INTRODUCING THE PROJECT SOILUTIL

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Only 3% of the Earth is covered by fertile soil and even this is subjected to various soil degradation processes starting from organic matter decline and pollution through acidification to erosion. Management and disposal of various waste materials produced as a result of human activity is one of the actual problems to be solved worldwide.

The ideal solution gives an efficient waste utilisation alternative. The comprehensive aim of the Soilutil project is to ameliorate degraded/contaminated soil, improve the stability of swampy, instable soil and sustain on long term soil quality developing non-hazardous wastes utilisation technologies with the help of a modern engineering toolbox.

Proven and potential use of wastes as soil amendments

Several kinds of wastes can possibly be used for solving soil problems. Some of these are widely used, and some are in different phases of experimental verification. Hereby we introduce the most promising wastes for our goals, showing their main features and examples of their applications publicated.

Fly ash
Fly ashes from different combustion processes have been used for several purposes as soil additives. Due to its silica content it can be used as stabilizing agent for trace elements, as a K and Ca-fertilizer and for improviing water conductivity of acidic and sodic soil. Fly ashes somtimes contain toxic trace elements above limit, which may limit its usage as soil amendment. The management of great quantites of this kind of waste means additional expences for the energy plants, meanwhile at least part of it could be re-used as soil additive.

Red mud
Red mud is the by-product of alumina extraction from bauxite using caustic soda. It is an alkaline, sludge-like material with high iron and aluminium content. Red mud is proven to be efficient soil amendment by international and Hungarian experimental results in laboratory and on field. It is used for the stabilization of toxic metals, and for phosphorus fixation in soil (Summers, 1997)

Fe-Mn-oxide-hydroxide precipitates
This kind of waste originates from drinking water pre-treatment plants, wherethe Fe- and Mn-content of the water from the bank-filtration wells is oxidized by ozone and filtered by sand filters. Due to its Fe (II)-hydroxid content, this kind of waste can also be an effecitve amendment for immobilizing trace elements in paralel to its further oxidation. (Müller and Pluquet, 1998; Feigl, 2008)

Iron forges
The efficiency of (elemental iron (also called ZVI=Zero Valent Iron) in remediation is widely proven in publications, as reviewed by Cundy et al. (2008). Iron can be used for remediating soil or ground water, in situ or ex situ, used as soil amendment or as charge of a permeable reactive barrier. The mechanism of its effect is either coprecipitation or reductive reactions.

Olive mill waste
Many studies mention olive-mill waste or wastewater as a potential soil fertilizer (Roiz, 2005; López-Pinero, 2008; Mekki, 2009). Oil facturation is a prospering industry in Hungary as well, only using sunflower seed as feedstock instead of olive. Accordingly it can be an important goal to examine the possibilities of using sunflower oil facturing wastes in soil remediation.

Alcaline wastes against soil acidification
The spreading problem of soil acidification called to life the long-used method of treating acid soils with lime. Several forms of lime are commonly used for this purpouse.However there are many types of lime-containg wastes, what could be used against acidification. These include sugar beet lime, building materials like crushed concrete and bricks, wastes of cement production, magnesite production, tan-yards, etc. Lime-containing wastes can have other additional benefits in soil amelioration/remediaton. The efficiency of metal stabilisation can also be increased by lifting soil pH, and lime addition may positively influence the role of soil in the global C-circulation, as explained below.

Case-studies of applications

Introduction of on-going researches of the SOILUTIL project

Reducing CO2-emission of soils ameliorated by organic wastes
Soil microbial activity plays a important role in the global C-circulation. Soil CO2-emission can vary between 10–100 kgCO2/ha/day according to soil properties and vegetation type (Rastogi, 2002). As a comparison the lowest rate, each ha of soil emits every day a CO2 amount equivalent to a 100 kilometers long journey with car.
A widely used waste management method for organic wastes is its application on soil as fertilizer and structure-developing material. One important disadvantage of this solution from the global point of view is that easily biodegradable compounds are degraded fastly by soil microbes, and instead of remaining in soil, cause an abrupt increase in soil CO2-emission.

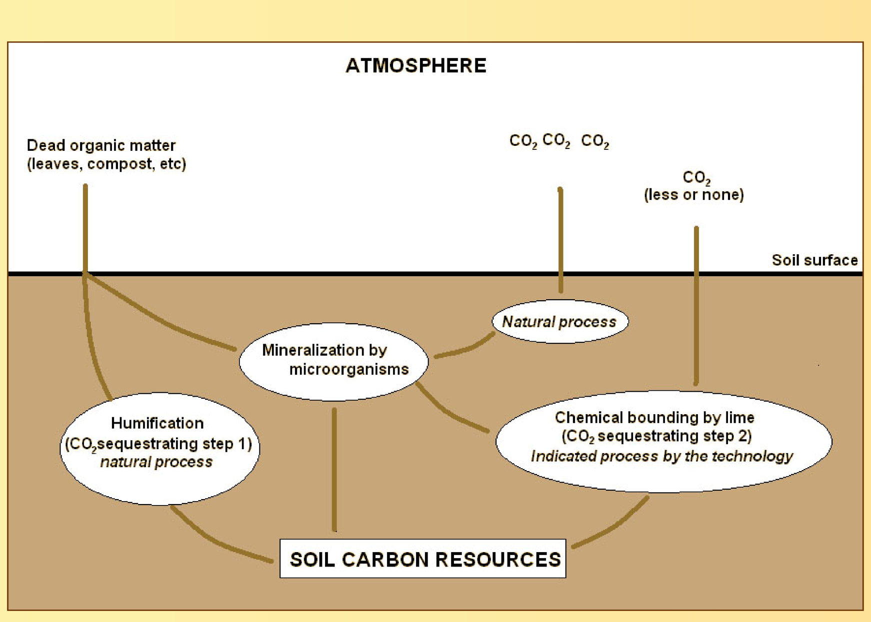


Figure 1.: *Possible way for reducing the global risk of soil amelioration technology*

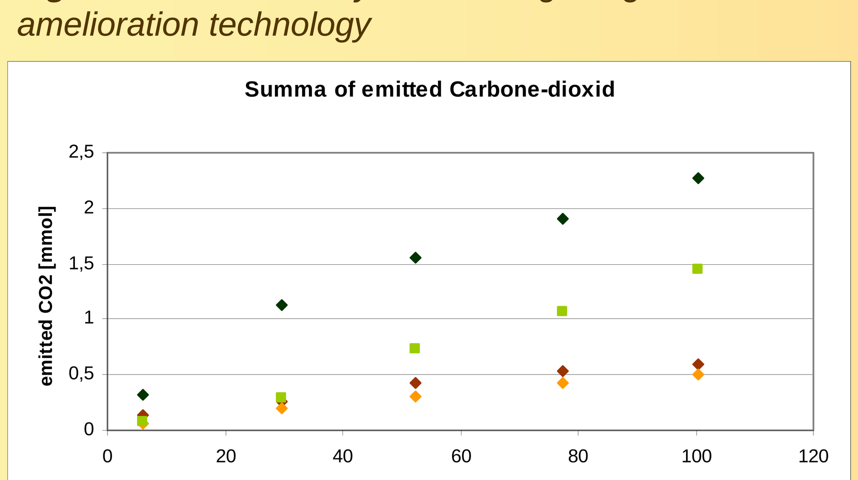


Chart 1.: *Total carbon emission in 5-day dynamic respiration test for different treatments with glucose and lime*

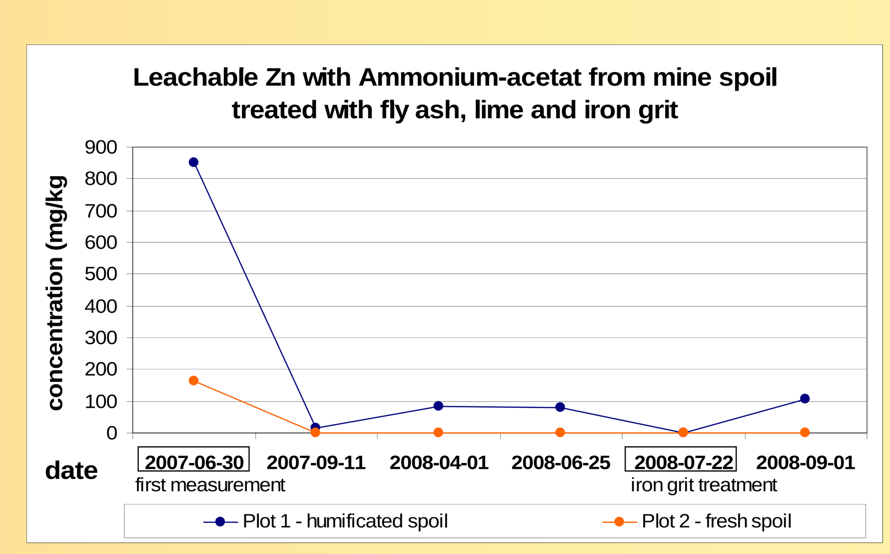
Our research’s intent is to reduce this carbon loss by by using additional amendments – if possible of waste origin – that can sequestrate CO2 in soil as an organic or inorganic compound. That way we could not only decrease CO2 emission of the landfilled surface, but at the same time increase the C-content of soil as well. The concept of the technology is illustrated on **Figure 1.**

In the preliminary laboratory experiences we tested lime as a promising sequestrator agent, to continue later with other alcaline wastes (e.g. sugar beet lime).

In small-scale laboratory experiments we areated 0,5 kg wet soil with CO_2-free air for 5x6 hours during 5 days, measured the quantity of captured CO2. we could determine an The emission trends according to the used treatments are shown on **Chart1**. It illustrates the effect of an easily digestable substrate (glucose) on the CO_2-emission of soil, and the effect of lime in fixing CO_2 and as a result decreasing its measured flux.

Remediation of metal contaminated sites
Toxic metal contamination from former mining activity is a serious problem of certain regions of Hungary. Our group continues remediation experiments on the former mining site of Gyöngyösoroszi, Hungary since 2003. During that period we developed and verified a combined treatment for immobilizing the toxic metal content of mining wastes and contaminated agricultural soils with fly ash, lime and steel shots, from small-scale lab experiments to field experiments. Our results show that this treatment combined with phyitostabilization can effectively decrease the leachable metal content, toxicity, and plant metal concentration. **Chart 2. and 3.** show an example of the monitoring-results of the field experiments (Klebercz, 2009).

Chart 2: *Leachable metal content drops in field experimental plots treated with 5% fly ash, 2% slack lime, and 0,5% iron grit – long time field results*



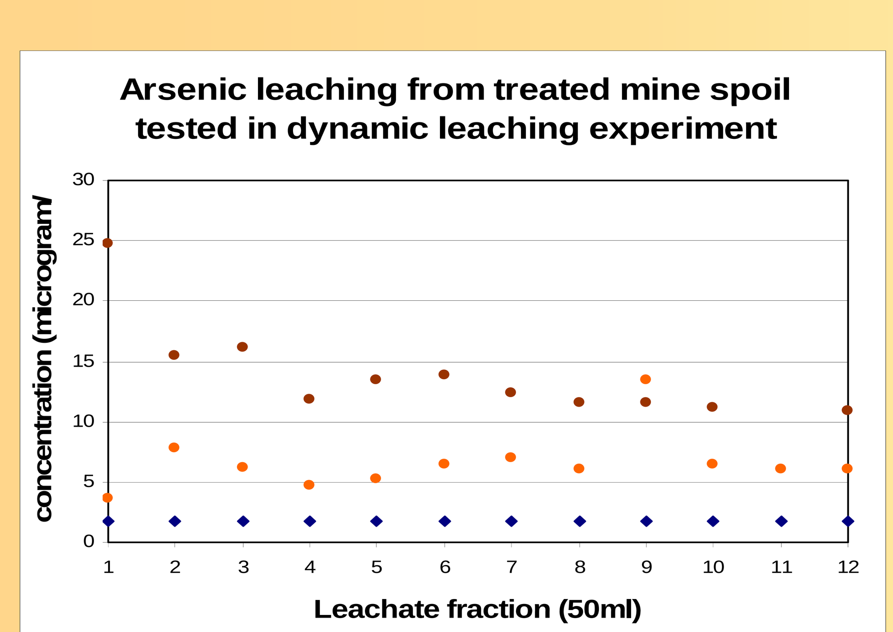


Chart 3: *Leachable metal content drops in field experimental plots treated with 5% fly ash, 2% slack lime, and 0,5% iron grit, dynamic leaching test*

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