EUREKA EU220 PROJECT

CONTENTO TRADE SRL

Technological innovation for the environment

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Processing for the consolidation of materials in the fields of road construction and construction, through the optimization of natural processes: diagenesis and laterisation

BRIEF DESCRIPTION:

Partners:

Vomm srl, Via Curiel 251, Rozzano, Italy
Contento Trade srl, Via Zorutti 84, Campoformido, Italy
Enterprise Malet, Toulouse, France
Veta Ltd, Kostroma, Russia
Ekvotormet ltd, Moscow, Russia

Objectives:

The project aims to identify new methods to realize street foundations with a low cost, which could be used in areas characterized by limited availability of gravely and sandy materials.

It includes:

The use of cohesive materials which are available in building area (clays and muds), treated with a diagenetic method (based on the use of small quantity of hydraulic binder and strong compaction to obtain low porosity and a good binder stability against water and other disaggregating agents).

In addition, the individuation of a new consolidation system which could allow the use of all incoherent material existing on the earth's crust. In this field, the research can show the consolidation of incoherent and natural materials sampled and their use as road construction materials.

OBJECTIVES:

The final objective of this research was to individuate new valid methods for the realization of road as layer at low cost to be used in areas characterized by scarce disposability of gravel and sandy material.

To obtain these results we decided to work with cohesive materials at disposition in the building area (clay and slime) and to strength them with a digenetic method based on use of small quantity of hydraulic binder and strongly compacting them to obtain low porosity and a good binder stability against water and other disaggregating agents action (freeze-thaw, carbonation, etc).

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For these application a new binder has been found and set up: the "ettringite", usually known as disaggregating agent for some kinds of concrete). Italian and French partners chose different ways to synthesize and activate the ettringitic binder: after a common beginning aimed at analyzing the chemical synthesis of ettringite, the research has been focused on the main problem of this kind of binder, that is the tendency of its crystals to grow without control under some conditions.

Italian research tried to control the phenomena using partially crystallized precursors that showed very good stability after hydration and after partial or total substitution of Al ions with Fe ions in the ettringitic molecule.

French partners developed thermal techniques to produce ettringitic clinker with controlled crystallization and these linkers gave good results as well. To realize a competitive production cost for these kind of binders, both Italian and French partners used industrial waste as raw material. Particularly French partners exploited residues rich in gypsum and Al oxide, while Italian partners used residues coming from titanium oxide working (rich in iron sulphate) and marble dust (rich in lime).

In both cases, wastes constitute over the 50% of binder components and this is a success from the environmental point of view.

From the technological point of view the the ways followed by Italian and French are different but complementary for some aspects.

Italian partners tried to obtain a binder with good physical and mechanical characteristics with a slow setting rate, to be used in different technologies used in different countries where it could be introduced (from barren regions to tundra).

French partners couldn't slow down the binder setting rate, so they realized a special equipment for a correct product application.

Therefore the most part of the Italian technological know-how developed within the research is related to the binder production, while French know-how is related to the road building phase; and this correspond to the specific knowledge of the two main project partners.

From the applicative point of view both the Italian and the French technology showed to be applicable both in developing countries and in the industrialized ones.

These are versatile systems through which it's possible to utilize, as raw materials, nearly all kind of existing soils (except soils too rich in organic matter)

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and obtain road foundation with the expected geotechnical characteristics, just varying the binding dosage and the soil moisture.

Obviously a very important role is played by the devices employed to realize the process and, from this point of view, the use of specific systems for the homogenization and thickening of the mix soil-binder, as the one realized by the French partner, is always advisable to obtain constant results.

To verify the results of Eureka research, the cohesion parameter has been chosen as significant parameter, which should have been superior to 1MPa with binder dosage inferior or equal to 20%. These values have been largely exceeded during the lab tests of lateral free expansion with dosage level around 5%.

It's not possible to transfer these lab results on the experimental demonstrative roads.

In fact, in these application, cohesion is strictly related to other variables that characterize the road (optimal and real density, moisture content, carrying capacity, est.) that depend on external parameters as the equipment used for thickening or utilization estimated for the structure realized (light or heavy traffic, on the plain or in the mountains, in arid or rainy regions, with mild or severe climatic exposure) or also on the building methods adopted for the structure (at soil level or on embankment, with or without bituminous covering layer).

moreover, within the same structure different layer parameters can be required with different functions (i.e. finishing layer, base layer, embankment body, foundation layer, etc.).

To realize some demonstrative roads, some mix of materials corresponding to the minimum indicated targets have been selected. For their realization, mixtures of low binder content have been selected, on the basis of the lab achieved results. The results of the tests made "in situ" show that in each realized application satisfactory results have been realized, which could guarantee several utilization possibilities of this technology for road construction.

STATE OF THE ART

The aim of the research is mainly of technical kind and can be summarized in the development of a new consolidation process, thanks to which all the incoherent material existing on the earth crust could be used and valorised. For this purpose

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the research particularly aims to demonstrate that it's possible to strengthen the natural incoherent materials sampled and afterwards to use them as road construction material.

The mechanical and rheological characteristics of the consolidated materials , as the chemical ones, are fundamental.

To simplify the control of the research results, just the mechanical characteristics of the strengthened materials will be considered, because they can be expressed easily and are strongly influenced by the consolidation process. So we can state that the consolidation treatment will be successful when the strengthened material, subjected to three different curing treatments, after a standard ageing period of about 15 days, will achieve a cohesion value of C > 1 MPa in the compression tests E.L.L.

Moreover, to make economically interesting this process, the dosage of additives and catalysts shall be no more than the 20% in weight of the total weight of the dry mixture. If these conditions will be satisfied at the same time, the consolidation process will be successful and the obtained material will be economically valorised.

MAIN INNOVATIONS

In brief, the final evaluation of the research shows clearly that, with the developed technologies it has been possible to meet the requirements initially set, anyway the most interesting result is the effective versatility in its use, both from the raw material point of view (practically any kind of incoherent soil is usable) and from the finished products (any kind of road structure built with "noble" granular mixes can be realized with this technology).

RESULTS OBTAINED:

The research showed that it's possible to create hydraulic binders for geotechnical uses, starting from industrial wastes and on the basis of such obtained results it's possible to confirm the achievements of the research aims, as regards the increasing of cohesion of incoherent residues.

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Some trials have been executed to demonstrate the durability of the obtained specimens, both with cyclic tests of saturation/desiccation, and with freezing/thaw tests. The produced binders can confirm the obtained result.

MARKET PERSPECTIVES:

The technology developed within this research can find large application in Russian plains, to realize byroads and country roads with good durability and low cost.

The availability of a know-how with wide market perspectives and a single optimized equipment for the production of the raw materials necessary for this application can assure a good diffusion of the technology also in other parts of Europe.

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