

Use of Fly ash from KKAB, for sealing of landfills

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Abstract –The paper must include an abstract, which should be no more than and 150 words.

Keywords: Fly ash, landfill, permeability, pilot surface, KKAB

BACKGROUND

KKAB (WtE facility) produces ash from burning fiber sludge from Metsä Tissues paper mill in Mariestad in Sweden. The raw material for the paper mill is mainly recycled paper. Paper contains, among other substances, paper fibers, clay and limestone. The fiber sludge has quite low calorific value, because the high content of inorganic material. The combustion process generates a lot of fly ash, 20 000 ton/year. The company KKAB is interested in the possibility to reuse the ash and Ramböll AB was commissioned to find an environmentally good application for their waste products.

The ash has been characterized geotechnically and chemically. Geotechnical laboratory testing was carried out on small samples. The tests showed that the ash had a high permeability. So for a long time it was considered that the ash was only suitable as a cover material for landfills.

But during another investigation of a landfill, we drilled for samples from the bottom of an ash landfill and the 10 year old fly ash felt as dry as new. The ash samples were put into non diffusion plastic bags and were left for a couple of days. When we looked at the ash after about 3 days, the ash had hardened significantly.

Chemically, the ash contains very low levels of heavy metals. Leaching tests carried out showed that the metal concentrations leaching out of the ash indicate that the ash can be classified as an inert sewage in accordance with EU legislation.

THE COMBUSTION

A combust test was used to investigate the possibility to use only fly ash as sealing material for to cover a landfill. Concerning permeability, the requirements for a sealing layer on a landfill for nonhazardous waste is a water velocity at $1 \cdot 10^{-9}$ m/s. The only natural material that is equivalent to that permeability is fine clay.

PILOT PLANT

In order to really know how the function of ash would be in full scale, we decided to build a pilot surface on a landfill.

Following prerequisites were set for the test:

- The ash layer should be 1 meter
- Two different way of constructions should be tested
- The leachate should be collected in lysimeters.
- Half of the lysimeters would be placed under the 1 meter ash layer and the other half in the middle of the layer at 50 cm level.

- In order to “stress” the system, there would not be any overlaying security layer – only 30 cm of topsoil.
- All the lysimeters were filled up with water and tested before they were covered with ash.

The lysimeters are made of plastic boxes with two plastic tubes – one for water out and one for air in. They are filled with macadam (crushed gravel) and sand. The function of all the lysimeters were controlled before they were covered.



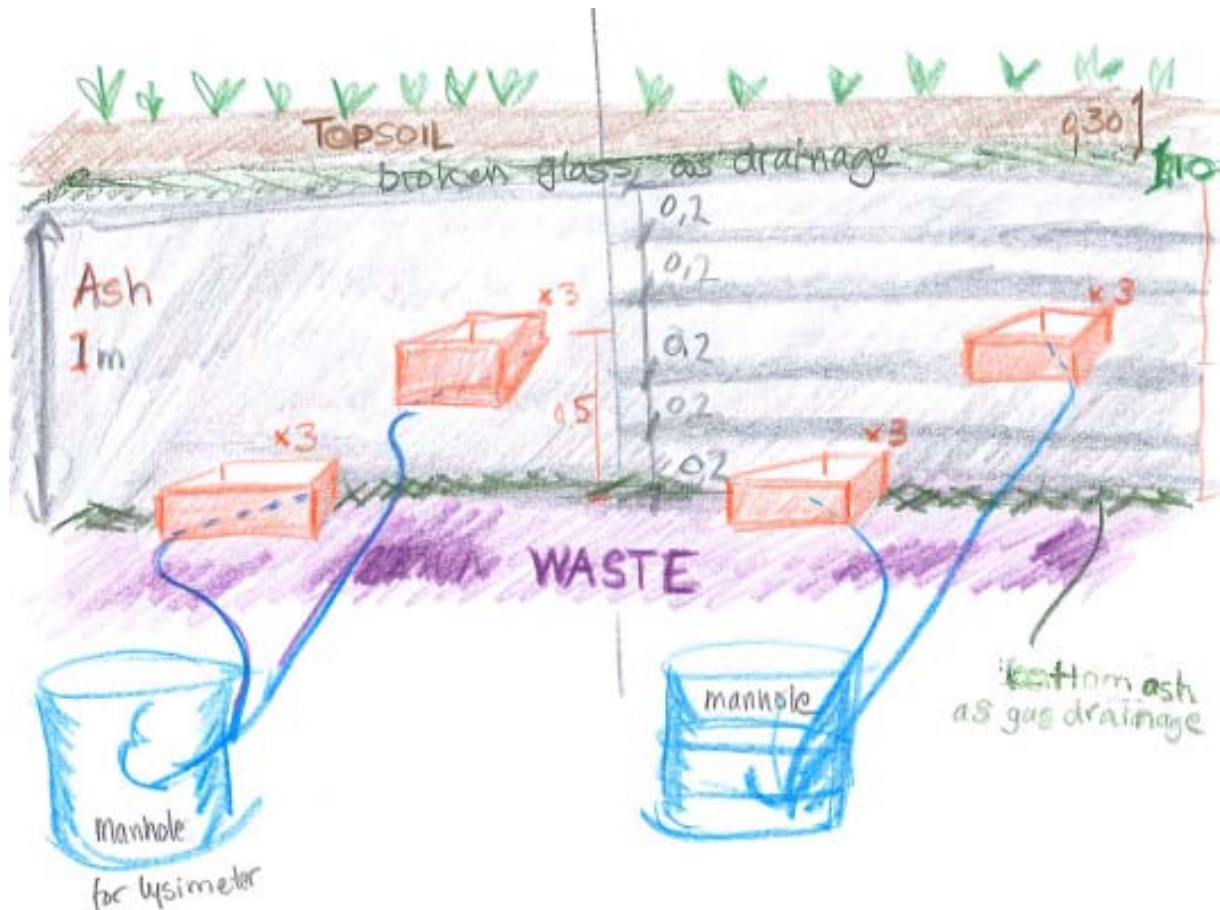
Picture 1 *Filling the lysimeters.*

The pilot surfaces were constructed in two different manners.

One was laid out in two 50 cm layers without water added and without any extra compression. The other one was laid out in 5 layers of 20 cm each. Every layer was irrigated, in order to hardening.

The purpose was to see if the permeability is depending of the way of how the ash is treated in the construction.

As gas drainage was used both bottom ash and broken (recycled) glass.



Picture 2. The picture shows the schematic layer construction and schematic design of the two pilot surfaces. One with ash in one layer, without water added and one with water added every 20 cm. There are 6 lysimeters in each surface. 3 in the middle and 3 at the bottom (over the gas drainage layer).

During the construction time the weather went from autumn into winter. During the autumn, there was a lot of rainfall and during winter it was really cold and all precipitation came as snow.



Picture 3 Snowy day during construction of the pilot surfaces.

SAMPLING METHODOLOGY

Water samplings are collected from the lysimeters, by pumping from the long tubes. We use a vacuum pump. It was planned to take mixed samples from the two surfaces for to analyze metals and organic substances.

In the sampling program is scheduled sampling every 3rd month for the lysimeters.



Picture 4 Pumping leachate from the lysimeters, using vacuum pump. The blue tubes are for water and the black for to let the air come in to the lysimeter. Just to avoid underpressure in the lysimeters.

RESULTS - PERMEABILITY

When water was to be pumped up from the lysimeters, it was so small amount of water, that it was only possible to control the metal concentration in the water.

The total volumes from the 12 lysimeters, during the last sampling occasions are presented in the table below.

Dates for sampling of water from the lysimeters	(The first test) 2010-04-21	2010-10-25	2011-05-09	2011-09-15	Total for 18 month
Total volume (l) from 12 lysimeters	3,75	0,3	0,05	0,15	4,25
Equivalent to liter/m ² a year	6,25	0,50	0,09	0,25	2,7

These values are to be compared with the EU legislation concerning permitted permeability for covering layers on landfills:

- Landfill for non-hazardous waste – maximum 50 liter/m² a year
- Landfill for hazardous waste – maximum 5 liter/m² a year

RESULTS – METAL IN LEACHATE

The content of metals in KKABs fly ash has been tested by leaching tests in laboratory. Leaching of metals from the fly ash shows that the ash would be classified as inert waste. It is only barium which is a bit too high, comparing to the limit values in the legislation. But compared to the levels for Swedish natural moraine, the levels are under the average level.

QUALITY CHECK

When things seem too good to be true, they usually are, so we had to check if the lysimeter tubes were undamaged. We pumped in a certain volume of colored water in to every lysimeter. Let the water be there for half an hour and pumped it out again. All the lysimeters gave water back, in an acceptable volume. – So the answer was – it was true!



Picture 5 Quality control – Pumping in green water into the lysimeters, in order to check if the system is damage or broken.

CONCLUSION

The fly ash from KKAB is an environment friendly material, whose geotechnical properties, make it an excellent material for sealing landfills, but also at good material for stabilize polluted soil, clay etc.

It is not necessary to mix the ash with sludge for to get a good sealing material and the ash is not negatively affected by frost. So it is OK to skip the cover of soil, whose function is to protect the sealing layer against frost.