



The Società Autostrade guarantees safety of the motorway network it administrates through constant maintenance of structures and related motorway facilities, particularly those serving the purpose of winter road safety.

GOALS OF THE SOCIETÀ AUTOSTRAD DI VENEZIA E PADOVA: DEICER SELF-SERVICE FACILITIES

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Due to the geographic location and the morphological characteristics of the Venice-Padova section of motorway and other sites in this area, snowfalls are not frequent and the period of the year when ice forms on the road is limited. However, the unpredictability of the weather, the high humidity and foggy conditions that are statistically frequent during the winter makes necessary concerted preventive action. To improve winter road maintenance and management, the Società Autostrade di Venezia e Padova SpA decided to set up a modular facility for the storage of chlorides. The facility, which develops horizontally, has a reduced environmental impact and features computerised management of the loaded and discharged quantities.

The special silo at the Venice-Mestre motorway station with easy access and in a centralised location to accommodate our purposes will allow trucks fitted with spreaders to load the salt and saline solutions essential for preventive and maintenance operations quickly and without assistance by other personnel.



A view of the passageways for loading vehicles



The 500-tonne modular salt storage facility with low environmental impact

We now outline the specific technical decisions made for this project by the facility's manufacturer, Agristrade based in Bolzano, who took into consideration our operating and organizational requirements.

Configuration of the facility

The modular facility has a storage capacity of 500 tonnes of sodium chloride and covers a surface of 12 m x 8 m with a height of just 10.7m. Lengthways and at the base, it has two passageways for the vehicles, each served by two hoppers for the conveying and unloading of the salt.

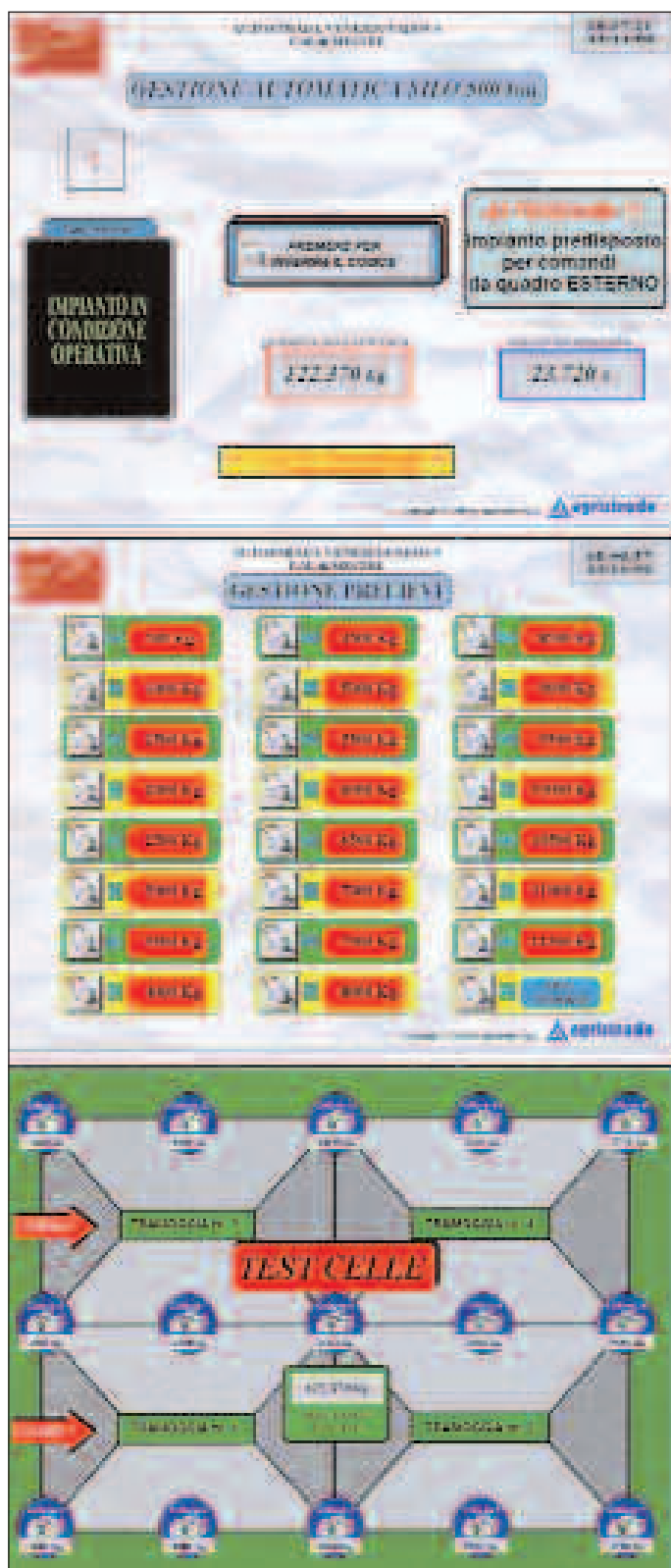
The passageways have a width of 3.4 m and are bordered by sidewalks that have the following important functions:

- ◆ Correctly guide the vehicles under the discharge hoppers
- ◆ Protect the load cells and the load bearing structure from involuntary impact of moving vehicles
- ◆ Lift the load cells and other components (the control panel and hydraulic unit) from the ground level and to protect them from malfunctions and downflows of rainwater from the yard.



Computerised management

The facility features a double system of computerised management. A “main” control panel installed with industrial computer with touch screen is housed in the cabinet located in the immediate proximity of the silo structure. The cabin is heated and windowed so that it affords a perfect visual control of the passageways used for the salt discharge.



The main panel for full management and supervision of the facility



The main control panel

From the cabin, in fact, all discharge operations by the operators can be performed automatically or manually. In addition, the manager of the facility can carry out full supervision, because he can manage a wide range of operations and controls from the main panel, such as:

- ◆ Inputting of automatic/manual operating modes
- ◆ Cut-out of individual hoppers for maintenance and other operations
- ◆ Transfer of commands to a secondary external panel
- ◆ Control of operating faults
- ◆ Interactive management of the facility through a reserved ID code, which enables:
 - ◆ the insertion/variation of operator codes
 - ◆ reading of counters
 - ◆ reset of the counters
 - ◆ filling status of the silo
 - ◆ printout management (this function allows a full statistical control of all loading and discharge operations performed by the operators)
 - ◆ saving of data
 - ◆ restoring of data
 - ◆ testing of load cells
 - ◆ system shutdown
 - ◆ updating of date and time



The auxiliary control panel



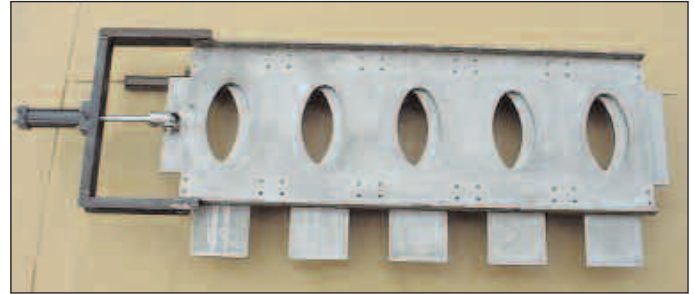
An auxiliary control panel installed with a programmable monitors, also with a touch screen and interacting with the main panel in the cabin, is located on the central sidewalk of the unloading passageways. For access only by operators, the panel is centrally located and has been designed to simplify as much as possible the salt discharge operations and to render the procedures easily comprehensible by outside personnel that has received no specific training.

Loading and weighing system

As stated, the facility allows salt to be dispensed through four hoppers, whose opening for discharge is located 4 m over the vehicle passageways.

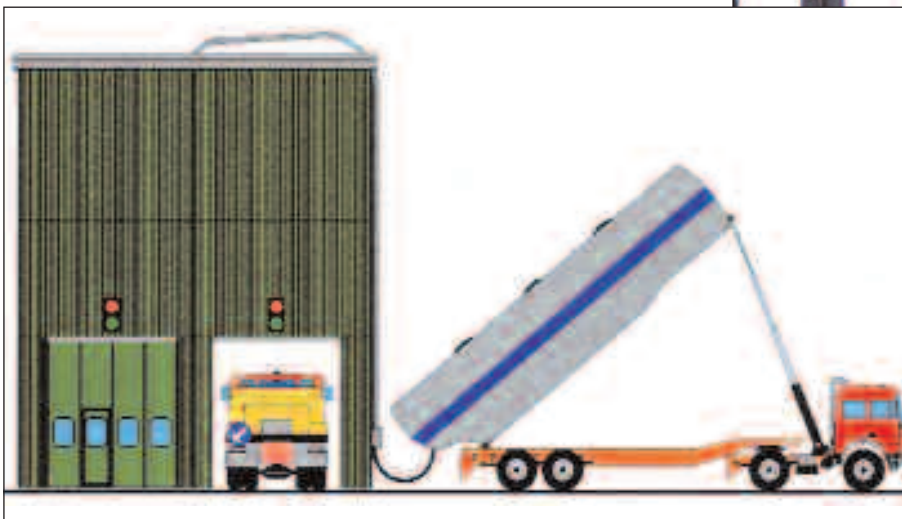
Each hopper is fitted with a special gate built in AISI 316 stainless steel which, thanks to its lengthened section, guarantees a uniform discharge over the entire surface of the spreader. As a result, the vehicle does not have to be moved during the discharge operations. The gate is operated by a hydraulic piston and is fitted with a set of transversal manual gates corresponding to each opening for the downflow of the salt.

These gates, as needed, allow the reduction of the deicer's discharge section (e.g., for smaller-sized spreaders) to perform maintenance operation (removing blocks of salt that have obstructed passage) and, in limited cases, to disassemble the entire discharge gate even

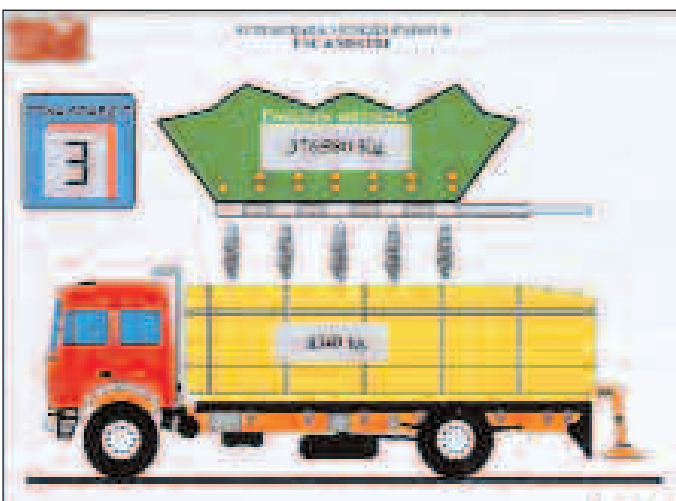


The discharge gate with manual shutters

with the silo full of salt. A hydraulic unit installed with pressure accumulator for emergency closing provides for the movement of the pistons of the gates. Positioned on the central sidewalk of the passageways is a manual emergency pump to guarantee dispensing of the salt even in the event of a total power failure.



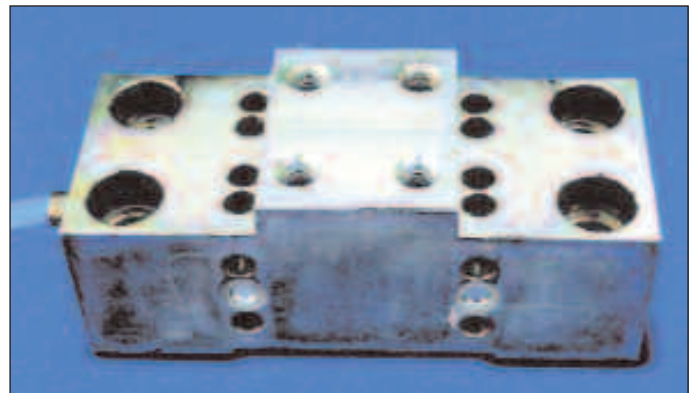
Diagrams of loading of the sodium chloride

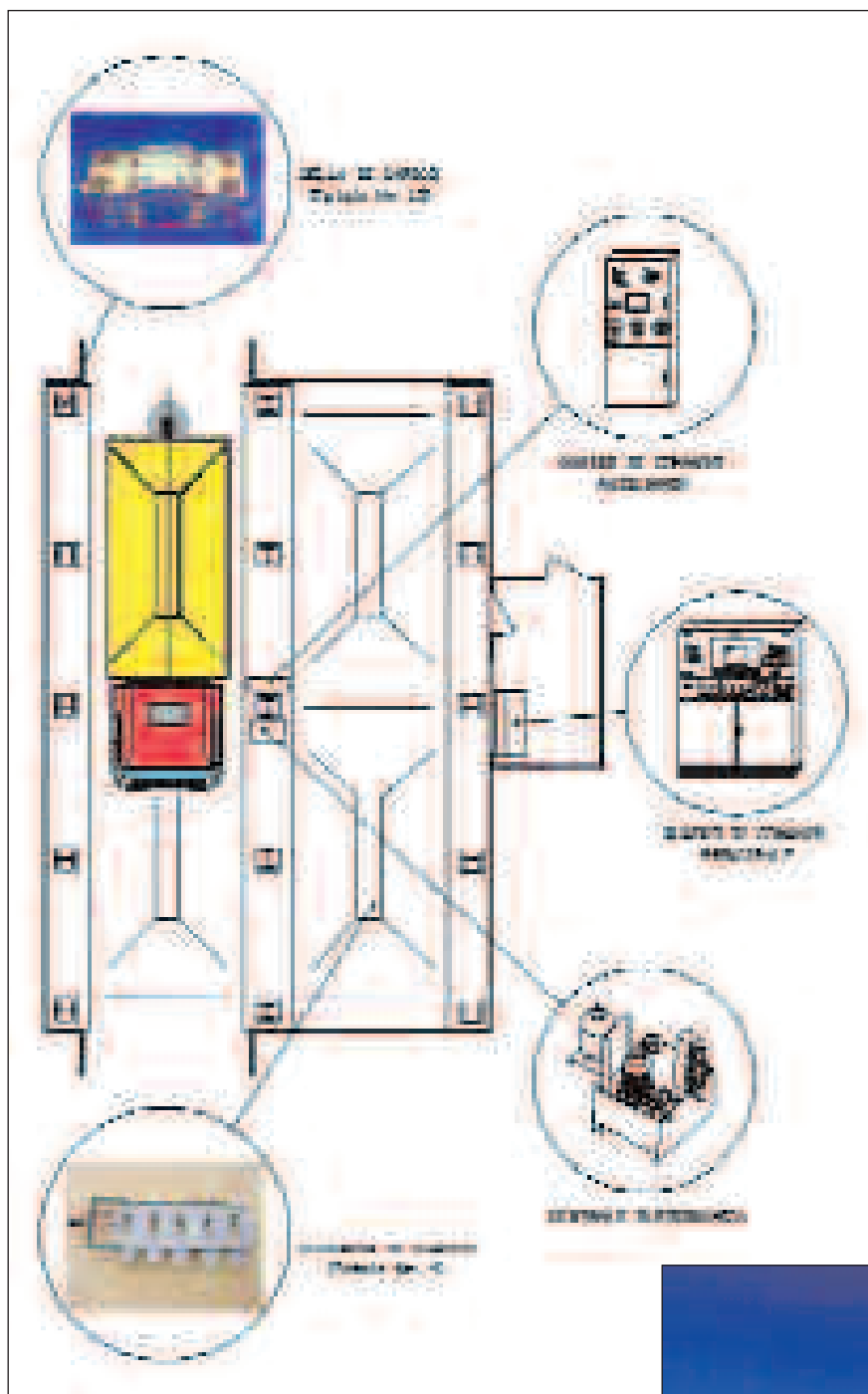


Diagrams of discharge of the sodium chloride



The load cell and positioning under the columns





This rotating type system is automatically activated when the watertight unit of the two loading pipes and the breather pipe is opened.

A red and green signal light system mounted next to the couplings of each loading pipes alerts the driver at every delivery of salt which of the two pipes will be used for the loading.

These signals are also managed automatically by the computerised system, which after verifying the data from each load cell, can establish with exactitude which of the sectors of the silos needs to be filled.

As a result, a uniform loading of the facility can be carried out.

Tanks for saline solutions

The increasing use of humidified salt has made necessary a storage tank for the calcium chloride solutions. Built in fibreglass with a capacity of 40 cu m, it includes an electronic system interfaced with the inverter for the automated management of the various handling and discharge operations:

- ◆ loading of the facility
- ◆ circulation of the facility
- ◆ loading of the tank truck road sprinklers
- ◆ loading of the spreader tanks.

Although the tank is positioned laterally with respect to the silo (to enable loading of the solid salt separate from operations to load solutions and to eliminate downtime), its data is managed by the main control panel.

Facility operation

As opposed to traditional sites, the facility guides the operators right from the outside of the silo by means of a system of signal lights.

A traffic light system located above the automatic doors at the entrance of each passageway and on each of the hoppers guides the driver of the salt spreader into the passageway and to the correct discharge hopper.

The general diagram of the facility

Opening and closing of the gate in normal conditions is performed automatically by the computerised system, thanks to a constant high-frequency reading of the weights from the load cells.

These cells, which are the double bending type, guarantee high degrees of precision (combined maximum error of 0.075%).

Uniform loading system

Because the facility is a special "building" type requiring a large surface (12 m x 8 m) for its installation, a double salt dispensing system was designed in order to reduce the filling sections in half.



The tank for saline solutions



The traffic light system is controlled by management software that verifies the weights read by the load cells, then determines which hopper has the heaviest load and directs the operator to that one. This enables a uniform discharge of the salt and a correct distribution of the salt inside the facility.

Automatic discharge

After the vehicle is positioned under the hopper, the driver can proceed with simple automatic unloading operations from the "secondary" control panel on the central sidewalk without distancing himself from the vehicle.

By inputting his code and the quantity of salt to discharge, he can wait for the salt to be unloaded while standing beside the vehicle and leave immediately once the discharge has been completed. A set of controls is activated by the system and any faults are displayed on the monitor of the programmable terminal. For example, the opening of the discharge gate is enabled by the system only if the infrared ray sensors, located at every hopper, detect the presence of a salt spreader. This feature guarantees that the product will be prevented from being discharged to the ground instead of inside the spreaders.

The discharge gate, moreover, opens only upon the loading of the pressure accumulator of the hydraulic unit, which enables an immediate stop of the salt dispensing in any emergency situation (sudden power failures, emergency stop, etc.).

Special vibrators applied to the hoppers are activated automatically by the system to each outlet to ensure efficient flow of the salt. After this operation, the salt discharge data (date, time, operator, quantity unloaded, and unloading conditions) are stored into the computer's memory and the system's printer produces a printout of the report.

The next operator from outside the silo is alerted by the traffic light system and guided to the hopper determined by the system.

Electrical manual discharge

From the main control panel the facility manager can select manual unloading for special operating requirements.

While maintaining active all control systems and alarms (traffic lights,

vehicle positioning sensors, load cells, etc.), this setting allows the operator to manually perform the opening and closing of the relative gate to the unloading by means of an electric selector located on the secondary control panel. The recording and printout of discharge data is carried out normally as for the automatic unloading.

Emergency manual unloading

The facility is designed to handle extreme emergency situations, such as a total power failure.

In this case, the operator can resort to a manual emergency pump and a set of control levers included in the hydraulic facility to open and close the discharge gate with ease, dispensing the salt from the facility by means of gravity. This is another feature that contributes to the total reliability of the facility, because discharge of the salt is guaranteed in the most critical conditions that may arise during winter road maintenance operations.

Maintenance

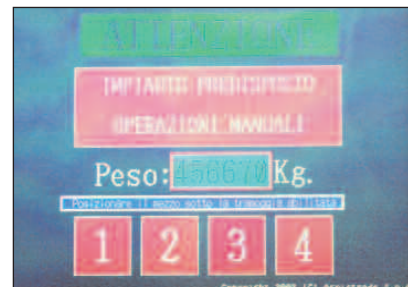
The facility manager has the option to cut out operation of one or more discharge gates from the main control panel in the cabin. This function makes it possible to perform maintenance on the discharge systems while keeping the facility operative. When the system recognises the disabled hoppers, it uses the traffic lights to automatically guide the operators to the operating hoppers according to the same logic as previously described, either with automatic or electrical manual discharge.

The many advantages deriving from the use of a self-service salt storage facility have been outlined and debated in previous conferences, and have been given field demonstrations at the Società Autostrade SpA headquarters. The reasons that convinced the Società Autostrade to adopt this innovative facility produced by Agristrade SpA can be summarised in the high quality and durability of the construction materials, the simple, yet comprehensive automated management system for the loading/discharge of the salt, the reliability of the discharge system, and the guarantee of its operation in emergency conditions.

Technical characteristics of the facility.

Corrosion-proof construction

The entire facility is built in high quality materials (vitrified sheet metal for the container, AISI 316 L stainless steel for the discharge equipment, galvanised steel for auxiliary and load bearing structures) which have demonstrated long life in previous installations.



The auxiliary control panel



The discharge gates with five openings under the individual hoppers



The hydraulic unit, manual and emergency for salt discharge



The load bearing structure of the silos in the installation phase



Curtain wall with panels to limit environmental impact

Watertight construction

The facility is completely watertight (verified with a leak test upon completion), ensuring excellent preservation of the ensilaged material. The chemical-physical characteristics and its sliding properties remain unaltered so that the spreading vehicles can be loaded correctly in any situation.

Discharge speed

The extremely simple discharge system allows operators to unload

8,000 kg of salt fully automatically and in less than three minutes without having to move the vehicle to spread the deicer uniformly inside the truck.

Precision discharge

Each column of the facility (15 in this case) weighs on a high precision double bending load cell (combined maximum error of 0.075%). This allows a precise statistical management of the quantities stored and dispensed by the facility.

Reduced operating power

The power used for each salt dispensing operation is only 1.5 kW for the movement of the discharge gate.

This is limited to very short intervals (fractions of a second) for opening the gate when discharge starts and closing the gate to terminate the operation, resulting in highly reduced management and maintenance costs.

Reliability

The four hoppers of the facility, and therefore the four discharge systems, are completely independent from each other. This ensures that there will be a sufficient number to supply the salt spreaders at all times, even in emergency situations.

Near-zero environmental impact

Because the facility is designed as an actual structure and can be painted in a colour of our choice, it integrates well into the building design of other structures in the Maintenance Centre.

Storage of machinery/vehicles

The facility has automated doors that enable safe storage of vehicles or machinery during the summer.

Among the many advantages we noted, these in our opinion are those most significant and those that will permit enormous improvements in winter road maintenance and the attainment of important goals.

For example, there will no longer be the problem of salt stored on the ground in large piles, which even when protected by large tarpaulins is subject to a runoff of atmospheric agents with related economic and ecological damage.

Because the salt is discharged quickly and automatically by one operator and can be spread immediately on the road, there is an optimum use of personnel and excellent road maintenance provided to motorists.

The accurate recording and storage of each operation allows immediate control and verification of the work performed by outside companies contracted to carry out salt spreading operations.

The precision of the weighing systems will lead to interesting developments in the future, already materialising in the Veneto region, specifically in the city of Venice, such as the use of the facility or similar facilities by other authorities in the area with economic benefits since investments and management expenses can be divided among several entities.

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