

In cooperation with:



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Landfill mining: What is the potential in Suisse Romande?

Introduction

Landfill mining is the concept of seeing the current landfills not as final destinations for unwanted materials but a valuable sources of materials. This brings the following possibilities:

- Add a **new value** to materials that had already lost it, and save on ores extraction.
- **Sanitize** old polluted places and thus **reduce the hazard** of water pollution.
- Old waste deposits might be a critical way to add an **extra resource** stream to meet the future needs.



Map of the location of all polluted sites in Switzerland. Only in old polluted sites there are an estimated 93 million CHF of value in metals currently interest in the territory of Suisse Romande.

Source of the map (BAF) – Sélection du traitement du site pollué

Types of landfills in Switzerland

For the purposes of this study we focus on the following 3 types of landfills:

- **Bioactive controlled landfills (DCB):** These landfills contain the ashes from incineration, as well as other hazardous materials: including asbestos, and highly polluted soils.
 - **Inert material controlled landfills (DCMI):** This landfills contain the non-recycled fraction of construction waste, including asbestos.
 - **Polluted Sites (PS):** These sites are defined in law as any site that has the possibility to pollute the environment, which can be old landfills, industrial sites and accident sites. In this study we concrete on polluted sites which are old landfills of municipal solid wastes and other materials.
- There are also the Stabilized Material Controlled Landfills (ISDS) these are not within the scope of this project.

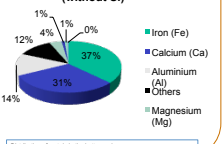
DBA – Chatillon (FR)



General view of the Chatillon landfill. Source: Ville de Fribourg

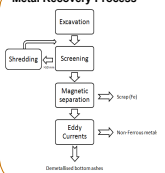
We have chosen the DCB of Chatillon (FR) for a detailed study of potential. The site is in operation since 1995 and is divided into two types of compartments.
•Bottom ashes (24 %): they consist of the BA coming from the MSW of SAIDEF, mixed with a little proportion of sewage sludge ashes of the WWTP (STEP) of Fribourg.
•Mix compartments: they consist of a mixture of bottom ashes, polluted soils and other hazardous materials, mainly friable asbestos from construction.
The potential of metal recuperation is only found in the bottom ashes compartments, due to the complexity of environment protection measures needed to excavate the mix compartments. However, most of the BA compartments can no longer be accessed because either they are already under more recent mix compartments or their excavation would endanger the landfill stability.
A landfill mining project is already starting to be implemented in partnership with SFR (Société Fribourgeoise de Recyclage).

Main metals distribution in the bottom ash (without Si)

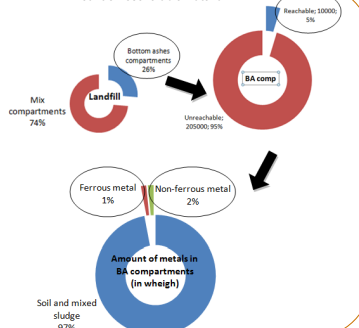


Distribution of metals in the bottom ashes

Metal Recovery Process



Amount of recoverable material



(left) Magnetic and EC separator scheme (Center) EC separation in Chatillon (Right) Non-ferrous metal exiting the EC machine



Economic Evaluation

	Metal	Average price CHF/ton	Average ton/year	Average CHF/year	(150% price) CHF/year	(150% price) CHF/year
Ferrous	80	36	36	1296	1944	1944
Non-ferrous	800	393	393	314,400	471,600	471,600
Total				315,696	473,544	473,544

We estimate a cost of operations of 60 CHF/m³, which would mean 937,000 CHF/year, rendering the project unprofitable. However, the current project is still in experimental stages and the real costs are very difficult for us to evaluate precisely.

SP – La Colliare (VD)



Aerial view of the site, the site of the La Colliare is highlighted within the red square. (source SESA 2012)

As specific site we have picked the old landfill site of La Colliare in the commune of Penzhaz (VD). This site has been exploited as a waste dump for MSW, shredder residue, and bottom ash from the 1960's to the 1990's (SESA 2012). The site is made out of 3 separate landfills in an old quarry, 2 small and 1 larger site. Due to water contamination the site was declared a contaminated site and a reclamation project was started. Due to the size of the site, it was decided not to remove the material from the site. Importantly, in the Figure 18 it can be appreciated that the site is situated next to a river, and although the site itself does not have any barrier against water pollution, this must be taken into account. The two smaller sites were dug out and the landfill was consolidated into the larger site. As of today, the two smaller sites have been reclaimed and have shown clear signs of environmental recovery (SESA 2012). The larger consolidated site is currently being monitored and a reclamation project for it is being planned.

Mean composition of a landfill

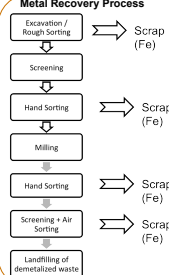
	Value	Source
Mean Density of a Landfill	889 kg / m ³	Bottom 2000
Total ferrous metals in landfills (weight)	1.7%	VAN VOSSEN (2011)
Total non-ferrous metals in landfills (weight)	0.2%	VAN VOSSEN (2011)
Ferrous metals total benefit per ton (2011 CHF)	313	VAN VOSSEN (2011)
Non Ferrous metal total benefit per ton (2011 CHF)	625	VAN VOSSEN (2011)

Composition of SP – La Colliare

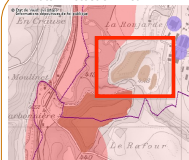
Type	Volume (%)	Total Volume in SP-LA Colliare m ³
Bottom ash	22%	185,000.00
Shredder residue	22%	185,000.00
Municipal Solid Wastes	40%	300,000.00

The site contains a total of 750'000 m³ of volume, the total waste is distributed between bottom ash, shredder residue and MSW (SESA 2012). The shredder residue is the dematerialized result of the shredding of cars and household appliances, and contains plastics and heavy metals, see (Menard 2007) for more details on its composition. For the purposes of this analysis we consider that the bottom ash has the same characteristics of the material found in DCB Chatillon, and that the MSW waste has the same characteristics as that one found in "Les Communales" and "Les Romaz" landfills which were reclaimed in 2005. For the economic analysis we only consider recovering ferrous metals from the MSW, this is as was done in these two landfills.

Metal Recovery Process



Water Protection Area



This site is next to a river, and although the site is outside the water protection zone there is still the potential for water pollution that must be taken into account.

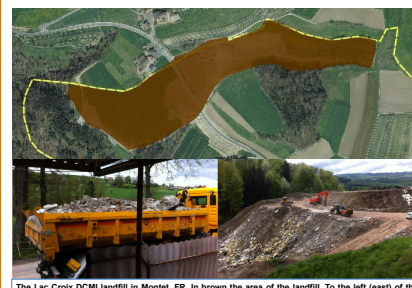
Examples of materials from the La Colliare site.



Economic Evaluation

This old quarry has a significant amount (750'000 m³) of mixed MSW, bottom ash, and shredder residue. We have seen that with the current metal prices and using reclamation strategies similar to previous projects the project would nearly cost 39 million CHF, with total costs of 45 million CHF and total income from metals of 6.5 million CHF. We note, however, that if metal prices increased around 7.4 fold the project would have a positive operating margin. Additionally, we recall that this cost estimate assumes that it would be possible to leave the non-recycled material at the same site; in the case where this would not be possible then the cost estimate would be significantly higher due to the costs of disposal of the material in proper controlled landfills (incineration plants, DCB and DCMI).

DCMI – La Croix

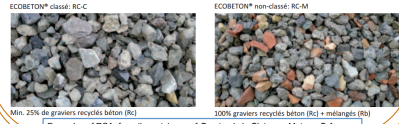


The La Croix DCMI landfill in Montet, FR. In brown the area of the landfill. To the left (east) of the road, the area is now covered and sealed, to the right (west) of the road this area is currently being exploited. The dotted yellow line is the cantonal boundary, south is canton Fribourg and north is canton Vaud. Source: Geoportail de Canton Fribourg (bottom Left) A truck coming in with waste to the DCMI La Croix, (bottom right) the current operational border of the landfill.

Although there is construction material suitable, it is mixed with other inert materials and its separation does not make economic sense. This type of landfill is intended to stock the construction material left after previous separation of the economically recyclable fraction. It also includes materials such as asbestos, whose treatment presents additional complications. Additionally, the specific site's structure means that most of the material is not reachable for excavation as it would destabilize the landfill. Due to the clear lack of economic potential of these landfills of the problems, a more detailed feasibility analysis was not performed.

Recycled Concrete Aggregate

This would be the main product possible from landfillmining of the DCMI. It involves using old structures to create new concrete aggregate, the Minerie-Eco standards encourages its use. Numerous commercial offerings for this material are found in Vaud.



Min. 25% de graviers recyclés béton (Rc) 100% graviers recyclés béton (Rc) + mélanges (Rc)

Conclusions

For landfillmining in Romandie we can reach the following general conclusions:

- There is a large amount of materials present in the region.
- With the current metal prices, none of the projects is directly profitable.
- From our analysis, the most profitable avenue is the landfill mining of bottom ash deposits; followed by old MSW dumps, while the DCMIs have almost no economic value.

DCBs have a clear economic potential, both due to the homogeneity of the input material, its concentration and high metal content. A significant problem for treatment is that the bottom ashes are cooled by water immersion in the incineration plant, so they reach the DCB with significant water content. This makes the separation of the metal fraction more difficult.

Specifically, DCMIs have almost no economic potential, while their volume of material is very large, it is in a state in which its reuse is very limited. An additional possibility would be looking for old construction material sites, not classified as DCMI but as polluted sites. These, however, due to the lack of information in the cadastre of specific sites with suitable material for transformation into RCA have to be found in a case-by-case basis and could be object of further study.

For polluted sites: The data available on the composition of current sites is very fragmentary, while a general estimation of the amount of material within the region is easily completed, the composition of the specific site requires an in depth study, this is a key economic barrier.

	Bioactive controlled landfills - DCB	Polluted sites - SP	Inert material landfills - DCMI
Material potential	✓	✓	✗
Technical Solutions	✓	✓	✓
Economic Potential	✓	✗	✗

References cited in this poster

SESA "Assessment de l'incinération de Colson - Canton de Vaud" Accessed May 20, 2013. <http://www.vd.ch/theses/environnementales/publications/assessments-de-charges-de-colson>
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