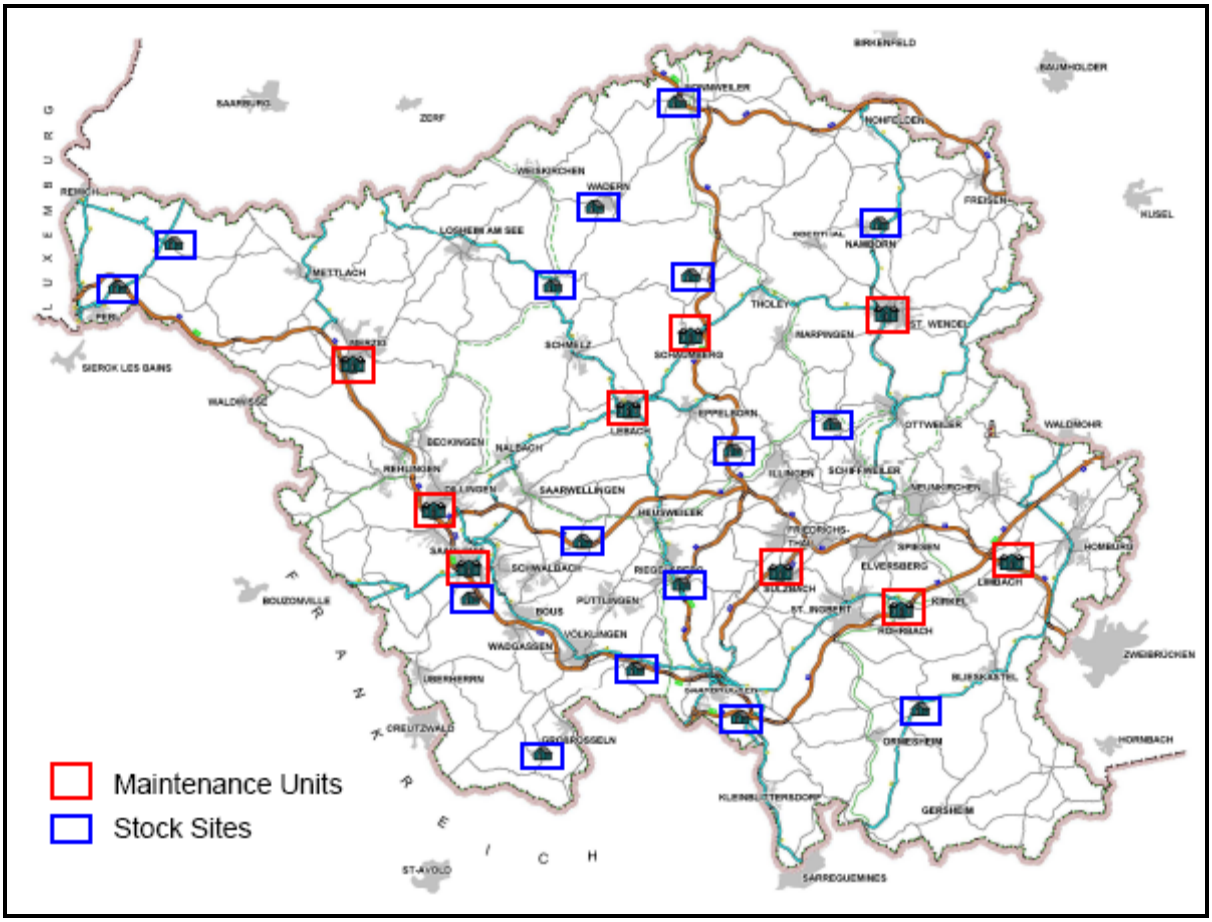

Figure 2 – Sites of the existing Maintenance Units and Stock Sites

An additional advantage is possible when the stocks are also used for other maintenance operators like cities and villages nearby. So the costs of the stocks can be participated to all users.

Before building a new stock site or before choosing the right site it is the best to carry out a cost-benefit analysis. In this analysis the benefits are calculated not only by saved travel costs and time for the trucks, but also by the economical cost saving caused by better and earlier winter maintenance, this means saved accident costs and road user costs. These are determined from special research studies [1, 2, 16, 19].

Figure 2 shows the network of Saarland State with his MU´s und stock sites before 2007. There were separated MU´s and stock sites for motorways and for rural roads. The optimizing of route network and route planning together with the cost-benefit analysis lead to the closure of two MU´s and four stock sites. One new stock site was planned (see figure 3).

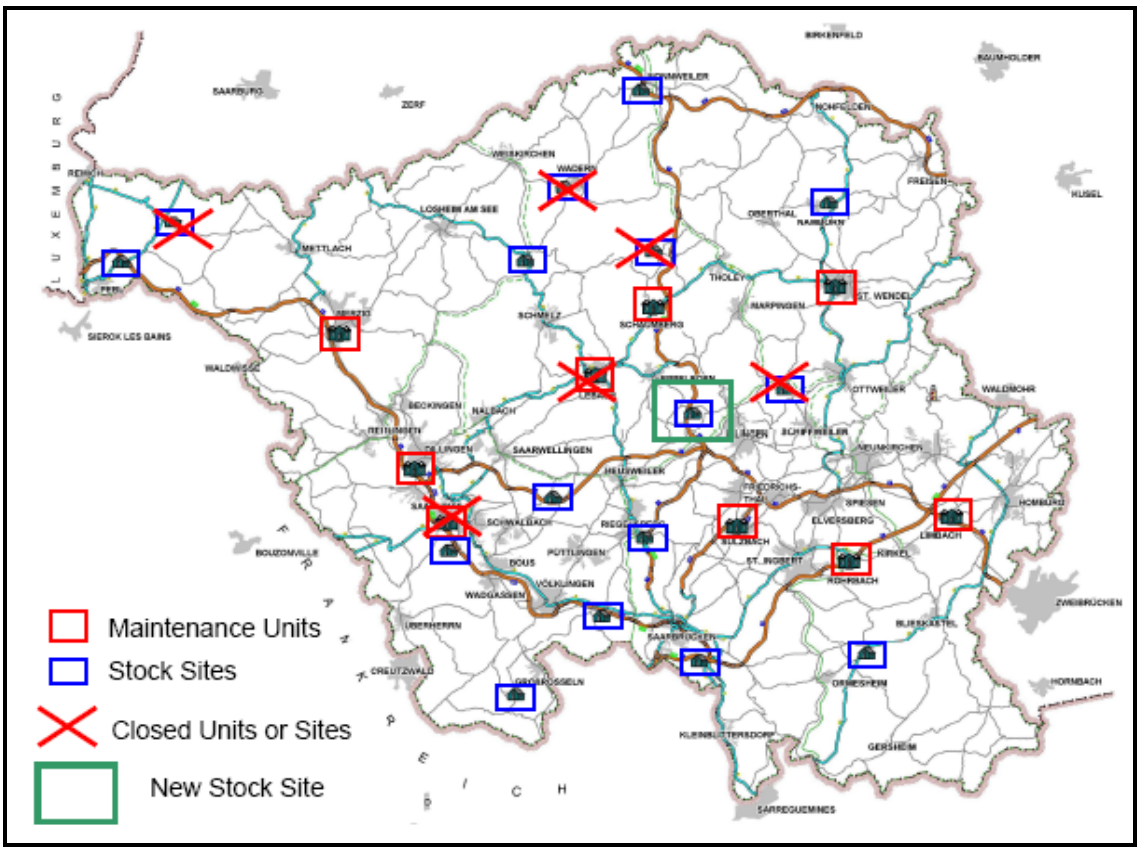

Figure 3 – Results of the cost-benefits analysis of the MU´s and stock sites

3. DETERMINATION OF THE STOCK AMOUNT

When building a new spreading agent stock it is necessary to determine the needed amount of spreading agents to stock there. It must be enough for enduring extreme weather periods but it should be minimized because of the costs for stocking.

In the old German winter maintenance guidelines there was recommended a stock amount of half the yearly consumption. But this is not the right way to determine the needed amount. It should be determined by the daily consumption in extreme weather situations.

So the new guidelines recommend the following method: For each salt stock (also in the central unit) it should be calculated the needed amount for one complete spreading covering the whole dedicated network. Then this has to be multiplied by the maximum number of turns per day under extreme conditions. This results in the maximum daily amount [5].

Referring to the maximum delivery time for new salt it is possible to determine the needed stock capacity. In Germany the delivery time normally is set to maximum 72 hours (3 days). Considering a buffer of 2 additional days for certainty and ordering the new salt there has to be a stocking capacity of 5 times of the maximum daily consumption. This can be more or less than half of yearly consumption.

For stocks in MU´s this calculation leads to capacities of approximately 1000 tons depending on the road network, for separate salt stocks it leads to 100 up to 800 tons depending on the trucks to be loaded there. The capacity of brine for pre-wetting has to be adequate to the dry salt capacity.

4. STOCK KEEPING

To minimize the stocking capacity but also having always enough salt in the stockpile it is necessary to control the actual filling amounts and to order new deliveries just in time. But the problem is that the stockpiles are often far away from the central unit and not manned. And when different users are loading in the stockpiles there is often no responsibility or a lack of information concerning the filling amounts.

Therefore in a systematic Spreading Agent Management System it is necessary to monitor the actual filling standards from the central unit. This can be done by automatic weighing systems or ultrasound sensors in silos or by video monitoring in salt barns. Figure 4 shows the video system used in Saarland. The video picture is calibrated so that it is possible to calculate the salt amount with computer referring to the picture. This calculation is accurate enough for the task of salt monitoring.

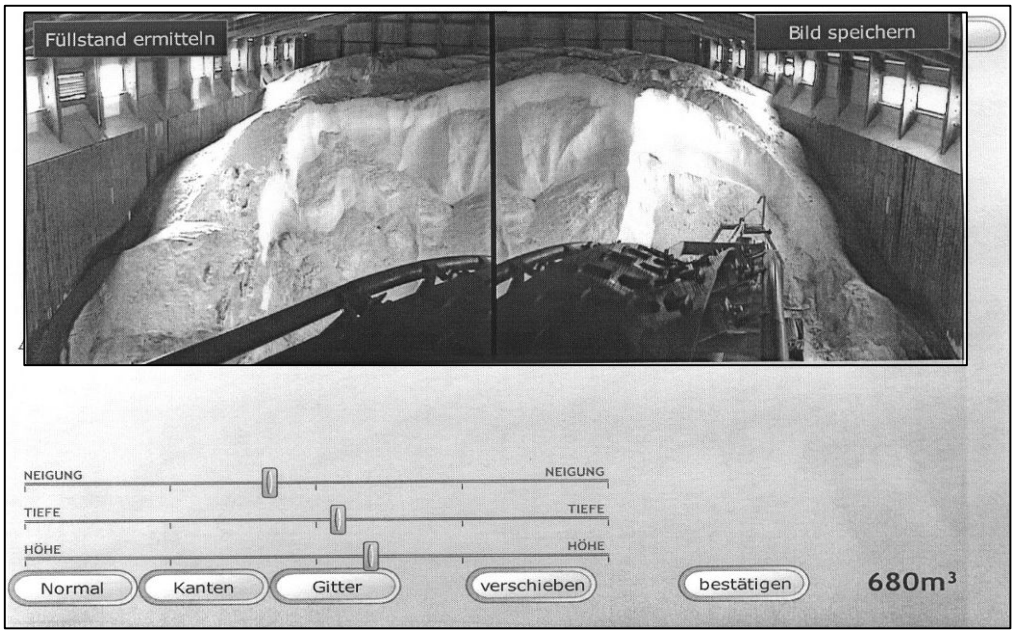

Figure 4 – Video picture of the salt barn with amount calculation

These pictures can be checked from the central units and digital stored any time wanted. In the SAMS system the filling amounts are automatically calculated and reported. They can be shown in a map or a table giving the information about the absolute and the relative amount (percentage of capacity) in each stockpile (see figure 5).

In the SAMS system it is possible to define special filling percentages for each stockpile for alarming. If this filling amount falls below this defined percentage an automatic alarm is generated from the system and a new order of salt is automatic suggested from the system to the supervisor. He needs only to check this order and can submit it by the system directly to the salt supplier by the SAMS system via internet. It is possible that also the salt supplier can see the filling status and prepare the delivery very early.

The whole orders and the delivery status can be monitored in the system so that the customer can check the status at anytime. Also the whole billing can be done by this system.

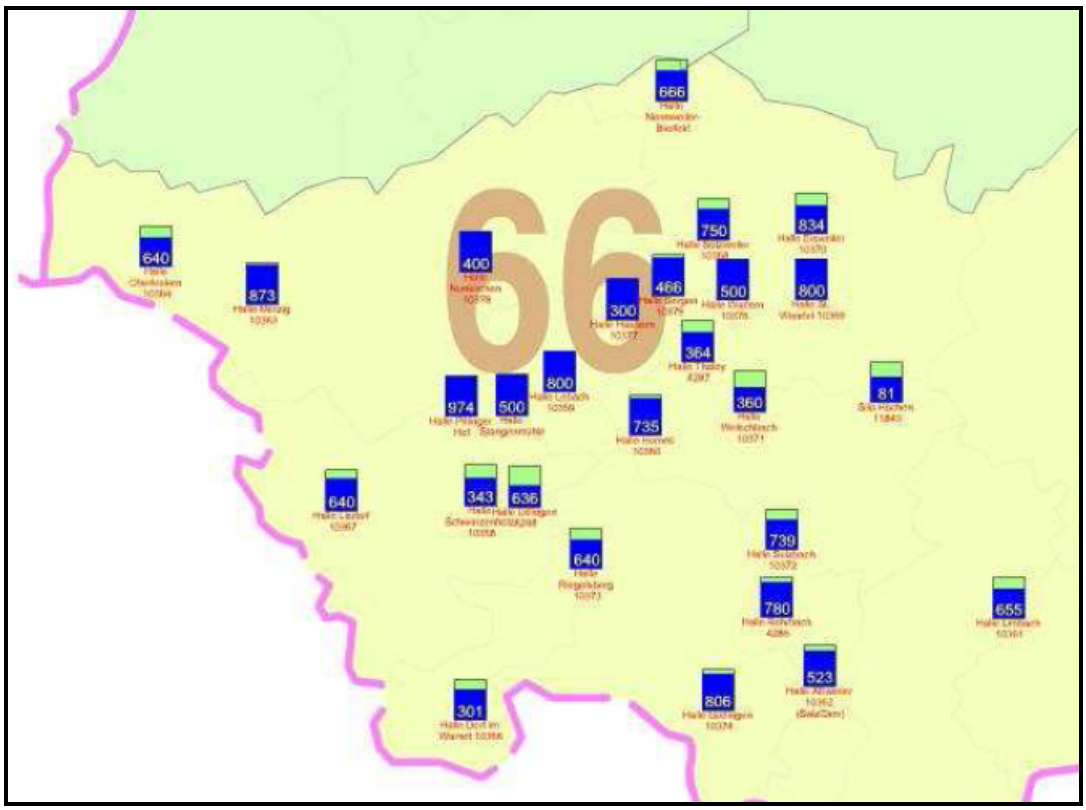

Figure 5 – Filling amounts overview in the SAMS system

So the system leads not only to an optimized use of the stocks and to optimized filling amounts but also saves a lot of time and costs for the ordering and delivery procedures.

5. LOADING TECHNIQUES

In the winter maintenance operation time is very important. Saving time leads not only to smaller costs for the vehicle and the personal, but also to more economical effort. This because on a spread road accident and road user costs are strong reduced [16]. Therefore faster operation leads to more traffic safety and less economical costs.

Figure 6 – Old loading technique per salt belt

Considering this connection it is very important to save time when re-loading winter maintenance trucks in operation. So an actual research project in Germany deals with the optimizing of the loading techniques.

In former times in Germany the most favourite storing technique was the use of salt barns and for the loading a salt belt was used (figure 6). But this technique shows a very bad performance because it needs more than 15 minutes for loading a normal truck. Besides this the work safety for the personal is not the best.

Much faster is the loading from a silo which needs less than 5 minutes. But the silos used in the past have not enough capacity. And it is not possible to build everywhere high silos especially when a salt barn is there.

So there are 3 opportunities to improve the loading speed under these conditions:

- Building a couple of silos (fig. 7) or a large silo (fig. 8) to reach an sufficient capacity
- Combine the existing salt barn with a small silo from which the trucks are loaded (fig. 9). The silo must be reloaded from the barn periodically. For this an automatic belt can be used.
- Loading with a wheel loader from the existing salt barn (fig. 10)

Figure 7 – Combination of 4 silos with brine tanks

Figure 8 – new salt silo with 500 t capacity

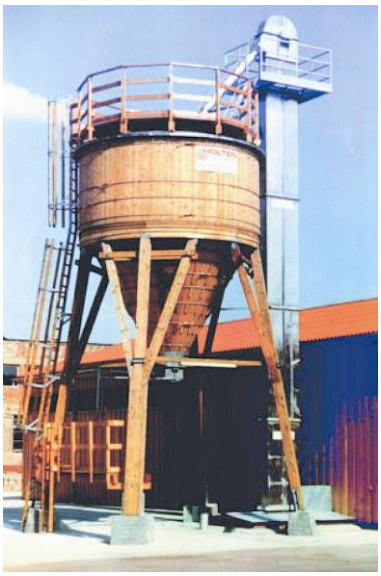

Figure 9 – combination of small loading silo with large barn

Figure 10 – loading from barn with wheel loader

Important is also that the loading of the brine for pre-wetting can take place at the same time when salt is loaded. Therefore the brine tank has to be situated just beside the salt loading station. This was also not usual in the past and lead to additional time gap. With combined loading salt and brine the time for brine loading is magisterial. Here it is also possible to rise up the speed using powerful pumps, large tubes and couplers.

With modern compact units using this loading techniques it is possible to save approximately 15 minutes for every truck loading and with this reaching much more traffic safety and economy.

6. BUILDING OF A MODERN COMPACT UNIT

Within the reorganisation of the maintenance in German State Saarland one stockpile had to be planned new. The optimum site was ascertained in Illingen nearby the Saarbrücken Crossing of the two motorways A1 and A8. It lies on the edge of 4 maintenance districts and will be used from all these four. Additional it will be used from the two cities lying nearby. So it will be used very much.

The needed capacity (maximum consumption within 5 days) was determined to 700 tons dry salt, additional there is planned a capacity of 150 m^3 brine.

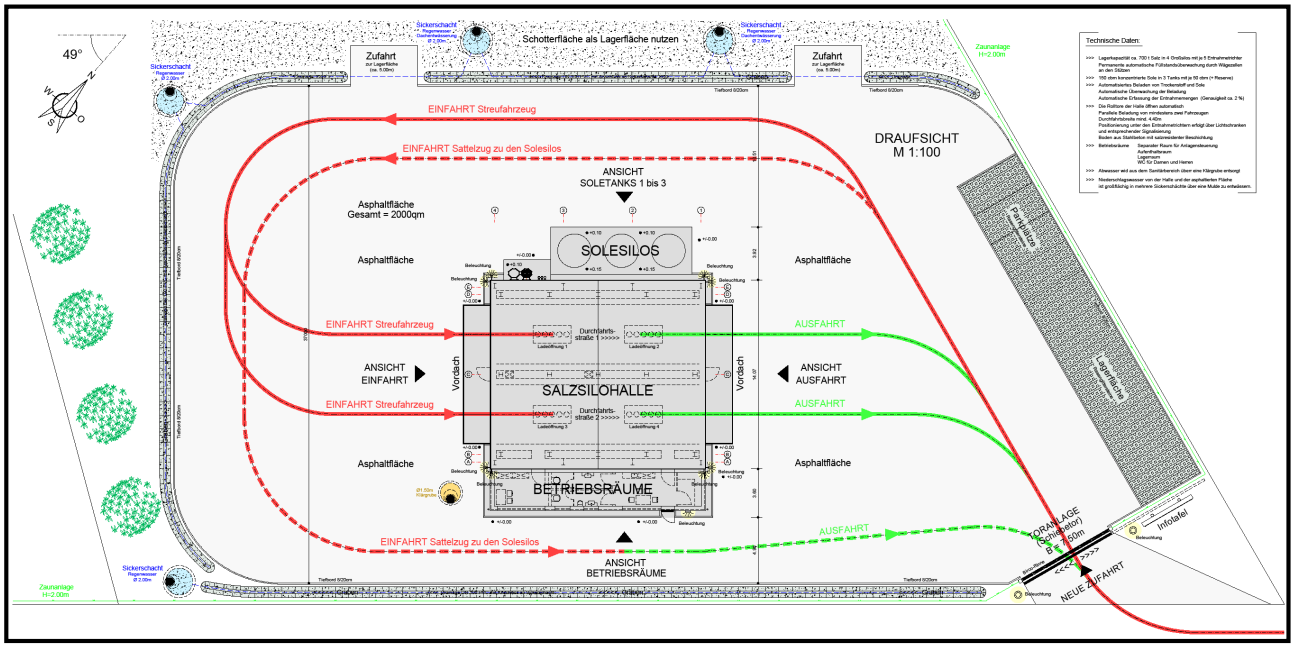

Figure 11 – plan of the new compact unit

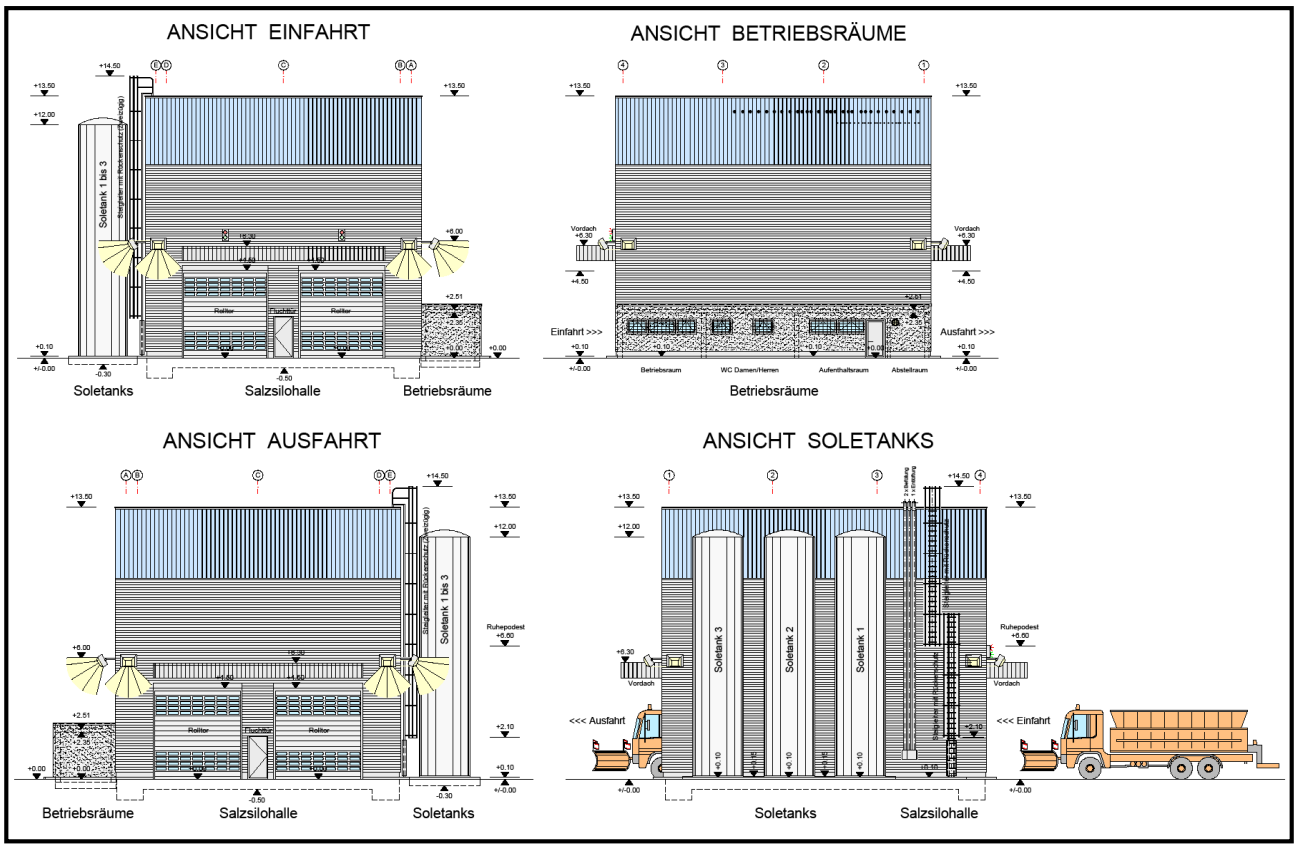

Figure 12 – view of the compact unit from each side

The stockpile is planned as a closed compact unit with all components consolidated under one roof. The salt is stocked in 4 integrated silos with 5 feed hopper. The silos have an

automatic weighing system which monitors the filling status at every time and which reports every loading operation exactly as basis for the internal and external billing.

Additional to the salt silos there are 3 brine tanks á 50 m^3, also integrated in the unit, so that brine tanking can be made at the same time as the salt loading.

The trucks drive through the compact unit so that no transposition maneuver is needed. Inside of the unit 4 trucks can be loaded at the same time.

The closed system also guarantees an independence from weather and temperature, so that loading can be made very easy. Additional it gives more quality and security in night times for the personal. So the reloading is light, warm and safe for the personal. And it is possible to integrate staff facilities and other functions for the maintenance in this building. An other advantage can be a better integration in the landscape or cityscape.

The cost-benefit analysis shows a positive result because the unit lies on a very strategic point so that a lot of time and costs can be saved by fast reloading. The unit is now under construction and it will go in operation by the winter period 2010/11. This will be the first compact unit in whole Germany.

7. RESUME

Strategic Salt Management is an interesting part of a Strategic Winter Maintenance Management. Winter Maintenance can be optimized by optimizing the locations of the stock sites and the loading techniques. Modern compact units and a Spreading Agent Management System can optimize the organization of winter maintenance by means of modern data management.

All this can save much time and money in every maintenance operation and it leads to more traffic safety by faster spreading.

REFERENCES

[1] Cypra, T.: Optimierung des Winterdienstes auf hoch belasteten Autobahnen
In: Kolloquium Straßenbetriebsdienst der FGSV September 2003 in Karlsruhe (D)

[2] Durth, W., Balke, J., Klotz, S. (2004): Vermeidung glättebedingter Staus durch Maßnahmen des Straßenwinterdienstes; Forschung Straßenbau und Straßenverkehrstechnik, Heft 873, Bonn (D)

[3] Durth, W., Hanke, H.: Straßenwinterdienst
Kirschbaum-Verlag, Bonn (D) 2005

[4] European Cooperation in the Field of Scientific and Technical Research – COST (2008)
Action 353: Winter Service Strategies for increased European Road Safety – Final Report

[5] Forschungsgesellschaft für Straßen- und Verkehrswesen (2009): Richtlinien für den Winterdienst auf Straßen, Köln (D)

[6] Grüneis, H.: Winterdienst-Steuerungssystem der Salinen Austria
Vortrag Informationstagung Saldome, Rheinfelden (CH) September 2005

[7] Hanke, H. (2004): Implantation of a Winter-Maintenance-Management-System for an optimised intervention control; Presentation SIRWEC-Conference March 2004 in Bingen (D)

[8] Hanke, H. (2005): Empfehlungen für die Beschaffung und den Einsatz von Streustoffen
In: Kolloquium Betriebsdienst der FGSV September 2005 in Karlsruhe (D)

[9] Hanke, H. (2005): Modernes Winterdienst-Management zur Optimierung des Winterdienst-Einsatzes
Vortrag 5. ASTRAD-Symposium September 2005 in Wels (A)

[10] Hanke, H. (2006): Winterdienst-Management in Straßenmeistereien
Vortrag Karlsruher Erfahrungsaustausch Straßenbetrieb Februar 2006 in Karlsruhe (D)

[11] Hanke, H. (2006): Aktuelle Entwicklungen im Winterdienst in Deutschland
Vortrag VIATEC 2006, Bozen (I)

[12] Hanke, H. (2006): Winter Maintenance by the Use of Floating Car Data
Presentation XII. International PIARC Winter Road Congress, Torino (I), March 2006

[13] Hanke, H. (2006): Nutzung innovativer Technologien zur Optimierung des Winterdienst-Managements
Vortrag Winterdienst-Fachtagung März 2006 Hüfingen (D)

[14] Hanke, H. (2006): Einsatz moderner Techniken zur Optimierung des Winterdienstes
Vortrag auf dem 23. INFA-Forum am 28.11.2006 in Ahlen (D)

[15] Hanke, H. (2007): Aktuelle Entwicklungen im Bereich von Streustoffen und Streutechnik für den Winterdienst; in: Straße und Autobahn, Heft 8/2007

[16] Hanke, H. (2008): Effects of Winter Service on Traffic Safety and Economics
in: Winter Service Strategies for increased European Road Safety
Report COST 353 Final Conference, Bad Schandau (D)

[17] Hanke, H. (2008): Entwicklungen im Winterdienst aus deutscher Sicht
Vortrag Internationales Meeting Straßenwinterdienst Dezember 2008 in Meran (I)

[18] Hanke, H. (2008): Winterdienst auf hohem technischem Niveau in Europa – eine Bestandsaufnahme
in: Straße und Autobahn, Heft 8/2008

[19] Hanke, H., LEVIN, C. (1990): Influence of Winter Road Maintenance on Traffic Safety and Transport Efficiency; 8. International PIARC Winter Road Congress, Tromsö (N)

[20] Larsen, O. (2008); Evaluation of existing Winter Maintenance Management Systems
in: Winter Service Strategies for increased European Road Safety
Report COST 353 Final Conference, Bad Schandau (D)

[21] Norkauer, A. (2007): Praktische Umsetzung eines Winterdienst-Management-Systems
in: Kolloquium Betriebsdienst der FGSV September 2007 in Karlsruhe (D)