



The CLEAN project is France's contribution to an OECD research programme on long-life roads. In order to permit the large-scale use of these ultra-thin wearing courses it is necessary to develop industrial processes which are accurate to within a millimetre rather than a centimetre as is currently the case. This high added value technique is of interest for busy roads, which are critical sections of the road network. Highway engineering is an area where France excels, and in which we wish to remain at the forefront. The PGCE gave this project its official seal of approval which has enabled us to contact infrastructure owners whose role is an essential one as they are willing to take risks on experimental worksites. »

François de Larrard,
senior researcher at the scientific directorate of the Laboratoire central des ponts et chaussées (LCPC)

**POSITION OF THE PROJECT
IN THE POLE'S STRATEGY:**

- DESIGN OF STRUCTURES IN COMPLEX AND/OR EXTREME CONDITIONS
- DURABILITY AND LIFE CYCLE OF BUILDINGS AND INFRASTRUCTURES
- RESOURCE SAVINGS
- ENVIRONMENTAL PERFORMANCE OF CONSTRUCTIONS AND FACILITIES
- OBSERVATION AND MODELLING FOR THE DESIGN AND MANAGEMENT OF A SUSTAINABLE URBAN PROJECT
- ECO-INNOVATIVE DISTRICTS

CLEAN

French industry is pioneering sustainable roads that reduce pollution

2009 –2011

The wearing course of a highly-trafficked pavement needs to be repaired every 7 years. whatever measure we consider (for example the use of non-renewable materials or the disruption caused by halting traffic) the cost is becoming an increasing burden on society.

An innovative material has been developed in the laboratory: a high-performance cementitious material which has a service life without maintenance of 30 or 40 years. Its high titanium dioxide (TiO₂) content means it markedly reduces pollution under the effect of ultra-violet radiation. how does this promising material perform under real traffic conditions? how durable is the pollution reduction it achieves?

CLEAN is a practical project that sets out to optimize the high performance cementitious material and develop an industrial laying procedure on two experimental sites in the pays de la Loire region.



The first experimental worksite is on a suburban roundabout in the sarthe département.

PROJECT GIVEN THE PGCE'S SEAL OF APPROVAL IN 2009

materials saving and infrastructure durability: the pavement is replaced to a depth of 1 cm every thirty years instead of 2.5 cm every seven years.

environmental added value: the road itself breaks down part of the pollution generated by the traffic it carries.

industrial competitiveness: the development of innovative technology from France in the framework of an international programme highlights the excellence of our research and our road industry.

THE R&D PROGRAMME

The laboratory study phase (2005-2008) of the international "Long-Life Pavement" (LLP) programme led to the development of a new wearing course concept involving the use of a high-performance cementitious material. In its current form this material consists of a thin layer of fibre-reinforced ultra-high performance mortar in which are embedded chippings with a high polished stone value.

The CLEAN project, which belongs to the operational phase of the LLP programme, includes a number of stages:

- **optimization of the material**, by refining certain mix design parameters (finding inexpensive, available local materials) and investigating a number of alternatives (including the addition of titanium dioxide).
- **development of a laying procedure**: designing mechanized construction equipment and creation of prototypes.
- **the development of the environmental monitoring methodology** to quantify the effectiveness of the pollution reduction function; producing energy and greenhouse gas emissions audits for the material; calculating the non-renewable resources savings resulting from this technology.
- **2010**: first experimental works in the sarthe département, on a suburban roundabout in order to test the material's behaviour under real traffic.
- **2011**: second experimental works in an urban area in montoir-de-bretagne (département 44), to test the material with added TiO_2 .
- **The appraisals will cover:**
 - **Mechanical aspects**: checking the absence of deterioration
 - **Economic aspects**: costs observed at the trial worksites, theoretical cost of the technique if widely used, total life cycle cost.
 - **social aspects**: appraisal of the effectiveness of pollution reduction (the limitation of reduction peaks is anticipated), the social acceptability of the material (opinions of infrastructure owners)
 - **environmental aspects**: energy audit, carbon audit, calculation of materials savings.



COST OF THE PROGRAMME

€ 2 M, with a subsidy of € 800 k from the French national research Agency's "sustainable cities" programme

THE CONSORTIUM

2 LABORATORIES

- **Laboratoire central des ponts et chaussées (LCPC)**: mix design and investigation of the characteristics of the material on the road (skidding resistance, noise and mechanical performance)
- **Laboratoire régional de l'ouest parisien (LROP)**: studying the pollution reduction function of the material

4 FIRMS

- **ciments calcia**: development of the material with added TiO_2
- **sika france**: concrete additives
- **SAE (FAYAT group)**: development of road construction equipment
- **Pro.sper**: development of pavement surfacing techniques

2 INFRASTRUCTURE OWNERS

- conseil général de Loire-Atlantique
- conseil général de la sarthe

••••• Further information

on the CLEAN project

Laboratoire central des ponts et chaussées
44341 bouguenais cedex
02 40 84 56 38
francois.de-larrard@lcpc.fr
www.lcpc.fr

on setting up a collaborative innovation project

PGCE
16 quai E. Renaud - BP 90517
44105 nantes cedex 4
02 72 56 80 52 -
lucile.guitter@pole-gce.fr
www.pole-geniecivil-ecoconstruction.fr