Project GEnIuS

An innovative graphene-based solution for tackling environmental emergencies through the adsorption of oils and hydrocarbons

surface waters | ground water | water pollution

PROJECT DESCRIPTION

The GENIUS project dealt with pollution problems of the aquatic ecosystems arising from accidental oil spills and hydrocarbon contamination. The possibility of ensuring both an efficient environmental protection and the recovery of the spilled hydrocarbon depend on the choice of the technology to be used for the decontamination operations. Decontamination technologies and traditional absorbing products are often not ecological and difficult to apply, moreover do not ensure recovery of the absorbed oil and are inefficient in removing hydrocarbons present in low concentrations in the water column or on its surface.

OBJECTIVES

The **GEnIuS project** had the objective to launch onto the market an innovative **graphene**-based oil adsorbing material, commercially available as **GRAFYSORBER®**, and usable as **loose product** or contained within **adsorbent barriers or pillows**. **GRAFYSORBER®** is able to quickly absorb any kind of oil (over 90 times its own weight). **GRAFYSORBER®** is effective also against hydrocarbons dissolved or dispersed in low concentrations in the water column. **GRAFYSORBER®** is chemically and biologically inert as far as it is obtained through a licensed thermal process working natural graphite without recourse to chemical additives. For this very reason the Ministry of Environment acknowledged Grafysorber's suitability (Min. Decree of 31 March 2009, published in the OJ no. 114 of 19/05/2009, and s.a.), including it in the list of products usable in the sea starting from 16/04/2013. The product **favors the recovery of the adsorbed oils** and it can be reused as secondary raw material for the reinforcement of the road surface. Disposal costs of the exhausted material result reduced due to the possibility to recover and recycle the material.

PROJECT PHASES

The GEnIuS project has been implemented through **6 groups of activities**, each of them covering a different aspect of the project, from the product's certification to the industrial development of the production plant, from the field test to the dissemination of results and the promotion of innovation.

- WP-1, project management, ensured the effective coordination of the activities during the whole project duration, including monitoring of the project goals' achievement and of the implementation of the activities.
- WP-2 focused on the definition and control of the quality of GRAFYSORBER® as well as the certification of its effectiveness by independent laboratories and standardized methods. Possible forms of recovery of the adsorbed oil and its reuse were also defined and experimented in the laboratories.
- Scale-up of the production plant, WP-3, was performed during the first year of the project.
- In WP-4 GRAFYSORBER® has been field-tested in collaboration with potential clients and end-users.
- In WP-5 an in-depth market analysis has been performed with the aim of defining a business and an exploitation plan able

to best set-up the commercial future of the product.
- WP-6 provided, during the whole project duration, an intense communication activity to promote the project results and the proposed innovation.

PROJECT RESULTS

During the first year of the project the most important result achieved was the implementation and improvement of the **GRAFYSORBER® production plant (*Officine del Grafene* - Graphene Factory)**, which was transformed from a demo-unit laboratory into a real factory with industrial level production capacity (production potential of 30 tons/year). The *Officine del Grafene* was inaugurated at the end of June 2014 and to date represents one of the largest European industrial plants of high purity graphene-based materials.

During the second year of the project the pilot activity of the product's field-testing was completed, realizing an important industrial remediation activity in Romania. In fact, **more than 30,000 m3 of water contaminated with petroleum hydrocarbons has been purified** in a former oil refinery area. Below is the detailed list of all the objectives set in the project plan and achieved during the two years of activity:

- Certification, by an independent laboratory according to the ASTM standard method 726-12, of the maximum oil adsorbent capacity of GRAFYSORBER® equal to 94 g/g. On this basis issue by the Ministry of the Environment of the authorization (reg. no. 0029911 pursuant to the Ministerial Decree of 31 March 2009, OJ no. 114 of 19-05-2009 and s.a.), starting from 16/04/2013, to the use of the product in case of oil spills in the sea and inclusion of GRAFYSORBER® in the list of products usable in the sea;
- Production and use in pilot testing activities of 150 kg of GRAFYSORBER®;
- Production of oleo-adsorbent barrier prototypes at the *Officine del Grafene*;
- Industrial scale-up of the GRAFYSORBER® production plant carried out during the first project year (potential production capacity of 30 tons/year). Inauguration of the plant on 23 June 2014;
- First pilot application test of GRAFYSORBER® carried out at Lake Como in collaboration with the local fire department, based on which the product characteristics have been improved in the form of an oleo-adsorbing barrier or pillow and its optimal commercial characteristics have been defined;
- Carrying out of the first industrial remediation of water contaminated by low concentrations of hydrocarbons in Romania obtaining excellent results both in terms of treatment efficiency (reduction of concentrations below the ppm) and in economic terms (savings in remediation costs equal to min. 30 %).
- Testing of about 150 kg of product by interested companies specialized in environmental remediation;
- Elaboration and improvement of the product's technical data sheet;
- Realization of a LCA (Lyfe Cycle Assessment) study on GRAFYSORBER® production and its use in the environmental field as an innovative super adsorbent material for hydrocarbons spilled in water;

The project was presented as one of the major successful projects of the Eco-Innovation program at the European Commission's forum in the section entitled "Best of Eco-innovation: project success stories" on 20-21 May 2015 in Barcelona.

Finally, the results achieved concerning the mitigation of the effects on the environment make it possible to highlight how, for example, an oil-adsorbent barrier containing 1 kg of **GRAFYSORBER®** is able to adsorb about 90 kg of petroleum product, and how it is possible to **recover at least 80% of the pollutant adsorbed by simple pressing**. Approximately 72 kg of petroleum product per kg of adsorbent product therefore avoids disposal which costs are quantifiable on average in around € 0.5/kg. If 1 kg of standard adsorbent (polypropylene) is able to adsorb about 18 kg of petroleum (usually a barrier contains 5 kg of adsorbent product) is not squeezed for the recovery of oil, as it also adsorbs a lot of water, it is possible to state that 1 barrier containing **GRAFYSORBER®** allows to recover from the water the same quantity of oil as a polypropylene barrier, but using 1/5 of adsorbent product and sending for disposal a maximum of 19 kg of material, with a cost of 9,5 €/barrier against € 45/barrier. **GRAFYSORBER®** can be produced directly on-site, avoiding transport costs, using special **mobile units** large as a 20-foot container (6x2,5 m). **GRAFYSORBER®** has already been used successfully in the frame of the GEnIuS project to carry out real remediation of water contaminated with petroleum products.

All certificates and technical information are available on the project's website.

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Beneficiary Coordinator
Directa Plus S.p.A.

Contacts
Razvan POPESCU (Project Manager)
Annalisa Pola (Environmental Application Manager)

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Beneficiary headquarters

Via Cavour, 2
22074 Lomazzo CO
Italy

Region
Lombardia