

**ANAS, WINTER ROAD MANAGEMENT PROJECTED INTO THE FUTURE WITH
INNOVATIVE TECHNOLOGIES**
**New strategies for self-service, multi-user de-icing salt
facilities**

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ABSTRACT

Winter Maintenance represents one of the major activities carried out by ANAS in its quality of roads and motorway's administrator.

Anas is going to develop its de-icing activity according to the internal management model, in order to render a service that others are not able to offer.

Within winter maintenance, a relevant role is played by salts stocking and distribution equipments. They enable, in fact, the possibility of keeping the safety of road users on the move in winter and a punctual and rapid collecting of the materials. The technological evolution of such equipments has made it possible the passage from the open-air storage in sacs and in heaps to the use of silos at first of small and medium dimensions, then of big dimensions. This resulted in great advantages for the quality and efficiency of the service.

The highest standards of technology available has been used: the available silos are completely automatic and this guarantees the use, the life cycle as well as the identity of the user; the most important innovation is represented by particular weighing systems, the management by means of software capable of identifying users and times of use, rapidity of intervention and reliability of the equipments.

The starting point has been the comparison with external experiences of storage silos and diffusion in terms of quality and costs of the service. Therefore, ANAS has implemented the modernisation of the service by means of the installation of a silos at the Department of Umbria. In the choice of its dimensions, the possibility of giving to third bodies both the salt stored in silos and the supplying of integrated services of winter maintenance has been taken into account.

The equipment, having an almost square shape, is made by six modules with many and modern options.

One of the most appreciable characteristics lies in the fact that high technologies systems are combined with simplicity in use for the operators.

In the end, the proposal of new technologies in a given sector of road maintenance and in winter maintenance in particular, produces new operational aspects with relevant positive consequences on the social and economic system. The use of such technologies, based on the realisation of the most advanced systems, with a high storage capacity, enables ANAS to improve quality, efficiency and inexpensiveness of the service while putting at community disposal the availability of such equipment, certainly on favourable terms.

KEYWORDS

SALT STOCKING/AUTOMATIC SILOS/SIMPLICITY/TECHNOLOGY

The road ownership bodies play a leading role within the context of having to transfer goods and people in the quickest possible way and with the greatest degree of safety: such entities in fact have the task of managing the communication routes offering road management service in an efficient, reliable and safe manner. This general priority is elaborated in very specific ways in the winter months and in a vast range of regions and areas at a national level, where road conditions may become compromised by ice and

snow. In fact, both the market players and the population are well aware of the heavy snows that Italy has experienced in some of the more recent years, requiring mobility operators and road administrators to provide a decisively important service.

Winter maintenance is one of ANAS' main activities because it is the principal road and motorway administrator, as well as the custodian of the toll motorway concession companies.

ANAS carries out this service with different operational methods, depending on the regional context in which it operates, which in turn depends on the special weather conditions and features of the road network being managed. It is obvious that, within the 21,000 km of road and motorway network managed directly by ANAS, there are different situations both in terms of types of roads subject to winter activities, in terms of traffic that affects the network and finally in terms of the impact of a possible critical situation on the local road management system.

As regards the overall snow removal activities, ANAS is working to strengthen the service in accordance with an internal management model, using its own equipment and personnel, meeting an objective that can be summed up by saying that it provides a service that others are incapable of offering. Currently, the service is carried out under its own responsibility in numerous management Divisions, while it is tendered out in a supplementary way in certain Sectors of the Alpine Arch where on the one hand, historically it has proved to be more difficult to procure staff with the necessary degree of specialisation, and on the other hand the employment of men and equipment, even if intense, is tied to a limited period of time over the year.

Within the ambit of winter maintenance Salt storage and distribution facilities play an important role. In general, they allow the road surface to be kept in a safe and practicable condition, combined with a careful and fast withdrawal of material. Over time, the technological evolution in the facilities has permitted the system to move from bulk storage in the open air and in bags, to the use of silos, initially small and medium, and finally moving to large silos (500 or 750 ton capacity), with significant advantages for the quality and efficiency of the service. We briefly point out that by using these evolved storage systems it was possible to avoid the occurrence of many negative factors: the washing away of salt by atmospheric agents with the related damage to the ecosystem, the loss of certain typical, original, chemical-granulometric features of the salt and the use of solvents in amounts exceeding actual requirements. In addition, the evolved storage systems have allowed the reduction in certain significant cost items: the use of loading equipment such as mechanical shovels and forklifts with the related personnel, the need to allocate areas for the storage of salt bags or piles, the time needed to load the material onto the salt spreaders and, depending on the weather, also the time and costs connected to the material dissolving.



Figure 1-Salt in protected piles that has clearly been washed away

In this framework, the strategy that ANAS has adopted over time can be described in two phases. In the first phase, dating back from the 1960s to the end of the last century, ANAS installed about 70 salt storage facilities over its network: these storage facilities were made of steel and had a capacity of 100 tons. Following the transfer of about half of the network to the Regions, between 1999 and 2001, ANAS now has 38 of these facilities. In the second phase, which started a few years ago and which is still underway, the Company has turned to large capacity facilities, introduced on to the market by the specialised industry, or rather it has turned to technologically more advanced products.

It should be emphasized that this choice fits into a more general investment plan in the development of company's *know-how* in the field of winter maintenance, both for the benefit of its own activities as well as in the light of *service* to the territory. Once this strategy was identified it was necessary to identify the best technology available on the market: the available products are the fully-automatic silos with guarantees relating to use, duration, user identification and with noteworthy features as regards weighing with loading cells, computerised management with software able to identify users and use times, the speed of the operations and the reliability of the facilities.

In this context, it is important to bear in mind the experience of certain important motorway concessionaries, who have equipped themselves in more recent years with self-service facilities of 500 and 750 tons with the aim of improving and optimising their service. The following companies are relevant in this context: Società delle Autostrade di Venezia e Padova (Venice-Padua Motorways Company), Autostrada Torino-Savona (Turin-Savona Motorway) and Società Autostrade per l'Italia (Italian Motorways Company). All these facilities have original features and network placement that have resulted in obvious advantages for the administrator as regards the provision of this particular road maintenance service.



Figure 2-Torino-Savona Highway

In this new corporate strategy, in the choice of the size of the facility, the entities took account of the possibility of transferring the salt storage silo activities to third parties, as well as the possibility of providing supplementary winter-road maintenance services, as set out above. Starting with the comparison of outside experiences in relation to the use of storage silos and the increase in the obvious advantages for quality and service cost, it was decided to implement the service upgrade by installing two silos in the Departments of Piedmont and Umbria. In Piedmont, as the road network is particularly subject to snow and ice, and there is articulated traffic, as well as an important tourist system (one must simply bear in mind the recent Winter Olympics). Potentialities similar to those found in Piedmont were also found in Umbria, as mentioned above, whereas at a level of first approximation the systems in Veneto, Abruzzo and Calabria are being examined.

The Central Management of ANAS, together with the Umbria Road Management Department, identified the Ponte San Giovanni maintenance centre as a strategic site for locating a large capacity silo (750 tons) for storing chlorides; this site is situated near the regional capital of Perugia and is at the centre of the primary regional route intersection. The site was also identified from the point of view of attracting the interest of the

neighbouring road Administrations, such as that of the Province and the Municipality of Perugia and other municipal Administrations situated in the area of the capital. In effect, during the assessment phase that resulted in the choice of the Ponte San Giovanni facility, letters were written that give context to the interest shown by certain owning entities.

The assessments relating to the Ponte San Giovanni facility during its construction resulted in the conclusion that during a normal season the storable quantities of salt could be equal to three times the effective capacity of the system. In a typical situation, it was calculated that more than 2,000 tons of chlorides per season could be made available to local Administrations. From a market survey it emerged that the cost of the special rock salt suitable for silos, with yield features exceeding definitely that of the salt commonly used, amounted to € 75-85 per ton. Naturally, this price is applicable only to the large quantities that the facility in question would handle and is significantly lower than the one that the Administration could obtain for isolated supplies (estimated at 100-120 €/ton). The Ponte San Giovanni facility could be made available to the external Administrations concerned with a mark-up on the price paid by ANAS in order to allow it to acquire the salt at a lower price compared to the one that could be obtained on the market if it acted in an isolated manner.

At this purchase price, the acquiring entities would obtain a number of advantages that can be summarised as follows:

- no pre-financing costs for the set-up of the facility;
- no pre-financing costs for the advance provision of the salt;
- no need to employ one's own space to position the facility;
- immediate availability of quality salt, which can be automatically withdrawn by one operator, resulting in a significant reduction in the staff operating on the road and the related costs;
- fast, safe road intervention;
- greater efficiency in the treatment, to the benefit of the user;
- accurate, automatic accounting for the quantities drawn, with the exact recording of the modes and quantities drawn;
- exact recording of the date and time of the withdrawal with the consequent possibility of checking the operational timeliness of the service, especially in the case of outsourcing.

It emerged from the assessment that, once up and running, 50% of the capacity of the facility could be used by the Administrations operating in the reference area of the facility.

The facility, supplied and installed by Agristrade S.p.A., is almost square in shape (14.70 m. X 15.00 m. including external masonry panels), is composed of 6 adjoining modules and is fitted with:

- 6 discharge hoppers in glazed steel that improve the salt flow and guarantee durability and consequently an almost total absence of maintenance. The remaining parts of the silo (upright walls and roofing) were also expressly covered in the same type of material;
- 6 discharge gates made in STAINLESS STEEL AISI 316 L, with an elongated section to ensure the rapid and uniform loading of the salt spreaders underneath, without moving them;



Figure 3-uniform discharge from the hopper

- external traffic light system, positioned above the access gates of the passageway and on the inside next to each discharge hopper, to properly guide the operators into the discharge area;
- hydraulic unit for automatic, manual and emergency (in the event of a black-out) handling of the discharge gates, fitted with nitrogen precharge pressure accumulators for instantaneous cut-off of the salt flow in an emergency situation;
- 20 double-bending load cells situated at the base of every load bearing column of the silo, for precision weighing (maximum combined error 0.075%) of the salt put into and withdrawn from the facility;
- system for loading the salt into the silo, made up of 2 loading pipes connected to the same number of rotating distributors inside the structure, one vent pipe and an airtight closing unit for the pipes with the related traffic light system;
- air dehumidifier with rechargeable silica gel cartridge.
- 4 anti-implosion valves in stainless steel mounted on the roofing to exclude possible damage caused by sudden collapse of anomalous salt bridges, which do not correspond to specific ensilage techniques (greater wetness, absence of anti-caking agent, etc.);
- computerised main control unit located in the cabinet next to the facility, managed by the person in charge of the Maintenance Post;
- computerised auxiliary control unit located in the unloading zone, reserved for the spreader drivers for salt withdrawal.

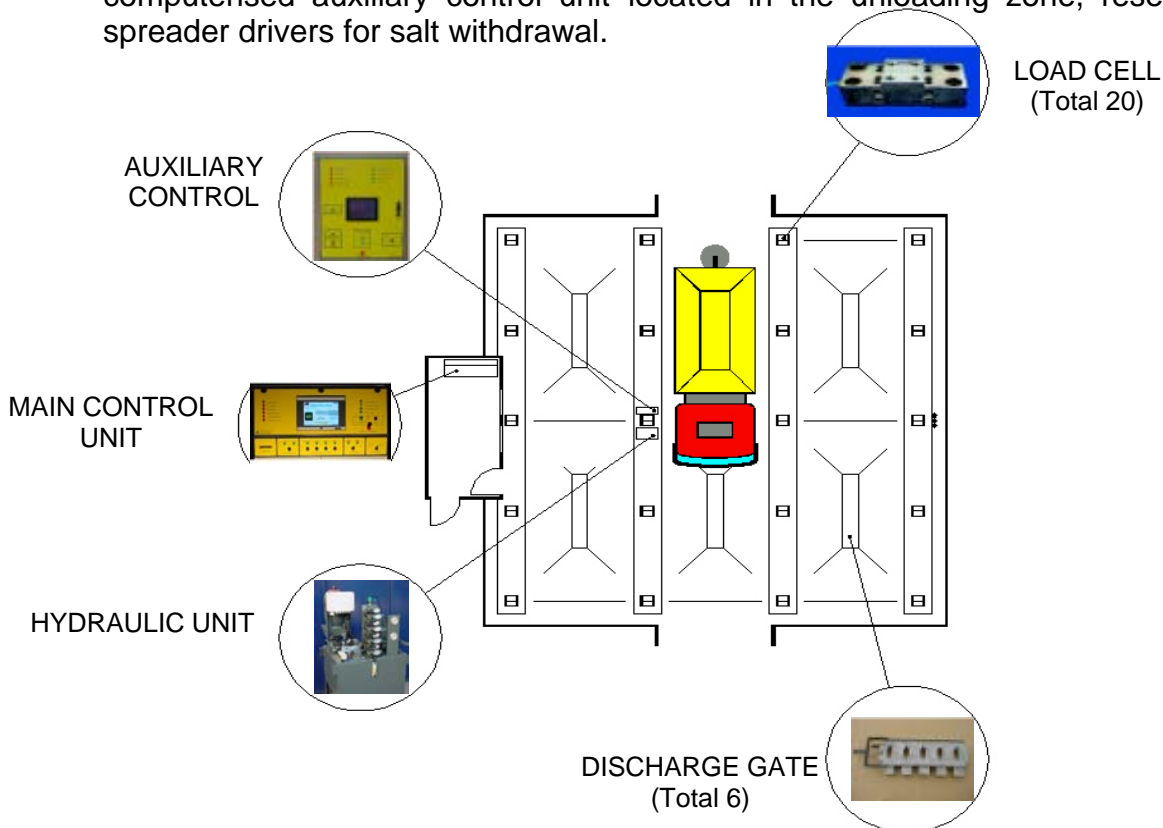


Figure 4-salt stocking scheme

One of the main features to be appreciated on this type of facility is the union achieved between high-tech systems and simplicity of use for the operators.

Sophisticated checking and statistical management systems, reserved for the managers of the facility, are contrasted by the extreme simplicity of use for the operators, tuned to the specific requirements of the Concessionary. This is of fundamental importance for the success of winter operations, which are often entrusted to external companies for the distribution of salt.

For a better understanding of the above-mentioned concepts, we set out an example of a standard withdrawal, ensilage and management operation at the facility.

Withdrawal operation: When the operator and his spreader draws up to the silo, he is guided by the external traffic light (green light) towards the correct passageway and by the internal traffic light (green light) underneath the hopper set up to discharge. These operations are managed by the computerised system that detects and processes the data from the weighing cells, which always identifies and signals the most loaded hopper. By constantly varying the points of withdrawal, a uniform level of salt in the tank is obtained.

A special infra-red sensor automatically detects the correct position of the spreader, giving the driver an acoustic signal in confirmation of this fact.

Once the driver got off the vehicle, to withdraw the salt he should simply enter his personal identification code into the auxiliary control panel and select the desired quantity from the menu, as if he were making cash withdrawal from an ATM machine. At this point, the system activates all the processes necessary for an accurate and quick withdrawal of salt (about 1 minute for 8,000 kg) and saves and prints all the withdrawal data.

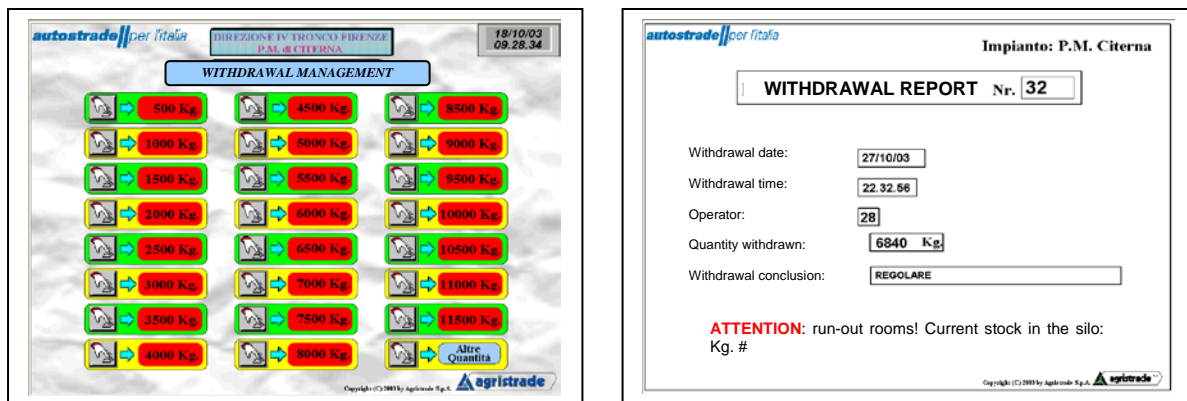


Figure 5-auxiliary control

Loading the facility: this operation is also fully automatic and particular attention has been given to making the process easy to carry out. The driver is directed by the traffic light to connect (using a fast coupler) the salt chute of the tanker to one of the two loading pipes which the facility is equipped with. This takes place using the above-mentioned computerised system that processes the data of the weighing cells and automatically activates the rotating distributor of the sector that is less full. The two distributors forming part of the silo equipment are positioned inside the silo and flanged to the end of the respective loading pipe. This guarantees that the salt in the tank is properly levelled. All the loading data are saved and printed by the system.

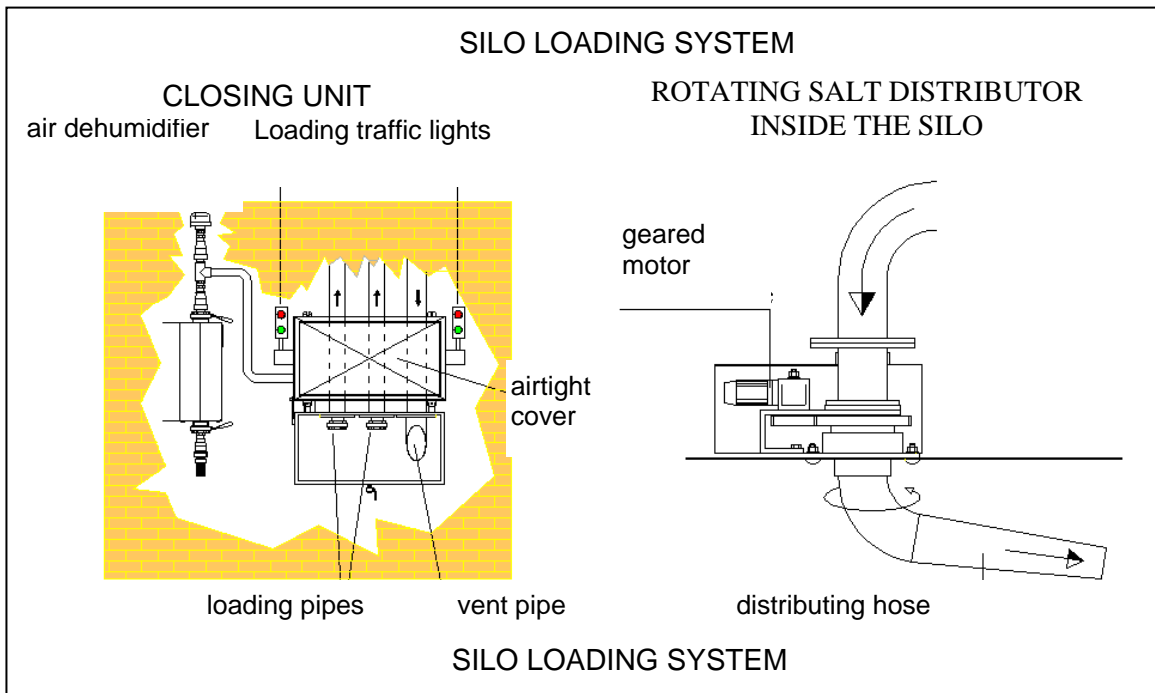


Figure 6-Silo loading System

Management of the facility: There are full control and statistical management, thanks to the continuous self-diagnosis within the facility (check of all the operating malfunctions and information for proper resetting); the system records and saves the parameters relating to every salt withdrawal operation (date, time, quantity withdrawn, withdrawal method, and any malfunctions experienced) as well as in relation to the loading of the tank (date, time, quantity at the beginning of loading, quantity at the end of loading, total quantity loaded). The maintenance centre manager can therefore, using the key-selector on the main computerised control panel and a personal software access code, manage a wide range of operations and controls, such as:

- set an automatic/manual operating mode;
- block an individual discharge hopper for maintenance or other reasons;
- transfer the commands to a secondary external panel;
- check malfunctions;
- enter/change operator codes;
- set the counters to zero;
- check the loading level of the silo;
- manage printouts (this function provides a complete statistical check of all the loading and withdrawal operations carried out by the operators);
- save data;
- restore data;
- test load cells;
- stop the system;
- update date and time.

Moreover, it is important to bear in mind that part of the above-mentioned statistical management can be carried out by modem, thanks to a remote control system, to rationalise the use of the facility, for example to immediately replenish the strategic ice-melting stocks.

A further development has already been tested that envisages the automatic recognition of the spreaders by using a receiving antenna placed on the facility and “badges” on the equipment (*TELEPASS*-type), which will further simplify the operation, eliminating the need to enter the code and select the quantity of salt.

The software now makes it possible to clearly and accurately separate the management of manual and automatic withdrawals.

WITHDRAWAL MANAGEMENT

Data	Ora	Op.	Quantità	Coord. Pref.	Data	Ora	Op.	Quantità	Coord. Pref.	Data	Ora	Op.	Quantità	Coord. Pref.
21/12/03	13.56	1	02.450	Ap. Gruppo	04/09/03	17.33	30	01.100	Regolare	27/09/03	10.00	31	01.840	Ap. Gruppo
01/09/03	09.42	6	03.720	Int. Operat.	04/09/03	17.42	30	01.670	Regolare	27/09/03	10.10	30	02.720	Regolare
01/09/03	09.51	1	05.550	Regolare	04/09/03	17.61	30	01.440	Regolare	29/09/03	09.42	29	02.720	Regolare
01/09/03	10.17	1	03.550	Regolare	04/09/03	17.58	27	01.100	Regolare	29/09/03	09.45	17	01.070	Regolare
01/09/03	10.21	1	06.550	Int. Operat.	04/09/03	18.01	28	01.600	Regolare	29/09/03	09.47	M	05.450	Regolare
01/09/03	10.25	M	02.800	Regolare	04/09/03	18.09	31	01.100	Regolare	29/09/03	09.49	M	05.460	Regolare
01/09/03	11.04	1	01.860	Ap. Gruppo	04/09/03	18.06	29	01.100	Regolare	29/09/03	10.12	3	01.340	Regolare
04/09/03	08.36	31	01.100	Regolare	04/09/03	18.07	31	01.100	Regolare	29/09/03	10.19	26	01.590	Regolare
04/09/03	08.40	30	01.800	Regolare	04/09/03	18.12	30	01.120	Regolare	29/09/03	10.19	M	01.360	Regolare
04/09/03	08.42	23	02.100	Regolare	04/09/03	18.16	29	01.100	Regolare	03/09/03	16.20	M	01.160	Regolare
04/09/03	08.44	25	01.600	Regolare	04/09/03	18.17	29	01.500	Regolare	03/09/03	16.23	26	01.590	Regolare
04/09/03	08.45	13	02.800	Regolare	04/09/03	18.01	30	01.100	Regolare	03/09/03	16.25	23	02.230	Regolare
04/09/03	08.47	M	02.900	Regolare	05/09/03	09.03	29	01.100	Regolare	04/09/03	12.00	1	01.310	Regolare
04/09/03	09.01	M	03.000	Regolare	05/09/03	09.06	29	01.100	Regolare	04/09/03	12.04	1	06.410	Regolare
04/09/03	09.04	M	02.000	Regolare	05/09/03	09.08	31	01.100	Regolare	04/09/03	12.09	2	05.000	Regolare
04/09/03	09.04	M	02.000	Regolare	05/09/03	09.10	30	01.100	Regolare	04/09/03	12.15	M	02.560	Regolare
04/09/03	13.56	M	01.110	Regolare	05/09/03	09.37	29	01.100	Regolare	04/09/03	17.19	25	01.000	Regolare
04/09/03	13.59	M	01.000	Regolare	05/09/03	09.39	30	01.100	Regolare	04/09/03	17.22	16	01.440	Regolare
04/09/03	14.06	M	03.000	Regolare	05/09/03	09.43	29	01.100	Regolare	10/09/03	15.49	16	06.370	Manc. Terna
04/09/03	14.07	M	03.000	Regolare	05/09/03	09.45	30	01.310	Regolare	10/09/03	15.51	16	01.200	Regolare
04/09/03	14.10	2	01.040	Regolare	06/09/03	11.06	1	02.640	Regolare	10/09/03	15.59	M	01.160	Regolare
04/09/03	14.12	6	01.200	Regolare	05/09/03	15.56	2	01.560	Regolare					
04/09/03	14.14	11	02.100	Regolare	05/09/03	15.58	22	03.440	Regolare					
04/09/03	14.15	17	01.910	Int. Operat.	05/09/03	16.01	31	03.720	Regolare					
04/09/03	14.17	26	02.330	Regolare	05/09/03	16.19	21	02.400	Regolare					
04/09/03	14.19	06	06.340	Regolare	05/09/03	16.25	M	01.000	Regolare					
04/09/03	14.23	M	02.760	Regolare	05/09/03	14.36	18	06.340	Regolare					
04/09/03	14.34	29	01.230	Regolare	05/09/03	14.49	3	03.890	Regolare					
04/09/03	14.36	29	01.230	Regolare	05/09/03	14.59	9	04.160	Regolare					
04/09/03	14.36	29	01.260	Regolare	05/09/03	15.52	1	03.600	Regolare					

Figure 7-Total (manual and automatic) withdrawal management

Data	Ora	Op.	Quantità	Coord. Pref.	Data	Ora	Op.	Quantità	Coord. Pref.	Data	Ora	Op.	Quantità	Coord. Pref.
21/12/03	13.56	1	02.450	Ap. Gruppo	04/09/03	18.17	29	01.500	Regolare	04/09/03	17.19	25	01.200	Regolare
01/09/03	09.42	6	03.720	Int. Operat.	05/09/03	09.01	30	01.100	Regolare	04/09/03	17.22	16	01.440	Regolare
01/09/03	09.51	1	05.550	Regolare	05/09/03	09.03	29	01.100	Regolare	13/09/03	15.49	16	06.370	Manc. Terna
01/09/03	10.17	1	03.550	Regolare	05/09/03	09.06	29	01.100	Regolare	13/09/03	15.51	16	01.200	Regolare
01/09/03	10.21	1	06.550	Int. Operat.	05/09/03	09.08	31	11.100	Regolare					
01/09/03	11.04	1	01.860	Ap. Gruppo	05/09/03	09.10	30	01.100	Regolare					
04/09/03	08.36	31	01.100	Regolare	05/09/03	09.37	29	01.100	Regolare					
04/09/03	08.40	30	01.800	Regolare	05/09/03	09.39	30	01.100	Regolare					
04/09/03	08.42	23	02.100	Regolare	05/09/03	09.43	29	01.340	Regolare					
04/09/03	08.44	25	01.500	Regolare	05/09/03	09.45	30	01.310	Regolare					
04/09/03	08.46	13	06.200	Regolare	05/09/03	11.06	1	02.640	Regolare					
04/09/03	08.47	M	02.900	Regolare	05/09/03	15.55	2	01.590	Regolare					
04/09/03	09.01	M	03.000	Regolare	05/09/03	15.58	22	03.440	Regolare					
04/09/03	09.04	M	02.000	Regolare	05/09/03	16.01	31	03.720	Regolare					
04/09/03	09.04	M	02.000	Regolare	05/09/03	16.19	21	02.400	Regolare					
04/09/03	13.56	M	01.110	Regolare	05/09/03	16.25	M	01.000	Regolare					
04/09/03	13.59	M	01.000	Regolare	05/09/03	14.36	18	06.340	Regolare					
04/09/03	14.06	M	03.000	Regolare	05/09/03	14.49	3	03.890	Regolare					
04/09/03	14.07	M	03.000	Regolare	05/09/03	14.59	9	04.160	Regolare					
04/09/03	14.10	2	01.040	Regolare	05/09/03	15.52	1	03.800	Regolare					
04/09/03	14.12	6	01.200	Regolare	05/09/03	15.52	1	03.800	Regolare					
04/09/03	14.14	11	02.100	Regolare	05/09/03	16.01	31	03.720	Regolare					
04/09/03	14.15	17	01.910	Int. Operat.	05/09/03	16.19	21	02.400	Regolare					
04/09/03	14.17	26	02.330	Regolare	05/09/03	16.25	M	01.000	Regolare					
04/09/03	14.19	06	06.340	Regolare	05/09/03	14.36	18	06.340	Regolare					
04/09/03	14.23	M	02.760	Regolare	05/09/03	14.49	3	03.890	Regolare					
04/09/03	14.34	29	01.230	Regolare	05/09/03	14.59	9	04.160	Regolare					
04/09/03	14.36	29	01.230	Regolare	05/09/03	15.52	1	03.800	Regolare					
04/09/03	14.36	29	01.260	Regolare	05/09/03	16.01	31	03.720	Regolare					
04/09/03	17.33	30	01.100	Regolare	05/09/03	16.03	29	01.100	Regolare					
04/09/03	17.42	30	01.870	Regolare	05/09/03	16.06	29	01.100	Regolare					
04/09/03	17.57	30	01.440	Regolare	05/09/03	16.09	29	01.100	Regolare					
04/09/03	17.58	27	01.100	Regolare	05/09/03	16.12	3	01.340	Regolare					
04/09/03	18.01	28	01.800	Regolare	05/09/03	16.16	25	01.500	Regolare					
04/09/03	18.03	29	01.100	Regolare	03/09/03	16.23	26	01.590	Regolare					
04/09/03	18.05	29	01.100	Regolare	03/09/03	16.25	23	02.230	Regolare					
04/09/03	18.07	31	01.100	Regolare	04/09/03	12.00	1	01.310	Regolare					
04/09/03	18.12	30	01.120	Regolare	04/09/03	12.04	1	06.610	Regolare					
04/09/03	18.16	26	01.100	Regolare	04/09/03	12.08	2	05.000	Regolare					

Figure 8-only automatic withdrawal management

Data	Ora	Op.	Quantità	Coord. Pref.	Data	Ora	Op.	Quantità	Coord. Pref.	Data	Ora	Op.	Quantità	Coord. Pref.
01/09/03	10.25	M	01.840	Regolare										
04/09/03	09.47	M	02.800	Regolare										
04/09/03	09.01	M	03.000	Regolare										
04/09/03	09.04	M	02.000	Regolare										
04/09/03	09.04	M	02.000	Regolare										
04/09/03	13.59	M	01.110	Regolare										
04/09/03	13.59	M	01.000	Regolare										
04/09/03	14.06	M	02.900	Regolare										
04/09/03	14.07	M	02.900	Regolare										
04/09/03	14.23	M	02.760	Regolare										
04/09/03	14.23	M	02.760	Regolare										
27/09/03	10.25	M	01.900	Regolare										
29/09/03	09.47	M	06.450											

automation for a potential self-service operation of the facility, which allows the recognition of the means of the external administration and the consequent automatic adjustment of the unloading section.

In addition, this type of facility offers the following operating advantages:

- as the system is modular (the one that is described here is made up of 6 modules with a capacity of 750 tons), there are no limits to the storage capacity. For example, the maximum capacity of the cylindrical silos used to hold salts does not presently exceed 500 tons;
- the power used for such high discharge quantities (8 tons/min.) is reduced to 1.5 KW and is limited to the gate opening and closing stages, estimated at a max. of 3 seconds;
- the greatly reduced unloading times translates into a quick and effective road maintenance service. This means clearing the road surface in the shortest possible time, with a consequent advantage for road safety.
It is a well-known fact that if salt is spread on the road quickly, this reduces or prevents the related problems, traffic jams and/or accidents with the consequent serious traffic issues;
- the special shape of the hopper results in the spreader being uniformly loaded along its entire length; for this reason, the truck does not need to be moved in order to unload the salt and form a pile, a characteristic of cylindrical cone silos, which thus saves more time;
- salt can be unloaded from the facility in all conditions: even if a gate is blocked, the vehicle can move to one of the other five that are free;
- the spreader is loaded under a cover, with both the drivers and equipment being protected against bad weather conditions.

To conclude, the proposed new technologies, in a specific sector of road maintenance, more specifically winter maintenance, gives new operating perspectives, which in certain areas could be particularly important from the point of view of the risk of serious disservice; thus the proposed new technologies will also have important positive effects on the socio-economic system. The use of these technologies, based on the construction of evolved facilities with high storage capacities for chlorides, will allow ANAS to improve the quality, efficiency and cost of the service and at the same time will give the group access to these facilities on definitely advantageous terms.

The study carried out by ANAS on its own network has identified some strategic sites for the implementation of a policy of high quality in the winter maintenance service, for the most part based on the use of its own personnel and equipment. Within the Umbria Road Maintenance Department, the Ponte San Giovanni site has been identified as the ideal location for a 750 ton facility, which is in an advanced state of construction.

This facility will have a barycentric function with regard to the road maintenance system both for ANAS and other ownership and road managing bodies. ANAS will be able to sell the salt - high quality rock salt withdrawn from its facility - to the Administrations on more advantageous conditions than those that these Administrations would be able to obtain on the market. The internal use of the facility and the sale of salt to third parties will allow ANAS to recoup the investment made in a relatively short period of time and at the same time offer a better service to the entire reference group.