LIFE02 ENV/FIN/329

ENVIRONMENTALLY FRIENDLY SYSTEMS TO RENOVATE SECONDARY ROADS. LIFE-ENVIRONMENT PROJECT: KUKKIA CIRCLET

What is Kukkia Circlet?

The project Kukkia Circlet (1.12.2001 – 31.12.2004) has been about demonstrating new, controlled, sustainable and efficient road construction processes that benefit the different European societies with different types of problems to maintain and renovate secondary roads. The project also aimed at the elimination of the major restrictions to the utilisation of certain industrial by-products (like ashes and paper sludge of the forest industry or certain process waste of the chemical industry) in the soil construction.

Kukkia Circlet has combined all the know-how that have been obtained in R&D projects since the beginning of the 1990's on the use of industrial by-products in soil construction.
The project innovations include new types of road construction materials that are based on industrial by-products, different types of applications and structures for the new materials, new types of equipment for the mixing of the materials, and in-detail-controlled construction processes to ascertain the target quality and economic benefits of the renovation. The applications include stabilisation of existing road courses, structural courses to compensate for the conventional stone courses of a road, a groundwater protection structure on the roadside and light traffic paths. The pilot structures have been implemented in the Luopioinen municipality, close to the beautiful lake Kukkia.

Which organisations have participated the Kukkia Circlet project ?

The leading partner and co-ordinator of Kukkia Circlet has been the Finnish Road Enterprise, Häme Service Unit. Other partners are Luopioinen Municipality, Council of Tampere Region, Finncao Oy, Georgia-Pacific Finland Oy and Kemira Chemicals Oy. The main part of testing and follow-up as well as the planning of the new structures for the pilots have been subcontracted from Ramboll Finland Oy (Luopioinen department). The project is co-financed by EU Life-Environment (Life02 ENV/FIN/000329), Finnish Road Administration and the partners.

Why do we need the new methods based on the by-products?

We are certain that the European society needs to benefit from the outcome of the project: the sustainable construction system and durable quality of the secondary roads, economical and efficient maintenance of the secondary road network, and increasing safety of the pedestrians and cyclists by the side of the narrow roads. The project has increased the possibilities to solve different types of economical, environmental and technical problems connected to the infrastructure development.

The problems of the road network in sparsely populated districts in Finland include constant inferior quality and frost damage of the secondary (gravel) roads. Especially in the frost heave season, in the spring, this means that a part of the secondary roads are not trafficable or allowed for heavy traffic. The road administration and other groups that are responsible for the condition of the roads have very restricted budgets for the road maintenance, and these budgets cover only a part of the renovation needs. One of the project objectives has been to introduce and propose sustainable and cost-effective alternatives to the conventional renovation methods in order to make it possible to increase the rate of annual renovation.

Figure 1: A damaged section of a gravel road in Luopioinen in 2002

The conventional road maintenance methods require high volumes of non-renewable stone resources. The use of conventional methods with natural aggregates is justified for the construction of motorways and other highways with heavy traffic loads. However, the secondary road network is mostly damaged because of the climatic load, and here the use of alternative materials based on industrial by-products would be justified on the basis of different studies in the 1990's.

The roadsides of the secondary road network are not safe for the pedestrians or cyclists. This makes it necessary to drive by car instead of by foot or by bicycle in the sparsely populated areas which is not environmentally sustainable. The construction of light-traffic lanes and paths in the sparsely populated areas is not a priority in the times of restricted budgetary resources. Therefore, the project aimed to show, that the safety of the light traffic could be improved less expensively when using industrial by-products for construction.

Different industrial sectors have big amounts of by-product (or waste) materials at the disposal for construction. For example, the use of fly ash and fibre sludge of the Finnish forest industry could in principle be used for the renovation of 400 to 700 kilometres of Finnish secondary roads each year. At the current maintenance level as the annual renovation comprise roughly 200 kilometres of secondary roads each year all renovation could be carried out with the alternative materials. Even if about only a hundred kilometres will be renovated with the new alternative materials each year the annual savings of natural aggregates may be about 0,18 Million tonnes in Finland. The corresponding savings in the EU area would be probably at least 2 Million tonnes each year.

Figure 2: Intermediate level. The gravel road during renovation, before finishing with covering course. Luopioinen Summer 2003, renovation with a fibre-ash structural course.

The use of industrial by-products in construction will reduce the exploitation of stone resources like gravel from hills and eskers or crushed rocks, and further decrease environmental problems like risks to the groundwater resources, ecology and landscape.

However, lack of knowledge on the behaviour and long-term impact of these by-product materials make it necessary to have studies and pilot constructions before it is really possible to establish the advanced and cost-effective methods based on industrial by-products in construction. Kukkia Circlet have made many step forwards but there is still need for further development.

What have been done during the project?

Kukkia Circlet project has tested the processes to renovate gravel roads, and to construct groundwater protection and light traffic lane structures on gravel road sides. The special focus has been on the logistics, and work methods like mixing. The project has also made assessments on the long-term properties, environmental impact and costs of the new applications in comparison with some conventional reference applications.

The activities involve pilot constructions during 2002 and 2003. Reports about the construction

and follow-up results as well as Video presentation and the Guide for the planning and construction of corresponding structures are available at the project website. The reports are included in the Progress Reports and Final Report as English versions. The Guide, however, is only in Finnish.

The pilots involve following tests and applications:

a) Renovation by stabilisation of an existing old gravel road with help of binder admixtures based on fly ash. This has improved the bearing capacity of the gravel road. This application has been implemented during the summer 2002;

Figure 3: Mixing station for binder admixtures in 2002.

Figure 4: Stabilation process in 2002. In the front the milling cutter.

b) Renovation of a damaged gravel road with help of fibre-ash structural road courses in the summer 2003. This seems to have solved the problems of heavy frost damage of the gravel road. A longer follow-up period will show the results. Fibre-ash is a mixture of fibre sludge with fly ash;

Figure 5: Stack mixer used for the mixing of fibre-ash in 2003.

c) Construction of a groundwater protection structure using fibreclay-mixtures in the summer 2003. This might become a cost-effective hydraulic barrier alternative ;

Figure 6: Compaction of the fibreclay for the groundwater protection structure's sealing course.

d) Construction of new alternatives for light traffic lanes with fibre-ashes and geo-reinforcements in the summer 2003. The applications include separate light-traffic lanes and safety lanes on the roadsides.

Figure 7: A section of the separate fibre ash lane before finishing in 2003.

Figure 8: The on-going safety lane construction where the fibre-ash course is bound inside a geonet before compaction and covering course.

The different pilot structures were finalised with different covering courses based on a mixture of crushed aggregate with filtercake (by-product of calcium chloride production in Kokkola). Filtercake consists of calcium chloride as well as other calcium compounds. With respect to the results from earlier tests, the filtercake would increase the abrasion resistance of the covering course and decrease the need for spraying salt on the road each spring and autumn. Additionally, the filtercake will help to prevent the road surface from freezing even as low as at (minus) -5 ^{o}C degrees. The hygroscopic effect of the filtercake will naturally decrease with the dissolution of the salt from the filtercake. The need for maintenance (i.e. additional mixing of filtercake on the surface) might be every other year.

Where can we get more detailed information?

Reports and other information at project website:
http://www.tieliikelaitos.fi/tieliikelaitos/yhteistyokumppanit/

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