



THE INNOVATIVE APPROACH TOWARD THE CLOSURE OF THE LIFE CYCLE OF QUARTZ SAND

ID 084

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ABSTRACT

Termit d.d. has developed an innovative approach toward the closure of the life cycle of quartz sand to be used in foundry processes. A carefully planned "cradle to grave" approach is adopted in the novel process, which can be divided into the following six sub-processes: a) extraction of virgin raw material for the production of quartz sand from open mining pits; b) processing of the raw material to obtain the quartz sand; c) use of quartz sand for core production in foundry industry; d) collection of the used quartz sand from the foundries; e) use of waste sand and waste materials from other industries, such as paper sludge from paper mills, as constituent materials in the production of a new product with added value - fertile artificial soil; and f) use of the new product (fertile artificial soil) for remediation of degraded landscape, e.g. damaged landscape caused by open pit mining and all other space planning measures where vegetation growth is required (e.g. slopes along roads, quarries, ...). The last sub-process closes the life cycle of the waste foundry sand.

Key words: fertile artificial soil, remediation, industrial waste.

THE CIRCUMSTANCES LEADING TO THE DEVELOPMENT OF THE PRODUCTION OF ARTIFICIAL SOIL

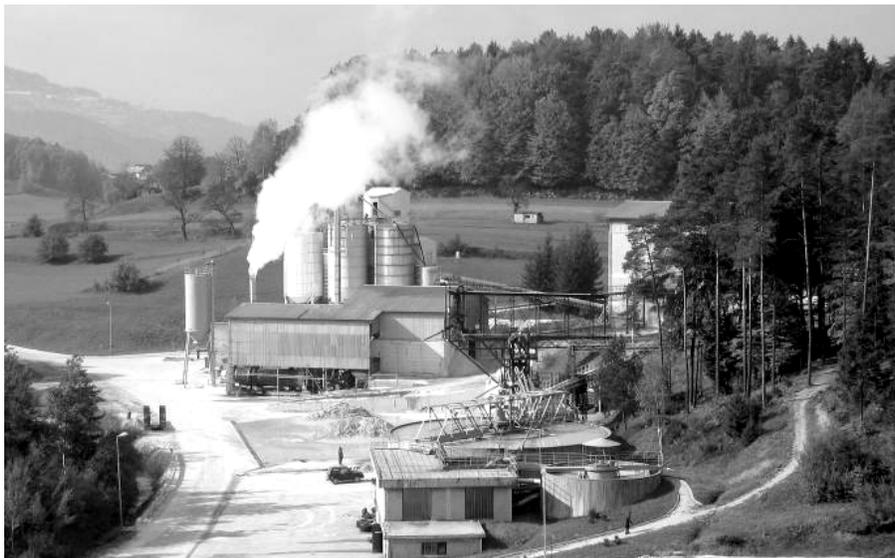


Figure 1.: Termit d.d. – production of quartz sand.

Termit d.d. is a mining company dealing with the production and processing of quartz sands. Quartz sand is mined in open pits. After the ore is extracted, the remediation can take place simultaneously with the extraction in the active as well as in all abandoned sand pits. The remediation requires large quantities of suitable material.



Figure 2.: Landscape changes due to the lack of material.

In the past, Termit used for the remediation process a mixture of cover (organic origin) and excess material generated in the mining process (on the site) mixed with the material that is removed during ore washing and sand separation (i.e. over- and under-sized particles). The mass balance is negative (due to quartzite sand extraction), such remediation lead to geomorphologic changes of the landscape.



Figure 3.: Platform for the production of artificial soils.

The major problem of such remediation material was its mineralogical composition. It was composed mostly of clay and had a small hydraulic conductivity, which is unsuitable for vegetation growth. Furthermore, and was infertile due to the lack of organic and fertile components. The areas remediate with the use of these materials soon get marshy and as such useless for agricultural activities.

Due to increased needs for humus bearing materials with suitable growth capacity, Termit d.d. lead to conclusion to tackle the problem in a systematic and comprehensive way. A R&D project aiming at development of artificial soils was carried out in co-operation with the Department of Agriculture at University of Ljubljana.

The new production process should ensure generation of sufficient quantities of suitable material that would enable the recultivation of degraded areas. On the other hand, Termit d.d. was aware of the environmental issues related to the generation of large quantities of waste foundry quartzite sand and its disposal.

A closed life cycle of the quartzite sand was formed by using the waste sand as one of the constituent materials in the production process of the new material – fertile artificial soil.

The R&D activities carried out showed that the new product has a potential to be used also in rehabilitation of other areas degraded by human actions.



Figure 4.: Soils ready to be filled into open pits

The whole process is innovative and the new material produced enables qualitative remediation and biological recultivation of degraded areas, which get as close as possible to the original state, and in most cases even surpasses them.

Degraded areas have been remediated with the use of fertile artificial soil since March 2005. The major proof of successful remediation is some turfed areas (Figure 5.).



Figure 5.: An area remediated and recultivated with fertile artificial soil.

ENVIRONMENTAL BENEFITS

Measurements conducted by the Institute of Public Health in Kranj show that remediation with the use of fertile artificial soil produced according to our procedure is beneficial for the environment. The pollution control includes monitoring of discharge from the artificial soils. The values of all monitored parameters are within the permitted limits and do not differ much from the values obtained in previous years.

We also keep a logbook of artificial soils, in which all basic data according to the Regulation for Allowed Intake of Waste into Soils are included. All deviations from the allowed values would appear in the logbook.

Control samples are regularly taken from all raw materials, and analysed by Department of Agriculture. The composition of the produced artificial soils is controlled daily.

The only material consumed in the new process is the waste material originating from different industrial processes: foundries, paper mills, etc. The quantities of waste materials are large. The estimated quantity of generated waste foundry sand alone in Slovenia is 130000 t p.a.. The corresponding number on European level is 12,000000 t p.a. (<http://europa.eu.int/comm/research/brite-eu/thematic/html/1-2-04.html>).

Energy consumed for mechanical work is carried out by the following machinery: weighing equipment, a mixer, and transport vehicles. Energy consumed for the transport of waste materials to be used as input to the production process is generated by burning the fossil fuels and has to be therefore outlined separately as described in the following section.

It is planned that a truck supplying virgin quartzite sand to the foundry returns to the sand producer with a load of used foundry sand. The only additional energy consumed for the new process (as far as waste foundry sand is concerned) originates from larger fuel consumption due to the full load on the truck.

The additional fuel is consumed also for the transport of other industrial waste to the open sand pits. This fuel, however, can be used also if the waste is transported to the landfill. Other machines and use of energy are not needed.

No waste is generated during the process. On the contrary, the major objective of the new process is to transform wastes into the useful material. Seepage waters are regularly monitored. So far, all measured values fall within the allowed limits. With regard to the characteristics of clay, which binds toxic substances, the limit values of parameters are not expected to exceed.



Figure 6.: Waste disposal site belonging to one of the Slovenian foundries.

SOCIAL BENEFITS

By means of the new process, the remediation of abandoned open pits will be carried out faster and cheaper, but most of all it will enable optimum biological recultivation of degraded areas. As a result, the new agricultural areas will be reclaimed. Health and life hazards originating from open pits will be avoided. The landscape will be greatly improved, which contributes to the overall quality of the life of the local community and its residents. Further, the local community will gain new recreation grounds.

Termit d.d. is already a sponsor to the local community. When additional income will be gained from the new production process, it can be expected that its contribution will increase, especially for the projects beneficial to the whole community (e.g. supporting associations, building roads, co-operation with the Municipality, supporting the school and kindergarten in Moravče).

Most of all, the new closed loop process is advantageous for our customers – all Slovenian foundries. They have to deal with large quantities of waste casting sand, which represents a major concern and financial burden for them. The new process also brings the solutions for the problems of other industry sectors that have to deal with large quantities of wastes, such as paper mills or civil engineering companies.

Consequently, our new process can be useful on a wider societal scale, as overloaded municipal landfills are the major problem of several Slovenian regions.

CONCLUSIONS

The new innovative process is universal as different types of industrial waste can be added to the core composition of the new material, depending on the geological properties of the quartz sand mine. In co-operation with University of Ljubljana, Termit will further seek new suitable constituent materials that can be included in the fertile artificial soils and improve their composition. This research has therefore a potential to be extended to non-toxic industrial waste handling in other industrial sectors, and it is aimed at entire Slovenia. Furthermore, the methodology for the determination of properties of artificial soil has already been established. This makes the process and product-related know-how easily transferable to any other quartz sand mining company in Europe or worldwide, regardless of the mine geological composition.

The major advantage of the new process is conversion of various types of industrial waste into a new useful material with added value. The new process fully complies with the principles of sustainable development as it eliminates the need of land filling waste materials used in the process.

The process and product-related know-how is easily transferable, since the methodology for the determination of properties of artificial soil is already established. It is also universal as different types of industrial waste can be added to the core composition of the new material, depending on the geological properties of the quartz sand mine. Its potential impact can definitely be expected on European/trans-national level.

The procedure is useful not only for Termit, but for all who deal with large quantities of non-toxic wastes of suitable composition and for all who need large quantities of fertile material. The procedure does not require significant additional financial resources and energy.



VZPOSTAVITEV ZAPRTEGA KROGOTOKA LIVARSKIH PESKOV

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POVZETEK

Termit d.d. je rudarsko podjetje za proizvodnjo in predelavo kremenovih peskov in pomožnih livarskih sredstev. Kremenovi peski se v livarstvu uporabljajo za izdelavo kalupov in jeder v katera se uliva kovina. Po končanem ulivanju se uporabljeni pesek zavrže.

Uporabljeni livarski pesek je odpadke livarske industrije, ki se pojavlja v velikih količinah. Letno v slovenskih livarnah nastane več kot 150.000 ton odpadnih livarskih form in jeder, kar predstavlja livarnam veliko ekološko in tudi finančno breme. Večina tega materiala, je do sedaj končala na deponijah, za katere vemo, da se nezadržno polnijo.

Na drugi strani pa rudarsko podjetje Termit za sanacijo svojih odkopnih jam potrebuje ogromne količine primerne materiala.

S ciljem rešiti ta dva problema smo razvili tehnologijo s katero iz odpadnih livarskih peskov s pomočjo različnih dodatkov ustvarimo umetno pripravljeno zemljino, ki nam omogoča lažjo, hitrejšo in kvalitetnejšo sanacijo in rekultivacijo izkoriščenih delov odkopa, livarnam pa rešuje problem odstranjevanja uporabljenih livarskih peskov.

Ključne besede: umetne zemljine, sanacija, rekultivacija, industrijski odpadki.