Pollution Prevention Technical Information note

Safe storage and use of de-icing products December 2010

1 Introduction

Most de-icing agents have the potential to cause environmental damage, particularly if they're stored or applied inappropriately. This technical note gives good practice guidance, but doesn't overrule the manufacturer's instructions. To reduce the environmental impact of using de-icers you should:

- follow this guidance and/or the manufacturer's instructions;
- understand the drainage systems around the treated area(s).

2. Common de-icing uses

The areas where de-icers are commonly used and those responsible for applying them include:

- motorways and trunk roads, local roads, cycle paths: road authorities, community and retail;
- pavements and pathways: local authority, commercial, retail, community, privately owned;
- airports and airfields (commercial, military and privately owned): aprons, planes, runways, car parks;
- railways: track, station platforms, car parks;
- car parks: private owned, local authority, community, commercial, retail.

3. Types of de-icing agents

De-icing agents are categorised according to their chemical composition. Products in the same category exhibit similar characteristics for example, all chloride based de-icers are highly corrosive to steel and aluminium.

- Chloride based: Sodium chloride (NaCl), magnesium chloride ($MgCl_2$) and calcium chloride ($CaCl_2$). These de-icers can also be mixed with corrosion inhibitors and anti caking agents such as sodium ferrocyanide.
- Acetate based: Calcium magnesium acetate, potassium acetate and sodium acetate.
- Formate based: Potassium formate and sodium formate.
- Urea based: Urea (also called carbamide).
- Glycol based: Ethylene glycol, propylene glycol, diethylene glycol.
- Additives: Agricultural based additives e.g. molasses. corrosion inhibitors and anti caking agents.

De-icing products are generally available as liquids and/or solids (granular, crystalline). The choice of the product type and form either as it's supplied and/or applied will be influenced by:

- efficiency in terms of:
  - lowest effective temperature;
  - penetration;
  - speed of action;
  - longevity;
  - dispersion susceptibility (e.g. by wind or rain);
- financial costs (of purchase and application);
- storage facilities and their security;
- application equipment (including Personal Protective Equipment);
- availability of competent staff to apply it.

4. Effects of de-icers

Table 1 shows some of the benefits, problems and environmental impacts of the main types of de-icers.

Type	Benefits	Problems	Environmental Impact	Comments
Chlorides				
Sodium chloride	• cheap • effective down to -7^{o}C * see note below this table • easily applied	• corrosive to steel, aluminium and re-enforced concrete	• high conductivity in watercourses • can be toxic at high levels • can build up as sediment in watercourses • harmful to vegetation	• most commonly used type as rock salt
Magnesium chloride	• effective down to -55^{o}C • can be used in solid or liquid forms	• corrosive to steel and aluminium and attacks concrete	• damages vegetation • may leave oily residue	• used at very low temperatures (-55^{o}C) that are not often experienced in the UK
Calcium chloride	• effective down to -45^{o}C • used as solid or liquid	• corrosive to steel and aluminium and attacks concrete	• damages vegetation • may leave oily residue • skin and eye irritant	• used at very low temperatures (-45 ^{o}C) that are not often experienced in the UK
Brine and pre wetted salt	• up to 25% reduction in rock salt usage • better adhesion than rock salt • faster application rates	• easily dispersed by rain	• high conductivity • possible storage problems	• brine may be stored as a dry salt requiring a batching plant to produce brine that can be held as a liquid
Acetates				
(Sodium, Calcium and Potassium)	• non corrosive to most metals • effective down to -22 ^{o} C • last longer than salt • less effective below -5 ^{o} C than salt, requires greater application rates	• corrosive to galvanised steel • 20 to 30 times more expensive than rock salt per tonne	• low toxicity • degrades in water environment which can cause low oxygen levels – BOD ** see note below this table	• acetates are mostly used on airport runways as they're less corrosive to aluminium

Formates				
(Potassium and Sodium)	• mostly non corrosive to metals and surfacing materials • effective down to -25 ^{o}C	• not often used in UK due to lower effective temperature range	• relative low toxicity • degrades in water environment • lower BOD than acetates	
Urea	• non corrosive to metals and surfacing materials • low conductivity • effective down to -12 ^{o}C	• lightweight granular forms can be easily blown away	• breaks down to ammonia and nitrates in the water environment • ammonia is toxic to aquatic life even at low levels	• presumption against the use of urea unless area to be de-iced drains fully to a treatment plant or is fully contained
Glycols				
Ethylene glycol	• non corrosive • good adhesion • low conductivity • effective down to -12 ^{o}C	• expensive	• large BOD • toxic to animals and humans at high concentrations	• viscous liquids used for de-icing aircraft
Propylene glycol	• non toxic		• exerts a higher BOD than ethylene glycol	
Additives				
Agricultural by-products e.g. Safecote – molasses additive	• enhanced performance • reduces corrosion • increased adhesion leads to fewer applications and reduced volume of salt	See chlorides • strong odour	• high BOD which can have a significant impact on small sensitive watercourses • can be a storage problem as a point source of pollution	•
Corrosion inhibitors e.g. Sodium nitrite, Benzotriazole, Sodium benzoate	• reduce corrosion effects at very low concentration (less than 1%)		• can be more toxic than more commonly used de-icers	• product data sheets provide information on specific inhibitors
Anti caking agents e.g. ferrocyanides-ferric or sodium	• management of stored salt to prevent crusting and caking.		• ferrocyanides can break down in the environment to form cyanide and hydrogen cyanide which can be toxic to wildlife	• percentages present are related to the moisture content of the salt

* The lowest effective temperature will depend on the formulation of a particular product. Some products can be a mixture of two forms of de-icers with other additives to enhance performance.

**** BOD - Biological Oxygen Demand. This is the amount of oxygen used up by naturally occurring micro-organisms when they break down organic material. If the concentration of the organic material is high enough, the oxygen levels in a watercourse can be depleted quickly which kills fish and causes water quality problems.

5. Storage

5a.Solid de-icers

All solid de-icers must be stored safely to prevent serious environmental damage.

By far the most commonly used solid de-icer in the UK is rock salt but the following advice and guidance also applies to other solid products. Because large quantities of salt are stored, there's a high risk of polluting the water environment by run-off from the stockpiles. This risk can come from both the salt itself, sediment mixed in with the salt, the sodium ferrocyanide anti-caking agent which is often added to it and other additives e.g. molasses. Even when a stockpile is removed, the ground beneath it may remain contaminated.

We recommend that salt stores are roofed or, if this isn't practicable, covered with an impermeable membrane. They should be sited on an impervious base at least 10m away from the nearest watercourse or soakaway. Drainage from stores and loading areas should pass to the foul sewer or a sealed tank. You will need the prior permission from your sewerage treatment provider before you make any discharges to the foul sewer. You may need a trade effluent consent which will set quality and quantity conditions.

You mustn't allow drainage from solid de-icer stores to run into a watercourse or soakaway without an Environmental Permit from us. The permit will contain strict quality conditions to protect the water environment and are not issued automatically.

You should have management systems and equipment in place to make sure the solid de-icer from the store can't spread onto the open yard, for example by regular cleaning and a ramp across the entrance.

Uncovered roadside salt stores may cause localised pollution problems. You should consult us about their location and how the salt is stored.

5.b Liquid de-icers

The storage of liquid product de-icer such as urea, acetate, glycol or brine should comply with the standards outlined in the Highways Agency Trunk Road Maintenance Manual, reference 1, and our Pollution Prevention Pays guidance, reference 2. We recommend that you produce an incident response plan. Our guidance in Incident Response Planning: PPG21, reference 3, will give you advice on how to write one. Any drainage from the store or loading area should be positively drained i.e. not allowed to soak away and should not pass into the surface water system or to soakaways.

Fires, involving urea stores particularly, represent a considerable pollution hazard as any fire water run-off is likely to be extremely polluting. You must consult us about the location of any new stores and write a site specific pollution incident response plan dealing with the risk of fire; reference 3. The plan should include the management of fire water and the use of fire water retention systems, see our guidance on Control of Major Spillages and Fire Fighting Run Off: PPG18, reference 4.

In some cases, where serious environmental damage could be caused by fire water and remediation costs may be very high, you should work with your local Fire and Rescue Service and consider if a controlled burn may be appropriate to reduce water and air pollution, see our guidance on Controlled Burn: PPG28, reference 5. This may be more cost effective than installing a fire water retention system but will need the agreement of your insurer, the Fire and Rescue Service, local environmental health officers and the Health and Safety Executive. If a fire occurs, you must tell us promptly and make every effort to contain any fire water.

If you have a spill or any type of product loss to the environment, tell us immediately on our free incident hotline number 0800 80 70 60.

5.c Decommissioning of a de-icer store

If you're planning to take a de-icer store out of use, you need to consider how the stores are removed and the condition of the site after you've left.

All stores should be removed carefully to make sure the de-icing agents don't cause pollution as they're removed. Any storage containers should be removed from site.

If you're taking the waste off-site yourself as the waste producer, you don't normally need to be a registered waste carrier; the exception is if the waste is construction or demolition waste, when you will need to be a registered waste carrier to transport it off site even though you're the producer. If your waste is removed by a business, check that they're registered as a carrier to meet your legal requirement under the Duty of Care. We recommend that you occasionally check where they're taking your waste.

You must complete a waste transfer note for all waste you pass onto another person. If you're moving hazardous waste, you must complete a consignment note instead. More information is available on the government on-line business advice and support service, reference 6.

You should consider having the ground where your store was located tested for contaminants after you've left to check that any pollution has been removed. You may need to have work done to make the area safe.

6. Safe use of de-icers

6.a Loading and wash down areas

We recommend that drainage from these areas should connect to the foul sewer or a sealed tank. You will need the prior permission from your sewerage treatment provider before you make any discharges to the foul sewer. You may need a trade effluent consent which will set quality and quantity conditions.

6.b Application

Always follow the manufacturer's instructions for using de-icing products. Over-application is costly, increases the risk of damage to the environment and may present a safety hazard to both the public and your staff. You should invest in suitable equipment to apply your chosen de-icer and train your staff in its correct use. We recommend that, if you are using any de-icer other than rock salt, you contact us for information on potential impacts on environmentally sensitive locations.

6.c Treated area drainage

A clear understanding of the site drainage is a pre-requisite for good site management and appreciation of the potential impacts of using de-icing products. We may require site owners to demonstrate their understanding of drainage and where any run-off will end up.

6.d Written plans

As de-icer users, we recommend that you have a written procedure for de-icing activities at your sites. This should include details of:

- the areas you will treat;
- the products you will use;
- when, how and by whom the products will be applied;
- how and where your products are stored;
- your individual site drainage plan;
- a simple assessment of potential impacts on the water environment;
- risks associated with all the above and how these are to be managed.

7. References

1. Highways Agency Trunk Road Maintenance manual volume 2 (routine and winter maintenance code) available from the Highways Agency website

2. Pollution Prevention Pays booklet and DVD available from the Environment Agency website below

3. Pollution Incident Response Planning: PPG 21

4. The Control of Major Spillages and Fire Fighting Run-off: PPG 18

5. Controlled Burn: PPG 28

6. The government on-line business advice and support service:
   - For England – Business Link www.businesslink.gov.uk
   - For Wales - FS4B www.fs4b.wales.gov.uk

The above Pollution Prevention Guidelines (PPGs) are available free by calling our enquiry line on 08708 506 506 or from our website www.environment-agency.gov.uk/ppg

Other useful references:

Association of Train Operating Companies (ATOC) – Operators Safety Group Guide Good Practice Guide – De-icing Agents for Station Use 2005 – available from ATOC Good Practice Guide for De-icing Stations