

ÉTANCHEITE DE PAROIS DE TERRILS

IMPERVIOUS FACING TO WASTE TIPS

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► Résumé

La méthode d'étanchéité choisie pour éviter la lixiviation par les eaux de pluie de terrils des mines de potasse d'Alsace est innovante car elle permet l'essorage du terril. Les eaux de pluie recueillies sur l'étanchéité n'ayant pas été en contact avec le sel peuvent être dirigées vers le réseau des eaux pluviales.

La géomembrane bitumineuse a permis de contribuer à soulager la nappe du Rhin d'un apport chronique de sels et à protéger ainsi notre environnement et les ressources en eaux potabilisables.

Mots clés : couverture, terril, lixiviation, bitumineuse, géomembrane

► Abstract

The approach used to prevent rainfall leaching chemicals from a waste tip at a potash mine in north-east France is innovative because it allows the tip to drain. Rainfall shed by the waterproof covering does not come into contact with the salt and can be discharged to the storm sewer system. The bituminous geomembrane is helping relieve the Rhine from chronic salt inflows, protect the environment, and conserve drinking water resources.

Keywords: *impervious covering, waste tip, leaching, bituminous, geomembrane*



Photo 1 Vue générale du site avec différentes phases du chantier :
préparation du support, géotextile, géomembrane, recouvrement en terre /
*Overview of the site with different phases of the work:
preparation of the support, geotextile, geomembrane, covering soil.*

1. INTRODUCTION

Industry produces large amounts of waste unsuitable at present for re-use or recycling. For reasons of cost, they are currently stockpiled in conical waste tips at the production site. Waste tips are highly visible near disused mines over practically the whole of France.

Some tips like those at coal mines present no danger known to the environment and the vegetation that eventually covers them helps them blend into the environment. Other stockpiled materials dissolve in infiltrating rain water and entrain pollutants towards streams and aquifers.

This problem can be approached in two ways:

- The polluted material exposed to leaching by rain water can be removed to landfills adapted,
- The sides and top of the tip can be made waterproof and run-off collected at the toe so that it does not come into contact with the polluted material.

The first alternative is very costly because it involves hauling large quantities of material over long distances to the appropriate landfill site. Over the last twelve years, covering the tip with a grassed or bare bituminous geomembrane has been yielding satisfactory results at various sites in north, western and north-east France.

2. EXAMPLE OF WASTE TIPS IN NORTHERN FRANCE

The Lille branch of Colas Nord Picardie has been covering waste tips with Coletanche geomembranes, with or without grass cover, since 1986.

2.1. Wattrelos Tip

In 1986, a large job was completed at Wattrelos on a stockpile of chromium ore refining waste. The tip is 10 metres high and covers an area of 40,000 m². The top is flat, with a fall of 1.5%, and an area is 20,000 m². It was covered with a bituminous geomembrane, 3.9mm thick. Run-off is channelled to a 6000 m³ holding pond lined with 12,000 m² of the same geomembrane material before flowing to the outfall. None of the geomembrane has any overlying protection and it has been exposed to sunlight and ultraviolet for twelve years without deterioration.

The geomembrane was installed on the top of the tip by a self-propelled seaming machine. To prevent uplift by strong winds, it is tied down into the underlying soil and weighted with concrete blocks, each placed on an extra piece of geomembrane to prevent it puncturing the main material.

Installation proceeded rapidly at 3000 m² per day on the top and slightly more slowly - 2000 m² per day - for the pond lining. The tip sides, sloping at 1.75H/1V, were simply covered with topsoil and grassed.

2.2. Containment of Waste at Carilhem France, 59)

In 1990, the local public works authority was faced with the problem of disposing of 18,000 m³ of ore refinery waste from the approach embankment to a bridge over the railway at Carilhem. It was dumped on the side of the Wattrelos tip, enclosed in a 7000 m² waterproof complex, one component of which was a bituminous geomembrane. The following table gives details of the complex on the stripped foundation and on the sides.

Waterproof Complex of Waste Soil Containment (seen from inside to outside)

Bottom	Face in Contact with Tip	Cap	Exposed Face
50cm stone 10cm sand Geomembrane Drain mat	Geotextile Geomembrane Drain mat	Air vents Geotextile Geomembrane	Geotextile Geomembrane Grass

The top was given a fall of 1.5% to shed rainfall into the holding tank described in 2.1 above. Since the outer faces are visible to residents, the appearance was improved by grassing over the geomembrane. To prevent it slipping, the soil is held in 17cm high gabions with geotextile wrapping around the bottom and sides to stop it running out.

Unlike the large Wattlelos tip, no precautions were needed against wind uplift because of the small areas involved. The rolls of drain mat, geotextile and geomembrane were dispensed from beams carried on a mechanical shovel. Geomembrane seams were made with a flame gun and flattened by hand.

2.3. Example of Higher Nearby Tip

A smaller (180,000 m³) but higher (14.50m) tip nearby was protected with the same type of bituminous geomembrane in 1991. The ore refinery waste was remodelled to improve resistance to slipping and a 5m wide berm was added. The material removed was used to shore up the toe of the slope. As at Wattlelos, run-off is collected with a holding pond discharging into the storm sewer system.

An internal drainage system discharges seepage from inside the tip.

The geomembrane was installed in the same way as before:

- The geomembrane alone seals the top
- The berm has the geomembrane and a geotextile
- On the geomembrane sealing the side slopes, there is a course of gabions, 20cm high, containing 10cm of 65-110mm aggregate and 10cm of topsoil, and grassed.

Since the bituminous geomembrane, unlike HDPE, has a very low coefficient of thermal expansion, strips could simply be overlapped like the tiles on a roof, which dispensed with the need for half the seaming work.

2.4. Installation of Geomembrane on Wattlelos Tip Sides

In view of the excellent performance of the tips covered with bituminous geomembrane, it was decided to use the same method for the 26,000 m² Wattlelos tip sides, consisting of a geomembrane, geotextile and 17cm gabions containing topsoil. In fact, the topsoil was finally only 7cm thick.

The geomembrane had sufficient strength to allow machinery filling the gabions to travel directly on it.

3. CHROMIUM OXIDE TIP IN NORMANDY

An electroplating plant in the nineteen-seventies was using copper cyanide and chromic acid and waste containing chromium dioxide was stabilised with cement piled in a space measuring 68 x 65 x 2 m³. To prevent leaching by rain, this was capped in 1995 with a complex consisting of

- a 15cm layer of 0-20mm random sand and gravel
- a 5cm layer of sand
- a 300 g/m² needle-punched geotextile
- a 4.8mm bituminous geomembrane
- a 15cm sand drain layer
- a 50cm layer of topsoil.

Clean run-off is collected in a perimeter drain. The work was performed in 1996 and covered an area of 4500 m². Seam continuity was tested with a portable echo sounding machine. Less than 1% of total seam footage had to be repaired.

Concrete blocks were placed at 15 metre intervals to prevent wind uplift until the two top layers were in place.

4. POTASH MINE TIPS

4.1.

The Company des Mines de Potasse d'Alsace have been worked since 1910, leaving 50 million tons of ore tailings in 17 tips near the workings. Ten per cent is sold as de-icing salt.

The highly pervious soil in the Alsace plain contains a very abundant Rhine aquifer supplying water for all purposes in this densely populated region, and French, German and Dutch residents have repeatedly complained of the increased salinity of the river. To answer these criticisms, the Company of Mines of Potassium of Alsace began the étanchéification of coal tips.

This day, two processes of waterproofness of the walls of the coal tip with superficial protection by végétalisation were experimented ~:

- Ensisheim's coal tips is, obtained waterproofness by means of a coat(layer) of clay,
- Coal tip Amélie 2 to Wittisheim ~: a membrane bitumineuse was applied during the summer, 1998.



Both approaches prevent rainwater infiltrating into the tip and underlying soil, provided the run-off is collected in a toe drain and discharged into the public drains.

The geomembrane will be protected with 40cm of topsoil and seeded. The tips will become grass-covered hills blending pleasantly into the surrounding countryside. Performance will be monitored for three years, in terms of leakage, soil stability, salinity and grass cover.

4.2. Bituminous Geomembrane

A geomembrane was laid, as said above, on the Amelie 2 tip in the summer of 1998. The top and sides were first remodelled by bulldozer before laying the geomembrane and 40cm of topsoil. The areas involved were 10,000 m² at the top and 20,000 m² for the sides. At the top, the geomembrane was unrolled in 4m strips, welded by flame gun and the seams carefully flattened. The thick covering of topsoil made it unnecessary to pin the geomembrane down against uplift by the wind.

The method used on the sides of the tip is different, in order to allow water inside the tip to drain away. The 4m-wide strips of geomembrane run almost horizontally, sloping 1.5% towards the outside, 1.5-2m apart (measured horizontally), so that they overlap rather like the slats of a venetian blind. This acts like a valve, shedding rain but allowing water to escape from inside. The ends of the strips overlap 4.00m, and are welded together in the same way as described above. All seams in the top and side covers were tested by an echo sounding machine.

5. CONCLUSION

The examples described of caps and containment to waste tips exposed to leaching by rainfall illustrate the advantages offered by bituminous geomembranes. They are easy to install, not always needing a geotextile underlay. If grassed cover is required for appearance or because ultraviolet exposure is excessive, the problem of holding the topsoil in place on the smooth sloping sides can be overcome by using gabions or synthetic mats which allow the grass to grow through.



Photos 2 et 3 Couverture de charrées issues du traitement de minerai de chrome / *Coverage of wastes coming from the treatment of ore of chromium*



Photo 4 Préparation de la couverture végétalisable / *Preparation of the cap*



Photo 5 Préparation du support, noter la qualité en phase 3 prêt à recevoir le géotextile / *Preparation of the support, to note quality in phase 3 ready for receiving geomembrane.*



Photo 6 Couverture par terre directement sur la membrane bitumineuse / *Capping by ground directly on the bituminous membrane.*



Photo 7 Machine à contrôler les joints par ultrasons CAC 94. / *Equipment to control joints by ultrasounds CAC 94*