PROJECT FINAL REPORT

Final Publishable Summary Report

Grant Agreement number: 262482

Project acronym: HAIFREE

Project title: A Novel Filtration Technology Targeted at enhancing the European Healthcare System's Efforts in Restraining the Spread of the Hospital Infection

Funding Scheme: FP7-SME-2010-1

Date of latest version of Annex I against which the assessment will be made:

Final report: 1st ☐ 2nd X☐ 3rd ☐ 4th ☐

Period covered: from January 2011 to December 2012

Name, title and organisation of the scientific representative of the project's coordinator[1]:

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[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the grant agreement

[2] The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm ; logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

Declaration by the scientific representative of the project coordinator[1]

I, as scientific representative of the coordinator1 of this project and in line with the obligations as stated in Article II.2.3 of the Grant Agreement declare that:

- The attached periodic report represents an accurate description of the work carried out in this project for this reporting period;
- The project (tick as appropriate):

  ☐ has fully achieved its objectives and technical goals for the period;

  X has achieved most of its objectives and technical goals for the period with relatively minor deviations[3];

  ☐ has failed to achieve critical objectives and/or is not at all on schedule[4].

- The public website is up to date, if applicable.
- To my best knowledge, the financial statements which are being submitted as part of this report are in line with the actual work carried out and are consistent with the report on the resources used for the project (section 6) and if applicable with the certificate on financial statement.
- All beneficiaries, in particular non-profit public bodies, secondary and higher education establishments, research organisations and SMEs, have declared to have verified their legal status. Any changes have been reported under section 5 (Project Management) in accordance with Article II.3.f of the Grant Agreement.

Name of scientific representative of the Coordinator1:

Date:

Signature of scientific representative of the Coordinator1:

[3] If either of these boxes is ticked, the report should reflect these and any remedial actions taken.

[4] If either of these boxes is ticked, the report should reflect these and any remedial actions taken.

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1. Executive Summary

At healthcare facilities, there is a strong demand for a new advanced air cleaning technology to prevent infectious diseases such as severe acute respiratory syndrome (SARS) and Hospital Acquired Infections (HAI). HAIFree system would avoid the high costs related to healthcare and legal matters which increase every year and are a burden to the fixed costs of maintaining sanitary systems in Europe and USA.

HAIFree has been focused on development of innovative air treatment solution allowing control the presence of pathogens within hospitalary environment. HAIFree solution shall be capable of immobilize pathogens and neutralize them using energetic catalytic processes.

In HAIFREE, a series of individual technologies was further developed to render a new air filtration technology that overcomes existing needs in healthcare facilities. The concept of the developed technology can be briefly described as follows: The contaminated air flow passes through a combination of electric fields which traps and destroy particulate matter, as well as VOCs through the simultaneous action of the biocide coating and the ozone generated. Ozone surplus is then absorbed by a zeolite filter to finally render a high quality air.

Key features of the new air filter may be summarized as follows:

- High purity airflow. HAIFREE technology, by a combination of technologies such as ozonation, electroprecipitation and biocide coatings, removes 99.9% of particulates over 0.3 microns and 95% of VOCs (in contrast to HEPA filters) with sustainable airflows of at least 5.5 m/s, according to operational and laboratory rooms requirements.
- Cost reductions (“Install-and-forget”). In contrast with HEPA filters this is a self-cleaning modular system capable of destroying particulates by means of a combustion reaction triggered by the ozone, thus converting them in CO2 and water. This means cost reductions because no replacement is needed and only a limited maintenance is required.
- Increased biosafety and environmentally friendly. Filtration efficiency and VOCs abatement make the healthcare facilities air safer to the patient. No replacement is needed, it does not clog. It is safer for maintenance operators since no living pathogens have to be manipulated. For those reasons, there are no biohazards recycling costs.

To validate the HAIFREE system the filter was installed and on-site tested in a surgery room San Pedro Hospital, Logroño (Spain) showing a good performance.

In summary, Haifree filtering system present many advantages in air purification when is integrated into air conditioning system of health-care facilities, reducing VOC´s and pathogen contamination at the same time that offers safe particulate matter and ozone control with low energy consumption

2. Summary description of project context and objectives

It is estimated that Healthcare Acquired Infections (HAI) cost around €17.1 billion per year across Europe. Every year, nearly 10% of European hospital patients develop a healthcare-associated infection (HAI), according to European Centre for Disease Prevention and Control (ECDC) 2007. HAIs increase hospital stays by around 2.5 times, what costs approximately €4,400 extra for each patient. Such infections account for an estimate of over 50,000 deaths and cost the EU an estimated over 1 billion Euros annually (ECDE, 2007) in each affected state.
Hospitals expend a considerable amount of money and effort in avoiding air contamination by using expensive filtration units that -such as HEPA or ULPA filters. However, these are limited to a certain areas due to the high cost of those devices, such as operational and surgical rooms, intensive care units, isolations rooms and army hospitals.
In a longer run, the improvement of air quality is a general problem, which affects not only the healthcare industry. So once HAIFree will be established in a healthcare sector, alternative solutions targeted for other use scenarios: like mass transport air conditioning, preventive maintenance of air conditioning infrastructure, buildings, hotels, etc.

The overall objective of HAIFree project with the proposed approach can be broken down into scientific and technical issues, as follows:

Scientific Objectives

The scientific objectives are based on research and develop of an “install and forget” air reduction system capable of trapping and destroying bacteria from air particulates.

Objective A. “Increase understanding electrostatic deposition and destruction of pathogens, viruses and bacteria.”

1. Characterization of airborne microbes and viruses and those susceptible to be killed by HAIFree process.
2. Determining the needed discharge to promote the microbe charge and their precipitation.
3. Determine the time taken for oxidatively remove bacterial mass from biocide surface
4. Determining the coating thickness for biocide compound
5. Determining Minimal Inhibitory Concentration (MIC) and Killing curves (KC) under bactericidal environment.

Objective B. “Study in detail of the electrostatic precipitation reactor vessel”

1. Power output parameters, such voltage peak, frequency, electric discharge gap and effective length.
2. Titanium catalytic efficiency in static and moving conditions
3. Effect for different densities of pollutants and air velocity.

4. Modelling of air flows and the means of optimising throughput and filtration efficiency.
5. Define the effect of atmospheric variables on the process.

Technological objectives

The technological objectives of HAIFree are focused in the development and validation of the effectiveness of the working pre-production prototype of the novel hybrid process. This will require the development of a prototype giving the following performance:

(A) A combined precipitation-biocide action due to titanium dioxide coated surface in the electrostatic precipitators (ESP).

(B) An expected removal rate of 99.97% of the absorbed contaminants as a consequence of the combined plasma/chemical reaction of ozone and volatiles in a reaction chamber.

(C) Low ozone concentration in the exhaust air stream by means of a quenching reaction with the catalyst cartridge.

(D) Capable to use a flow velocity profile to slow the flow in the centre of a pipe so that the operating electric field has enough influence to improve the mean particle capture.

(E) Capable to achieve laminar flow of 0.5 meter per second for operational and laboratory rooms application.

3. Description of main S & T results/foregrounds

The actual developments obtained for each result after the execution of the HAIFREE project have been:

1. Consortium has acquired deeper understanding of the physical properties of airborne pathogen.
2. Were formally defined a set of requirement for developing a laboratory test bench for handling pathogens
3. It has been concluded a study of variables affecting the efficiency of ESP units, design of ESP unit
4. Construction of laboratory test bench incorporating, ESP unit, measurement probes, air velocity humidity, temperatures, data loggers, etc
5. Enhanced technological knowledge in electrostatic precipitation and biocide coatings integration that led to design an advanced electrostatic precipitator coated with TiO2
6. Well understanding of ozone safety limit, use for pathogens and VOCs elimination and operational parameters has allowed designing the ozone reaction chamber.
7. Adequate catalytic system for surplus ozone depletion within the air regulations.
8. A compact pre-production prototype integrating the individual components from previous WP showing good performance for particle trapping and VOCs and pathogens elimination.
9. The HAifree pre-production prototype has been validated on-site. It presents many advantages in air purification when is integrated into air conditioning system of health-care facilities, reducing VOC´s and pathogen contamination at the same time that offers safe particulate matter and ozone control with low energy consumption

4 Potential impact and main dissemination activities and exploitation results.

POTENTIAL IMPACT ON EU SOCIETY

Societal Impact.

A huge cost benefit will be derived by the improvement of ambient air quality around restaurants and laboratories. The quality of life of people living the immediate vicinity of these places will be improved; the incidence of respiratory disorder and the financial burden for caring from people with these diseases will be lowered. Based on a 10% market penetration 8,800 reduction of the 10,7 million annual cases of respiratory disorder among European citizens and €24M reduction of €10,2 billion annual costs of respiratory disease to the EC is estimated. In addition, the quality of life of chronic patients such as patients represented by X8 wills drastically improved because of the clean air. The Hospital´s stays will be decreased due to the significant decrease in HAI infections numbers; it is expected that patients who has suffer operational process should stay in a free pathogen environment that assures a fast recovery**.**

Employment opportunities

Based on our estimates of penetration of the European / Global markets for the generic product groups, and in addition, the indirect market for automated cell sales, this could potentially safeguard and generate new job opportunities over a 5 year period. It is estimated that HAIFREE project will create or safeguard 220 jobs. It is also expected to create of safeguard 21 jobs due to the non European sales. Therefore, a total employment opportunities of 240 jobs will be created or safeguard.

POTENTIAL IMPACT ON PARCIPANTS

The main benefit for participants consists in accessing a niche market in which exists a real quantifiable problem. All of the SMEs plan to become the initial players in the supply team able to offer this new technology. They are also keen to licence the technology to other companies in the EU, spreading it as rapidly and widely as possible, since they realise that the high volume, even at low market penetration, is outside their capacity.

The SMEs will benefit from royalty free non-exclusive rights to manufacture and sell the HAIFREE technology. VMR will benefit of new products based in functional filters with cleaning properties and a new filter system. In addition, VMR will expand their portfolio of new products for filters. VIEIRA will benefit of a new technology of electrostatic precipitator for microbiological contamination. NANOCAT will benefit for manufacturing and selling the final biocide formulation for electrostatic filters. Finally, SOMEZ will benefits for a introducing their products on a new market share, air filter systems.

DISSEMINATION ACTIVITIES

Several partners have attended to different dissemination events where the prepared communication materials (e.g.project brochure, PPT´s) have been distributed. Relevant events where Haifree has been present:

- Conference: Teinsa European Projects Conference in La Rioja (Spain) November 2011
- Conference: Teinsa R&D project management in 7FP La Rioja (Spain) April 2102
- Conference: Vimansa and Teinsa ACCIONA and IBERBROLA seminar in Madrid (Spain) (May 2012)
- Workshop: Vimansa and Teinsa, has been present in "Itinerario Mexico + Cerca", a trade mission to Mexico organized by ADER (Agency for Companies Development of La Rioja Regional Government of Spain) in November 2012 in Mexico.
- Trade fair: Teinsa y Vimanasa were invited to participate in Enomaq 2011 trade fair, at Zaragoza
- Trade fair: Vieira& Lopes was invited to participate in Expoindoor 2012 International Seminar and Fair about Indoor Air Quality in Hospital Environments held on September 26th-27th 2012 in Sao Paulo (Brazil).

A project brochure and a poster regarding about project aims, needs to fulfil, strategy, and expected benefits to users. This brochure and poster were distributed among the partners in order to be used in every conference or trade fair they attend. Both dissemination materials have been updated in the last quarter of the project integrating new achievements.

An intense activity has been done by the RDT performers to show technology developments to SMEs. Many of this activity has carried out in devoted meetings, some of them carried out after or before the consortium meeting (to save project resources), but other took place by teleconference or special visits.

EXPLOITATION OF RESULTS

The HAIFREE project Foreground exploitation strategy is constructed under following pillars:

- To identify key user groups who have influence in their own regions.
- To work with key users groups to test and trial product ensure the end product is what the market needs
- To develop product Champions throughout Key European markets.

Consortium has done a market search identifying: market needs, target customers, market segment, competitors, and SWOT. A strategic approach for investments and commercial activity and an implementation schedule has been developed. The business plan has estimated pricing for the final equipment and a sales forecast. Different options for public and private funding mechanisms for future investments have been evaluated.

The exploitation of developed technology will occurs in four stages: 1) Time to market and Study of Introduction into international markets, 2) Introduction to Spain and France, 3) Introduction to Germany/Italy and 4) US markets. This schedule has been designed according to the importance of the market due to the incidence level of such infections, hospitals and industries facilities suitable for their use, and the interest of the partners

The SME partners have worked well together through the project. To make the advances necessary we propose to apply for a demonstration activity.

5. Address of project public website and relevant contact details

5.1. Consortium Members

PARTNER	SHORT NAME	COUNTRY
Victoriano Martinez Riomansa SL	VMR	Spain
Astato SA	AST	France
Nano-Cat srl	NANO	Italy
Societe Mediterranee des zeolites SARL	SOZ	France
Tecnica en Instalaciones de Fluidos	TEI	Spain
Inspiralia Tecnologias Avanzadas	ITAV	Spain
Instituto Pasteur de Lille	IP	France
Vieira & Lopes	VIE	Portugal

5.2. Project Contact and Logo

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