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WASTE MANAGEMENT- A FUTURE CHALLENGE FOR THE PROTECTION OF MINERAL SOURCES

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1. ABSTRACT- In fact the quarry industry is fighting with the static rule of the last decades, with the structural changes of the business world and the upcoming competition from recycling material and waste, something which has been no issue for the industry for long and this requires corrective measurements..

In a way this fact is perplexing, because the quarry industry is producing by itself a lot of waste material -mineral residues- the greater part of which is dumped today but would be -under the proper management and with effective , suitable techniques -a valuable raw material for new products in terms of both cost and quality, adding profits to their operation.

The problems are excellently described in some articles dealing with „Recycled Aggregate“, „Slime Management“, „Low-cost By-product :Fillers“ in the „Quarry Magazine“ as well as in Mr. Bill Bolsover` visionary article „The Future is in Our Hands“.

We are speaking about huge resources in waste material to be upgraded to saleable material. The EU expects within the next 5 years 1 Billion tons ; (the UK 130 Mio. tons.). It is the future which ask to deal with the change from a static industry to a dynamic one, by using the existing resources as much as possible and creating new products and markets for this new products.

This paper will show you methods and ways to use all of the waste material to produce saleable products and becoming very active in serving the construction industry with products they can use as alternative to the primary material, which becomes scarce and more and more expensive with time due to the restrictions of the Government for the protection of nature, environment ,in best way shown in the intention to establish an Aggregate Tax.

The paper will show you the unique possibility to upgrade any cohesive waste material. being waste from the production of primary material or trash from recycling any recyclable material like demolition material, worn-out roads or railway ballast, polluted with soil from the embankment, to riskfree new construction material, which can be tailored to any specification. In using this possibility it will not only be possible to reduce your high costs for disposing waste dramatically, you will create a number of new products and opportunities, which can and will lead in construction to substantial savings additionally. It will avoid impact in form of irreversible changes in landscape and possible alterations of the hydrogeological system.

2.INTRODUCTION

The Quarry Industry is challenged to leave their static situation to become dynamic in developing their future. Their precious resources of minerals are becoming scarce and often exhausted; there where the resources still exists they are producing too much waste material and stiff competition in building up there, where recycling of waste from demolition is reducing their market share in primary material. The Quarry Industry will do good in changing their mind toward widening of their product palette by

- incorporating the recycling of material in their activities;
- developing new products which allow to make it possible to reduce the own deposits of waste material;
- Technical assistance and partnership in solving technical problems of the customers.

This paper will inform you about amazing possibilities to use the existing installations – without great additional investments – to widen your activities with new products, at same time reducing your management problems with quarry waste disposal.

A treatment of soils with additives – products of the CONSOLID SYSTEM - allows to upgrade any kind of soil to riskfree construction material. The improvement of the treated soil is substantial and allows to incorporate up to 30% of clayey, silty fines – material which is usually classified as unacceptable for construction purposes in road construction or road rehabilitation. The treatment improves not only the stability and loading capacity; it enables also a tailored realisation of full impermeability, which allows to use treated soil as lining in ponds or artificial lakes, dams and other water exposed constructions. Such treated impermeable soil material is also excellent construction material for dams, railway embankments and formations, but also of high value to form bottom soil layers as well as covering soil material at disposal areas to avoid seepage and the pollution of groundwater.

For the quarry industry this offers the opportunity to produce, based on existing resources of mineral material, which is today waste and probably causing substantial costs for their disposal, high value products, tailored to the requirement of the construction industry.

Supposition for this possibility is, that the CONSOLID SYSTEM is capable to be used „in place“ as well as „in plant“ for the proper treatment of soil. Pre-mixed material can be produced exactly always to the same soil parameters respecting any special specification to be or already issued by RILEM, CEN, BRE HWSP and supplied from stock on demand without risking any adverse effect in the full effectiveness of the treatment. This means at same time for the quarry industry the possibility to produce the treated soil mixes during the low season, stockpile the finished mix and supply it on demand to enable best use of the relatively short construction period for any kind of earthwork in the moderate zones.

This application becomes possible because the CONSOLID SYSTEM is changing the behaviour of any soil itself toward petrification and does not act as a binder or chemical reactant. A soil, once treated remains treated for permanent and will keep the advantages of the upgrade without timely limitation. As mentioned above the system works with any kind of cohesive soil; not cohesive soils will have to be „polluted“ with clayey-silty fines to get in the soil mix a very compact, dense packing as supposition for best possible performance. All these advantages can be made visible in simple spoil laboratory tests well in advance of any application in the field. This prevents absolutely any failure in the field application, something which is of extreme high value in any soil work, too often main reason for great troubles during construction. In the following chapter we will discuss some special applications of the CONSOLID SYSTEM of value for the quarry industry in their aims to widen their product line.

3. NEW PRODUCTS FOR ANY EARTHWORK FROM QUARRY WASTE AND RECYCLED MATERIAL

Quarries and gravel pits produce 15% to 25% of waste which cannot be sold, costing them often a lot of money for the handling and their disposal. Collecting slimes behind dams by sedimentation on settling ponds often leads to instable conditions – the slime remains liquid under the crust forming on the top. Similar the recycling of trash from demolitions; a greater part of this material is again waste, to be disposed at substantial costs.

The CONSOLID SYSTEM allows to upgrade any in situ soil and the riskfree use of clayey and silty fines in construction material – just the material which is at majority the waste at quarries and gravel pits. In road construction clayey and silty fines are banned due to their adverse effect in respect of stability; bad water resistance, destruction of the density by swelling when exposed to water, frost heave capacity, to name a few. Properly treated these fines become a valuable part of the construction material; 30% to 50% of such fines can be mixed into sandy, coarse material, forming a soil mix tailored to the requirements of the customer.

The fact that the treatment of such a soil mix in form of a pre-mix is possible allowing to stockpile the treated material for prolonged times without losing the upgrading effect, makes it possible the quarry industry to prepare for any purpose always the same soil mix getting the same soil parameters and quality for the subgrade, subbase as well as the base course.

The treated soil mixes perform like real „mineral concrete“ ; soil laboratory tests allow ahead of any application of such material to see exactly the substantial improvement and the security that the

specified parameters will occur in the field; for the quarry industry these treated soil mixes allows to use great parts of their waste material to convert it into saleable material, avoiding disposal costs, the production of these soil mixes can be laid into the low rainy and cold season because the treated material can be stockpiled and is „ready-for-use“ once the weather conditions allow to start working in the field. You can offer the contractor and other customer a service, they would like to use in view of their tight construction schedules due to bad weather conditions, but also harsh limitation caused by the holiday season just when weather conditions would be fine.. Besides road construction and – rehabilitation , in the same way it is possible to prepare soil mixes which allow to build with pre-treated material impermeable layers of soil e.g. as dams or barriers in disposal areas, easily reaching k-values of 1.10 -10 and lower.

Based on very few , low cost changes in the equipment and installations any quarry and gravel pit can extend their product line to high quality specialities, - MINERAL CONCRETE , ready-for-use - needed for the contractor and the reduction of his stress in dealing with more and more problems from all sorts of regulations , environmental limitations, disposal costs, etc. Exchanging excavated soil with such „RM mineral concrete“ speeds up the construction and offers the possibility to take the excavated soil to the plant as base material for new „RM mineral concrete“ – the contractor will be pleased and will even pay for this take over. It will be even possible to enable substantial saving in construction costs, when the design will respect the full capacity of upgrading possible with such pre-treated soil mixes, marketed as „RM mineral concrete“. Due to the fact, that the once properly treated soil mix remains treated for all times, the effectiveness is a permanent one and grows with time under after-compaction in the field. It is even possible to „recycle“ treated material without the necessity to repeat the CONSOLID treatment and re-use it with the same effectiveness again and again.

The marketing of such new products – „RM mineral concrete“ – can be easily managed because each quarry and gravel pit has many places, where they can demonstrate the quality of their new products in the own premises; on their roads, storage places, slime dams, even as impervious layers of treated soil to avoid pollution of ground water as well as in many aspects of the recultivation of abandoned sites. There they can easily demonstrate that such purpose tailored „RM mineral concretes“ ,using any mineral waste material are by far not limited to low grade applications only. They create a totally new class of highly reliable construction material in any earthwork. All soil parameters are substantially improved and continue to improve under traffic as specific of the chosen way to get influence in the behaviour of the treated soil toward petrification.

With these new products an active contribution to the protection of the nature and environment as well as to secure and protect the valuable resources for those applications, where primary mineral material is required and cannot be replace by recycled or upgraded material. The high effectiveness of the CONSOLID SYSTEM is shown in a paper from the TH Karlsruhe (Graph.2) in respect of the possibility to get even excellent results, when light nuclear contaminates soil material has to be disposed safely.

The CONSOLID SYSTEM offers to the quarry and gravel pit the chance to widen their product line with valuable new products at the following advantages to them:

- 1) The selling of their wastes, incorporated into the new products, giving a new profit line and preventing costs for disposal ;
- 2) Active contribution to save the scarce, valuable resources and the use of primary mineral material only there, where it is really required;
- 3) Valuable contribution to help to solve the problems of the customers/contractors in presenting them construction materials which allow them to build faster better and even cheaper their projects;

And all these without the requirement of heavy investments. They becomes actively involved in assisting the customer with a service, which secures him satisfied customers and a fast improvement of the profitability of the quarry or gravel pit operation.

4. RAILWAY BALLAST -A SPECIAL MARKET DESIGNED ESPECIALLY TO SOLVE DISPOSAL PROBLEMS WITH WORN BALLAST

Assisting the administration to solve their disposal problems with wornout ballast. The U.K. require per year an average of 3 Mio. tones of ballast for their railways, of which 1.8 Mio tones are for renewal of existing railway tracks.

The kind and quality of ballast is very accurate defined and has to respect strict specifications. But what to do with the worn-out replaced old ballast, heavily contaminated with polluting material like traffic fallout (grease, oil, heavy metals, organic matter, etc.) as well as filled with lots of fines which develops with time in the ballast. Very often also the formation is not as stable as required, the soil embankment under the ballast is softening by water and let ballast stones sink into the mud, which fills up the ballast sooner or later.

Such excavated ballast cannot be disposed easily because the pollution status makes it a material to be disposed only in special places – something which goes substantially into the costs.

A recycling of such contaminated ballast material to use it as raw material for the formation and sub-grade is a challenge which can be very successfully solved with the pre-mix capability of the CONSOLID SYSTEM and offer the quarry industry another field for supplying new products to their special customers – in this case all engaged in the railway track system.

The possibility to get with the proper treatment and in adjusting the soil mix to best possible mechanical stability a pre-treated material which secures that the formation as well as the sub-grade remains stable and will not require maintenance for the future. The improvement in these layers is substantial as shown on practical results from several applications in the Czech Republic in recent years.

Low MPa values in the formation and sub-grade leads straight to the need to reduce the speed on such stretches. On all examples in the above graph the starting point in the MPa was very low between 5-10; with the treatment „in place“ it was possible to improve the MPa values by 10 times and more with further improvement under traffic. No longer „slow motion“ required at the application sites. Preparing the formation and sub-grade material for exchange „in plant“ makes it possible to tailor the quality exactly to the desired values and at same time you can take from the customer the problem, what to do with the excavated worn-out ballast material.

Taking in consideration that transportation costs add also substantially to the renewal costs your service will assist the administration in getting more for much less on costs. The same container, collecting the new ballast from the quarry could bring to them the excavated, polluted ballast for recycling. Properly treated, it can be stockpiled unlimited at the quarry but also at strategic supply centres to be easily available to the contractor, engaged in the renewal of the railway track. By controlling the moisture content in the formation as well as in the sub-grade with such treated material, there will be no future problem when the embankment is exposed for long time to moisture or flooding and also no problem will occur with frost heave.

5. SLIME MANAGEMENT PAVE THE WAY TO NEW PRODUCTS – IMPERVIOUS , TREATED SOIL MIXES OPEN A NEW WIDE FIELD FOR PROFIT.

The effluent from quarries carry the fines with them, which forms the greater part of waste; collected in settling ponds, there is the requirement to have impervious conditions in the bottom of the ponds as well as the surrounding dams to avoid the effluent to escape or to pollute the groundwater due to seepage. Impervious layers of soil are not easily to produce and maintain in conventional ways; plastic foils are possible as linings but easily punctured; how much better would be a stable, thick layer of treated soil, which prevent seepage forever ?

The extreme influence of the CONSOLID SYSTEM in the water sensitivity of soil by reducing capillary rise as well as the seeping through of meteor water close to zero has opened a completely new additional market for pre-mixed soil mixes, produced at the quarry , using any in situ soil as well as waste material to prepare pre-treated soil mixes, which are impervious.

As impressive example: The City of Heilbronn/Germany had great problems with an artificial lake (using a abandoned site of a brick factory, where they have excavated clayey/silty soil for burned bricks) –their intention to line the lake bottom with a mix of clay and bentonite failed, they never got the heavy seepage under control. When they treated the existing lake bottom with the CONSOLID SYSTEM the problem was solved at 100% at total costs of less than 25% of their former investment.

The great advantage of the CONSOLID SYSTEM was shown here in a convincing way; the treatment solves not only the problem, it is also absolutely safe in respect of the protection of the environment; no harmful polluting material can be leached out even when permanently under water. Years of experience in this respect led in Hungary to an unlimited use of the system in the construction of impervious layers at the bottom of many large disposal areas covering in meantime already more than 1 Mio sq.m. Besides these protection layers at the bottom of disposal areas, pre-treated material offer also excellent covering material once a disposal area is filled off. Covering layers prevent the seeping in of surface water, building a tight barrier on which fertile soil can be placed and recovered to the nature.

One of these applications fits very well in any other and offers to the progressive quarry a lot of opportunities to turn costly waste into new, profitable products without the need to invest heavily in Research & Development work.

Further special applications of similar kind are connected with the immobilisation of polluting material to be washed out of polluted soil. One example has been already mentioned above in respect of radioactive polluted soil around a nuclear power plant in Romania. There are already since years extensive studies carried out in the Netherlands in respect of immobilise the wash-out from heavily polluted harbour sludge, not anymore allowed to be dropped into the Northern Sea. Such treated sludge can be safely buried in dams or other earthwork, when properly treated. Another wide field where quarries can assist customers by offering their service in solving their specific problems.

6. SUMMARY:

This paper has shown you possibilities to enlarge in quarries and gravel pots are very low investment costs the number of products and services substantially by using resources, which has been until now only heavy cost factors.

But why should this be possible in the described way? What is behind the CONSOLID SYSTEM? Soil stabilisation is a method to enable the use of in situ, low class soil for construction purposes. Unfortunately, the classical methods, working with any kind of binder or chemical reactions failed in most cases due to physically or chemically problems. Binder will only work properly when the ration between binder and soil is adequate, something impossible to realise in the field; chemical reactions needs also always the same partner, something which does not exists under the thousands of different soil admixtures. Therefore we had to go another way with our aim to get to a system, which works with any kind of soil.

Soil is formed of minerals, which former has been rock and remains back to stone by petrification after millions of years e.g. as sediment stone. Therefore soil has the ability to petrify and a catalyst may have the capacity to activate these sleeping potential in a soil to change the behaviour toward petrification. At first wish thinking, this idea has been realises in 13 years of R&D work to a method of soil improvement, which today allows to improve any kind of soil (really 100%) substantially more or less with the same quantity of additives „in place“ as well as „in plant“. The only modification in situ soil has to be arranged is, to improve the mechanical stability as much as possible ahead of a treatment by intermixing missing fraction to the soil – e.g. clayey, silty fines to sandy, coarse material; sandy / coarse material to heavy clays, to get a high dense packing once compacted with a less as possible voids left; stones are also harder and heavier the more dense they are.

Simple laboratory tests allows well ahead of any field use to see exactly the possible improvements; there will be at no time any risk that the treatment could fail.

The CONSOLID SYSTEM goes back to have been started 1968 and needed 13 years to get the 100% coverage of all kinds of soils. The whole time the development was carried out under a low profile to avoid disturbance and to have sufficient time to collect the proof that the system has the required full lasting long-time performance. A very impressive example is shown on the following picture: (Witbank)

A heavy haulage road was built already 1975 in Witbank, TV, RSA for a coal mine, planned as temporary road for only two years until a railway link would have been finished. It took 5 years until then and in this time they run 5 Mio tons of coal over the soil road, made of the in situ laterith gravel sandy clay. The CBR was soaked untreated 67%, treated >236%; under the heavy traffic the mod AASHO density rose to values >110%. From 1980 onward the road was abandoned due to the finished rail connection, but the road remained in best condition; the nature could not take over, the level had no deformation, the road needed during service no maintenance and when they dried to re-use the

treated soil – as recommended from us 19 years later – they could not rip-off the road, very impressively shown at the photo. The teeth have scratched only the surface. The treated soil has really turned to be „mineral concrete“.

I guess the above mentioned facts will be worth to be discussed with those quarries and gravel pits being interested to enlarge their business despite the fact that they may have problems to enlarge their existing resources to primary mineral products – the future will be more and more deal with recycled material as well as the upgrading of low class material in wide field of earthwork and this will widen your activities into new profitable fields.

Using in situ soils instead of borrowed material or recycled material will be also a very impressive factor for cost savings. The simplicity of the CONSOLID SYSTEM and the extreme small quantities of additives required, gives not only an interesting margin but allows also to re-design construction work in a way, that, respecting the possible improvements, the construction costs can be reduced from 20% to 50% only during construction, compared with same quality construction work realised in a conventional way,

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