The LIFE programme:

The LIFE programme is the EU's funding instrument for the environment. The general objective of LIFE is to contribute to the implementation, updating and development of EU environmental policy and legislation by co-financing pilot or demonstration projects with European added value.

LIFE began in 1992 and to date there have been three complete phases of the programme (LIFE I: 1992-1995, LIFE II: 1996-1999 and LIFE III: 2000-2006). During this period, LIFE has co-financed some 3104 projects across the EU, contributing approximately €2.8 billion to the protection of the environment.

The current phase of the programme, LIFE+, runs from 2007-2013 and has a budget of €2.143 billion that covers both the operational expenditure of DG Environment and the co-financing of projects.

During the period 2007-2013, the European Commission will launch one call for LIFE+ project proposals per year. Proposals must be eligible under one of the programme's three components: LIFE+ Nature and Biodiversity, LIFE+ Environment Policy and Governance, and LIFE+ Information and Communication.

LIFE+ Nature & Biodiversity

The Nature & Biodiversity component continues and extends the former LIFE Nature programme. It will co-finance best practice or demonstration projects that contribute to the implementation of the Birds and Habitats Directives and the Nature 2000 network. In addition, it will co-finance innovative or demonstration projects that contribute to the implementation of the objectives of Commission Communication (COM (2006) 216 final) on "Halting the loss of biodiversity by 2010 – and beyond". At least 50percent of the LIFE+ budget for project co-financing must be dedicated to LIFE+ Nature and Biodiversity projects.

LIFE+ Environment Policy & Governance

The Environment Policy & Governance component continues and extends the former LIFE Environment programme. It will co-finance innovative or pilot projects that contribute to the implementation of European environmental policy and the development of innovative policy ideas, technologies, methods and instruments. It will also help monitor pressures (including the long-term monitoring of forests and environmental interactions) on our environment.

LIFE+ Information & Communication

This component will co-finance projects relating to communication and awareness raising campaigns on environmental, nature protection or biodiversity conservation issues, as well as projects related to forest fire prevention (awareness raising, special training).

LIFE+ is open to public or private bodies, actors or institutions registered in the European Union. Project proposals can either be submitted by a single beneficiary or by a partnership which includes a coordinating beneficiary and one or several associated beneficiaries. They can be either national or transnational, but the actions must exclusively take place within the territory of the 27 Member States of the European Union.

http://ec.europa.eu/environment/life/funding/lifeplus

ENVIRONMENTAL PROBLEM TARGETED

The environmental problem targeted is the treatment of overspray powders produced in thermal spray processes. The proposed solution consist in their recycling as secondary raw material to replace the common procedure of sending them to waste disposal, which has, at the same time, a high environmental impact and high cost to be sustained.

Thermal spraying is a family of versatile coating technologies, currently employed to deposit thick (50 μm - >1 mm) layers consisting of ceramic, metallic, cermet or composite materials for a variety of applications in such fields as: mechanical industry (wear and corrosion protection of mechanical parts, like shafts, joints, plungers, impellers, etc.), aeronautics and energy production (thermal insulation of gas turbine components, protection against high temperature oxidation and hot corrosion), biomedical industry (osteoconductive coatings on metallic prosthetic implants for dentistry and orthopaedics), etc.

The processes consist of injecting a feedstock material (in powder form, seldom as wire) into a hot gas stream generated by a thermal spray torch.

The coating is therefore built up by the superposition of various layers of flattened particles as the torch, usually controlled by an industrial robot, traverses repeatedly in front of the substrate.

WORK PROGRAMME

The project LIFE12 "***Recycling of thermal spray waste in sintered products***" has a duration of 36 months, starting on 01/07/2013 and end on 30/06/2016 and will be achieved through the following actions:

Preparatory actions

- Characterization of spent thermal spray powders (overspray), assessment of classification methods and of compatibility with glass frits and ceramic glazes raw materials

Implementation actions

- Development of pre-treatment processes for spent thermal spray powders
- Characterization of spent thermal spray powders after mechanical and chemical pre-treatments
- Development of frits modified by using thermally-sprayed scrap powders
- Development of glazes using thermally-sprayed scrap powders as secondary raw materials
- Test protocol of the new frits
- New glazes application protocol
- Sintering of ODS (Oxide Dispersion strenghtened) composites by SPS (Spark Plasma Sintering)
- Ceramic substrate preparation for the new glazes

- Characterization of sintered ODS; process optimization with recovery of unused powders
- Development of a system for the production of new frits and glazes using industrial plant
- New glaze application line and firing line for the production of tiles decorated with the new glazes
- Characterization of frits, industrial glazes and tiles glazed with new glazes; new products LCA

Monitoring of the impact of the project actions

- Monitoring of the environmental impact of the project
- Monitoring of social-economic impact of the project

Communication and dissemination actions

- Communication and dissemination

Project management and monitoring of the project progress

- Project management
- Monitoring of the project progress
- E3 Networking
- Audit Report
- After LIFE Communication Plan

PROJECT OBJECTIVES

The main project aim is demonstrate the feasibility of valorising and recycling thermal spray waste of different nature into high value products for industrial and residential use. Based on the powders type and morphology, the project aims to realize demonstrative products, like frits, glazes, glazed sintered tiles and sintered parts for targets and inserts, containing up to 100% of spent thermal spray powders. The focus is on two classes of powders: high temperature alloys like NiCoCrAlY and high temperature and abrasion resistant ceramics, like alumina and zirconia, which nowadays due to contamination problems and loss of spherical morphology, become hazardous waste after only one or few uses.
In thermal spraying, a jet of hot particles used to coat a given substrate, only a small portion of such particles is effectively sticking to the substrate. The remaining, up to 80-90%, simply bounce back, loose adhesion or are sprayed out of the target substrate, are collected and can no longer be used, for spherical shape lost and thermal alterations, or recycled, as contaminated by foreign materials.

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ENVIROMENTAL BENEFITS:

- Zero-waste approach from the production site (thermal spraying plants) to the reuse and valorisation

of the powders in spark plasma sintering or in ceramic firing, absorbing 100% of waste produced by the thermal spraying plants, with no solid waste production

- Separation of waste generation at the source: no cross contamination of waste streams will occur
- Immobilization of harmful contaminants of spent thermal spray powders (mainly heavy metals) in matrixes (glass matrix, ODS composites) which do not leach such elements. Preliminary tests conducted on Ni-based superalloy powders dispersed in soda-lime glass matrix evidenced a negligible leaching
- Absorption of other waste, like recycled glass cullets, for preparation of the glass matrix and to lower its softening point
- Application of low energy consumption techniques for recycling of thermal spray spent powders: rapid SPS and gas-fired roller kilns in rapid firing cycles. In case of the NiCoCrAlY, estimated required recycling energy is less than 10% of the embodied energy of the starting powders
- Realization of antistatic and electro-magnetic field shielding tiles, for the attenuation of the electromagnetic fields in residential and work places, and risks of fires reduction.

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TECHNICAL AND ECONOMICAL BENEFITS

- Realization of innovative products (ODS tools, low-cost targets for PVD, antistatic and EM shielding tiles, abrasion resistant or anti-slip tiles) currently not available on market or manufactured with much higher costs for starting raw materials

- Cost savings for spent thermal spray powders disposal (approx 1.2 €/kg)

- Cost savings for supplying refractory ceramic powders by recycling the alumina and zirconia ones; availability of the NiCoCrAlY powders as raw material for ceramic tile industry

- E.M shielding tiles can be used also to further protect the wireless intranet by unwanted external access due to the strong electromagnetic field attenuation achievable

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INNOVATIVE ASPECTS

The main innovative aspect lies in the possibility of a complete recycling of thermal spray powders. As a matter of fact no other recycling route is currently available excluded the overspray remelting and refining, which presents high energy consumption and high costs. According to the proposed project, instead, the spent thermal spray powders, even if slightly contaminated by Ni or Co, will be used for the first time to create innovative ceramic tiles and innovative sintered materials. This will convert an originally waste material into a high value product, with outstanding properties and different fields of application. Moreover, the transformation processes leading to the new materials and products are intrinsically able to completely reuse their own solid byproducts: unsintered powders exiting from SPS

will be used as they are, while abraded powders produced during the new ceramic tiles polishing will be reused in the glazes.

A further innovation aspect lies in the separation of the spent powders stream which will be implemented in two different stage: a first stage during thermal spraying, where the oversprayed powders collected in the dust filters will be separate from the particles collected at the bottom of the deposition chamber, automatically collected by a conveying system and temporarily packaged in small closed bags for further separation. As a matter of fact, the second separation stage will occur outside the deposition chamber, where the use of physical means (gravimetric, steric and magnetic separation) will allow to obtain spherical and small particles, non spherical particles (both metallic and ceramic) and contaminated ceramic powders, the latter to be used only in composites manufacturing by SPS or in non reactive addition to glazes.