Industrial by-products used in a landfill cover

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Introduction

A small industrial waste landfill in Obbola, Northern Sweden is being completed and a final cover is installed. The landfill is owned and used by SCA Packaging, a paper mill factory nearby. An alternative final cover will be used, consisting mainly of industrial by-products from the paper mill. The aim of using industrial by-products is to save virgin materials, not to use synthetic materials and to make a cost-effective and environmentally safe closure of the landfill, while relevant laws and regulations are complied to.

Construction of test area and sampling

To ensure and control that the final cover was constructed in a geotechnical and environmentally safe way and that it fulfilled the requirements in existing legislations, a test area 40 x 25 m was constructed in 2007. A 0.6 m thick layer of green liquor dredge (GLD) was used in the liner of the landfill cover. GLD is an alkaline by-product from paper mill production consisting mainly of $CaCO_3$. It has a low hydraulic conductivity which makes it suitable to use as a liner. Because of its high water content (37% dry weight), the GLD was mixed with rock dust in the proportions of 60/40 to increase the shear strength of the material and to increase the ability to compact the material. As drainage layer, shredded tires were used to a thickness of about 0.5 m. Shredded tires have high permeability and hence, high drainage capacity and they also have an isolating effect that prevents the liner to freeze during cold winters, which otherwise might cause cracks in the liner. The liner and the drainage layer were separated by a geo textile.

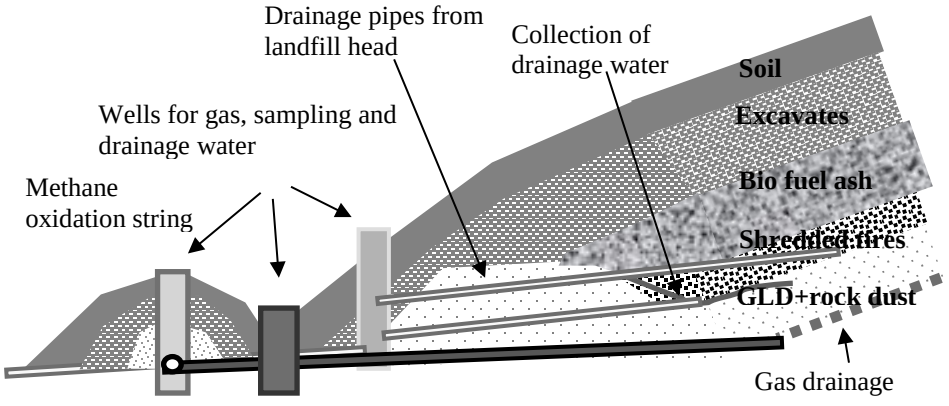

Figure 1. Cross section of test area of final cover at Obbola industrial waste landfill.

Bio fuel ash (mixture of bottom and fly ash) from the bio fuel incinerator of the paper mill, compost and excavated material were used in the protection layer from the bottom up to a thickness of 0.7 m of each layer. The purpose of using compacted ash in the protection layer was to prevent root penetration and to sustain the humidity of overlying layers. The protection layer was finally covered with a soil layer for plant establishment. Materials used in the cover were tested for leaching properties and mechanical stability before construction. The test area was prepared with six randomly spread lysimeters beneath the liner, six gas probes measuring the gas composition at two different depths and three temperature probes measuring the temperature at five different depths in the protection layer. The area was also prepared with drainage pipes and wells for gas and water drainage and sampling. Figure 1 shows a cross section of the test area. The test area has been monitored, and gas and water samples have been taken 1-2 times a year since the construction.

Results and discussion

Some field observations made so far is that the infiltration through the construction was 7.5 l/m^2*year in 2008 but which has decreased since then and was 0.21 l/m^2*year in 2013. This is far below the requirement of 50 l/m^2*year. Leachate collected from the lysimeters showed, compared to criteria's for waste accepted at different landfill classes, that the mean leaching of Mo and As exceeded the threshold value for inert waste up to two years after the construction of the cover but the concentrations then declined to levels below the threshold values. The concentration of DOC has increased since start and was above the threshold value for non-hazardous waste five years after construction. Regarding the high leaching of DOC it can be mentioned that in guideline values for waste used in landfill covers developed by the Swedish EPA, DOC is not included as a critical substance.

Table 1. Concentration of critical substances in leachate collected beneath the liner two (2009) and five (2012) years after construction. The concentrations are compared to acceptance criteria's for waste put in a landfill and to guideline values from the Swedish EPA for waste used in constructions.

Substance	2009 (n=6)	2012 (n=6)	Inert waste C_0	Non-hazardous waste C_0	Waste used in landfill covers
As (µg/l)	244±300	40.7±46.1	60	300	50
Mo (µg/l)	1165±462	198±173	200	3500	-
DOC (mg/l)	544±229	824±172	160	250	-

Conclusions

Certain industrial by-products can be used for construction of landfill covers and is a competitive alternative to conventional materials.