

COFIROUTE'S APPROACH TO WINTER SERVICE LEVELS

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Abstract:

Faced with increasing demand from motorists for uninterrupted mobility in all winter conditions, in 1996 Cofiroute's Technical Services and Operations Department started an in-depth study of winter maintenance, notably covering the following issues:

- General organization of winter road management,
- Tailoring of equipment resources,
- Road surface treatment methods,
- Behavior of different deicing agents on different pavement surfaces,
- Definition of the target winter service level. (The calculation and test methods used to assess the service level were presented at the 10th International Winter Road Congress (theme: "Strategies").)

Drawing on the conclusions of this detailed study, Cofiroute has revised its policy of winter serviceability of its motorway network. This article reviews the main evolutions implemented over the last 5 years, notably as regards intervention equipment and organization.

1. General context

Cofiroute is a private company that holds the concession for operating an 800 km motorway network in the north-west quarter of France. In this region where winters are generally mild, motorists do not appreciate any inconvenience caused by snow or freezing rain.

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This study was particularly pertinent in view of the increasing use of porous asphalt on Cofiroute's roads. While this pavement material is appreciated by motorist for the safety it provides in rainy conditions (the most common "bad weather" in our region), it is more difficult to treat in very low temperature conditions.

In parallel with this study, Cofiroute decide to reinforce its winter maintenance efforts notably as regards equipment, treatment methods, organization and training.

We present below the main evolutions in winter maintenance implemented by Cofiroute over the last 5 years.

2. Winter service level perceived by the motorist

2.1. Determinant factors

For a motorist driving in winter conditions on a given road network subject to given treatments, the perceived level of road safety is determined by various factors, notably including:

- a) Local weather in the region traversed by the itinerary,
- b) Road length and number of lanes,
- c) Thermal and hydraulic characteristics of the surfacing material,
- d) Characteristics of intervention vehicles (speed, payload of deicing agents...)
- e) Characteristics of the deicing agents employed,

- f) Training and organization of intervention teams,
- g) Traffic density (which depends on what we could call "motorist collective behavior"). This density can become very high (gridlock) even in low precipitation conditions.
- h) Behavior of individual motorists (vehicle preparation, risk-taking during precipitation, etc...), knowing that the breakdown of a single large truck can block an entire motorway.

The in-depth studies made by Cofiroute have succeeded in quantifying the impact of some of these factors and taking them into account in winter service planning.

2.2. Definition of service level

Blocking situations (for example, due to stoppage of a heavy truck) can arise even in conditions of light snowfall, especially when traffic is dense. We therefore decided to express the service level as the *average number of days per year on which an accumulation of snow occurs between consecutive passes of snow plows* - which implies degraded driving conditions (see Cofiroute's paper presented at the 10th International Winter Road Congress and figures 1 to 3).

The winter service level, as defined above, is obviously influenced by many factors, so the changes in Cofiroute's winter maintenance policy not surprisingly affect several areas.

3. Main areas of maintenance development

3.1. Observations on the limitations of salting and snow removal means

Cofiroute's salting equipment is of course largely sufficient to cover preventive treatments.

On the other hand, it is easy to demonstrate that during snowfall at normal rates and at moderate road surface temperatures, despite curative operations using conventional means (salting and scraping), snow still tends to stick on the road surface between passes of the snow plows. This accumulation of snow is observed even for rapid snow plow turnaround and for high deicing dosages.

As a simple example, for a surface temperature of about -3°C , and snowfall of $3\text{ kg/m}^2/\text{hour}$, and trucks with a 30 minute turnaround, it would be necessary to spread (while scraping) about 80 grams of deicer per m^2 at each pass.

Even if we were able to assure such heavy dosages and short salting intervals, one should remember that common chemical deicing agents do not assure instantaneous melting of snow (and, what's more, they tend to lower the surface temperature!).

Consequently during snowfall at relatively common rates and temperatures, snow deposits remain between successive salting/scraping operations. In these situations, the mobility of traffic (including that of the salting trucks) can be affected by the smallest incident.

Concerning porous asphalt, which has many advantages in rainy regions such as ours, we have confirmed that beyond a certain limit there is little to be gained in terms of service level by reducing the salting interval.

The time between passes of snow plows is a critical parameter to maintain a high service level. This time can be reduced notably in two ways:

- a) by enhancing the means: to obtain even a small improvement in the service level, a large increase in the means is necessary, given that the number of interventions each year is relatively small and, in most cases, localized;
- b) by reorganizing the resources in order to:
 - reduce the "dead time": loading, transfers (i.e. vehicle movements without deicing activity),
 - mobilize means over a area larger than the perturbed zone and move snow plows into this zone.

Consequently, Cofiroute has made a limited increase (10) in its number of trucks (now 60) principally to take account of the increasing area of roads paved with porous asphalt, while concentrating its main efforts on its organization.

3.2. Organization to reduce turnaround times

3.2.1. Design of snow removal routes

In classic snow-removal circuits, trucks can spend a significant portion of their time making non-working transfers or U-turns via service exits. Recovering this lost time can be equivalent to adding an additional truck!

Today, we adopt a new approach to routing planning: during precipitation, we favor simple circuits covering the main carriageway only (i.e. excluding slip roads, parking areas, etc.) and running from one Operations Center to the next (about 60 km apart) where the trucks reload. The usual geographic limits of responsibility of Operations Centers are ignored during curative operations.

3.2.2. Loading stations

Reloading can account for a large portion of a snow plow's time; this portion depends on the truck's fuel autonomy and payload - and on the organization of the loading station. In view of the time spent refueling and loading deicing agents, Cofiroute works constantly to make its loading stations more efficient.

3.3. Concentration of trucks

Once the truck loading stations and circuits are optimized, it is vital to concentrate the vehicles where they are most needed.

3.3.1. Prior assignment of trucks

When investing in new trucks, Cofiroute allocates them taking into account not only the length of road to be covered (allowing for the weather pattern and assuming homogeneous traffic over the whole network), **but also the risk indices (cf figure 1) and the actual traffic on each section. The aim is to assure a uniform service level over the whole network.**

3.3.2. Concentration of trucks in zones under pressure: the Solidarity Principle

In the past, each Operations Center covered a given section of the network, and triggered alerts and undertook actions autonomously and independently.

In our region, where snowfall is most often localized, a single Operations Center could be engaged in snow clearance without any mobilization of neighboring Centers.

Today, the weather situation is assessed globally, and is known to all, notably via Intranet. An Operations Center is mobilized when a neighboring Center is faced with snow or freezing rain.

The "Center-to-Center" routing approach mentioned previously facilitates the application of this solidarity principle. Moreover, successive "translations" between Centers are used to concentrate snow trucks in the affected zones to the detriment of unaffected ones.

3.3.3. Concentration of snow plows on a limited number of lanes

In the past, we attempted to keep the whole carriageway clear, even during precipitation (an approach which could lead to blocking situations).

Today, during snowfall, deicing and snow clearance are limited to a number of lanes, abandoning one or more right-hand lanes while the precipitation persists. The objective is of course to reduce the salting interval and keep the motorway open to traffic - at least partially. Complete clearing of all the lanes is started only after the precipitation has stopped.

3.4. Evolution of equipment

3.4.1. Truck payload and autonomy

The autonomy of Cofiroute's salting vehicles has been increased so as to reduce the proportion of time spent loading (or making non-working transfers), and to enable the "Center-to-Center" routing necessary to apply a solidarity principle between Operations Centers.

A new model of vehicle has been chosen to replace the ones being taken out of service at Operations Centers. Today, all the centers are equipped with these new vehicles.

3.4.2. Brine spreaders

Cofiroute's equipment has always included brine trucks which fulfill several functions:

- the usual "spreading" function of liquids on the road surface;
- the "mixing" function to ensure free, permanent circulation of liquids (notably for products in suspension for which pipework blockages can pose a problem);
- the "fabrication" function to prepare solutions and suspensions (e.g. calcium chloride).

With the increased use of "wet salt" techniques, the use of these brine trucks was decreasing. However, in order to re-assess their role, Cofiroute performed new laboratory tests which confirmed (once again!) the very strong dependence of ice melting speed on the the presence of water.

For this reason, Cofiroute decided not only to keep brine trucks in its fleet, but to develop the more efficient models that now equip its Operations Centers.

3.5. Organization of Control Stations

3.5.1. Action coordination and supervision

A manager is appointed to coordinate actions over a given section of motorway (about 300 km in length).

3.5.2. Handling of motorists' calls

As for the organization of the curative operations circuits, the solidarity principle between Operations Centers is also imposed in the organization of the Control Stations.

The work-force of a Control Station is often reduced at night and weekend. While the personnel on duty is sufficient to handle purely operational tasks, it may be difficult to handle at the same time telephone enquiries from road users concerning traffic conditions, for example.

To avoid saturation of the Control Stations, "non-operational" calls are redirected:

- a) to an Operations Center not concerned by the event, and therefore more available.
- b) then, if required and as rapidly as possible (less than 2 hours), to a Crisis Unit to provide information to road users by telephone.

3.6. Personnel training

Cofiroute internal staff (or those of subcontractors) are trained in the various techniques of winter maintenance. Their training programs notably cover:

- use of deicing agent fabrication systems,
- driving and use of winter service vehicles,
- road meteorology.

To adapt the programs and certain training courses to each individual, the knowledge and skills of Cofiroute personnel are regularly and individually evaluated.

3.7. Information for motorists

Cofiroute's own permanent customer information service includes:

- Displays at the toll barriers;
- Broadcasting of messages on the "Autoroute FM" radio channel;
- Specific messages on electronic panels along the motorway;
- Internet and Minitel services;
- "COFIROUTEL" voice server.

During crisis periods, to handle additional calls these means are complemented by a special Crisis Unit that can be brought to its peak capacity of 6 telephone operators within 2 hours.

4. Summary and conclusion

The studies concerning road deicing agents and winter service levels have led Cofiroute to:

- increase its vehicle fleet slightly with the goal of assuring a uniform service level,
- modify the vehicles notably to increase their autonomy.

Regarding road surface treatments, Cofiroute is pursuing its own research and tests on porous asphalt.

The main changes as regards winter serviceability concern the organization of curative interventions: the general situation is assessed over the whole of the motorway network, but trucks can be directed and concentrated in adversely affected zones, regardless of the Operations Center to which they are normally attached.

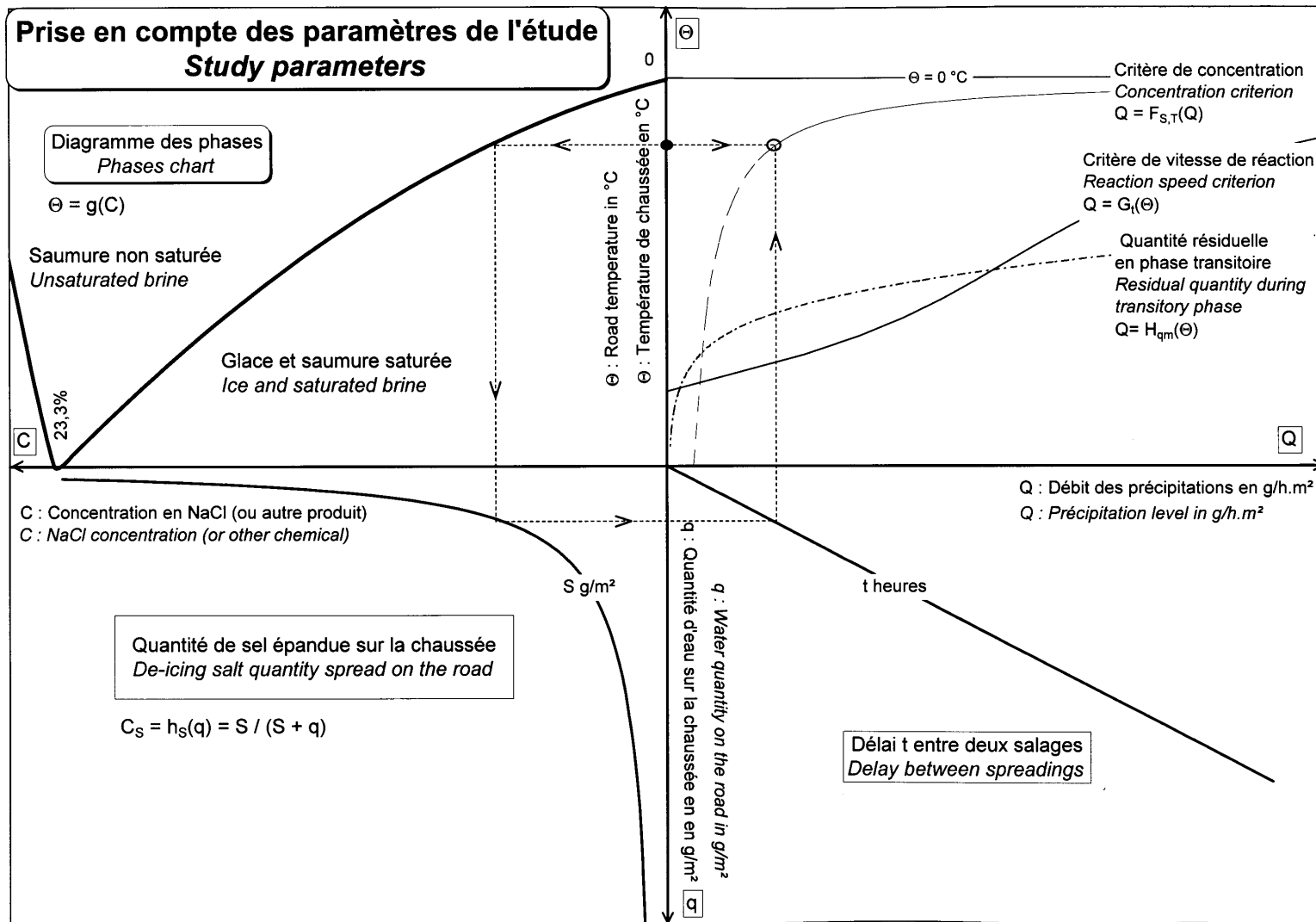


Schéma 1

**QUANTITE CUMULEE DE PRECIPITATIONS SUR LA CHAUSSEE
CUMULATED PRECIPITATION QUANTITY ON THE ROAD**

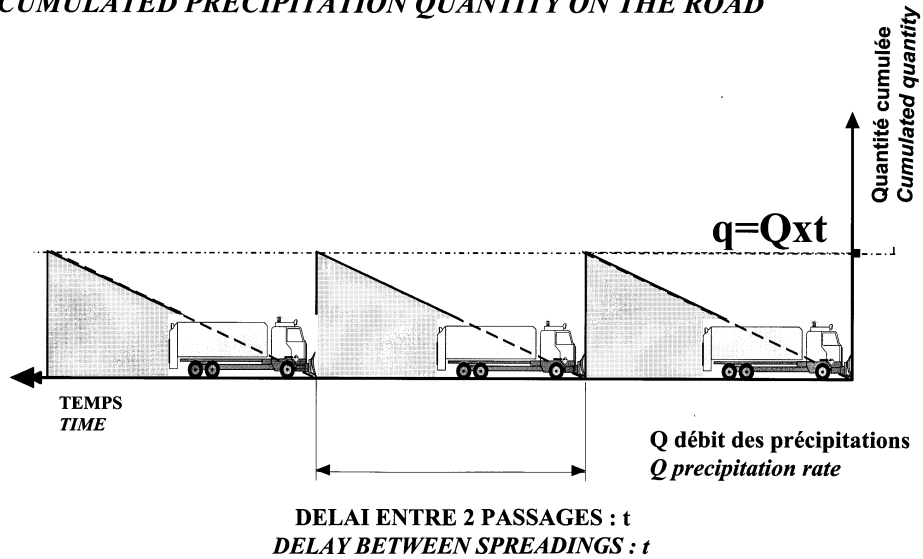


Schéma 2

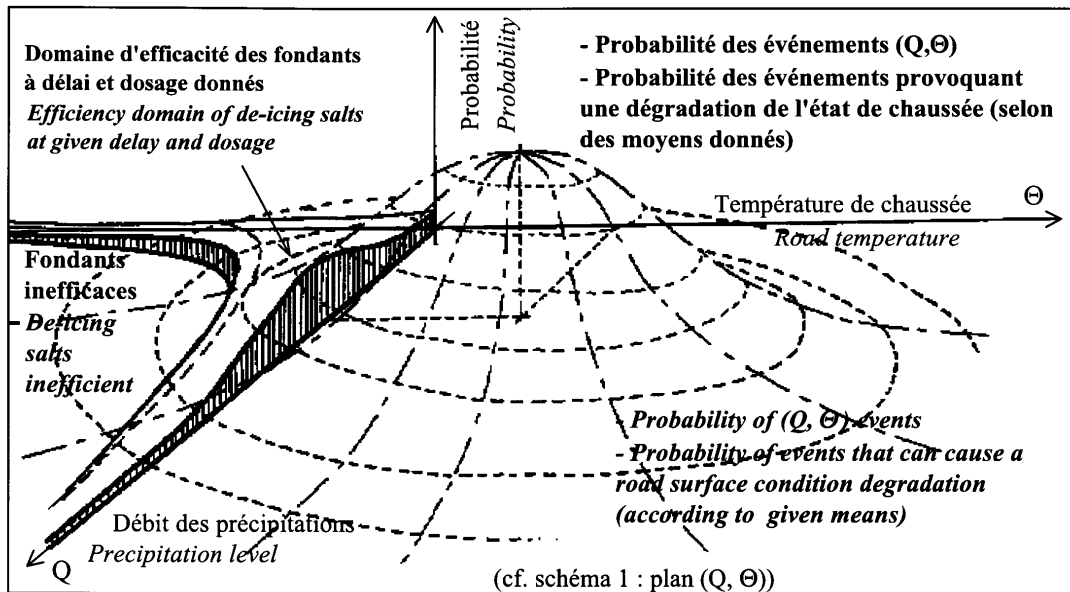


Schéma 3