



**Sub-task 3. Environmental applications of electron beams**

**Sub-task 6. Barriers to accelerator adoption by industry**

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## Task 12.1 -Sub-task 3. Environmental applications of electron beams (RTU, INCT)

12.1.3 – Development of processes for environmental applications starting from theory, through laboratory rigs up to pilot plants.

- Study some new and important societal applications of accelerators with the aim of developing roadmaps for their innovation: reduction of environmental pollution of air, wastewater and municipal biological wastewater treatment plants sludge.

# Organic Pollutants Treatment

## Strategy – theoretical and laboratory research.

- Organic compounds containing halides such as perfluoroalkyl and polyfluoroalkyl substances (PFAs) or chloroquinum and its derivatives are widely used, and at the same time they are difficult to degrade in the natural environment.
- The technology of organic pollutants treatment with the use of an electron beam is one of the most modern technologies of removing impurities from the gas phase.. In the event of decomposition of PFAs, secondary electrons can attach to the chlorofluorocarbons causing dechlorination and defluorination of these compounds. Additionally, the presence of hydroxycyclic (OH) radicals and oxygen can accelerate the decomposition of fluorine-containing compounds.
- Chlorinated organic compounds, chloroquine and hydroxychloroquine are widely used in pharmacology as antimalarial drugs and in the treatment of rheumatic diseases. Therefore, it is presumed that these compounds are released into the environment and may contain significant amounts of wastewater. So far, no information has been found in the literature on the removal of chloroquine and hydroxychloroquine from aqueous solutions under the influence of ionizing radiation. (PhD student from Kenia)

# Organic Pollutants Treatment

## Strategy – theoretical and laboratory research.

- Explaining the mechanism of decomposition of organic pollutants, including chloroquine or hydroxychloroquine in aqueous solutions under electron beam irradiation;
- Explaining the mechanism of removing chlorofluorocarbons under accelerated electron beam irradiation by means of numerical simulation;
- The proposed research task will expand our knowledge on the removal of organic compounds containing halides in the gas phase and in aqueous solutions using an electron beam;
- The results of this research may allow the development of technologies for the removal of halogenated organic compounds.

# Balast Water Treatment

## Strategy –laboratory and industrial site research.

- Ballast water discharge typically contains a variety of biological materials, including plants, animals, viruses, and bacteria. These materials often include nonnative, nuisance, exotic species that can cause extensive ecological and economic damage to aquatic ecosystems, along with serious human health issues including death. •
- IMO standards a) *Vibrio cholerae* (O1 i O139) less than 1 CFU (colony forming unit - cfu) per 100 ml or less than 1 CFU per 1 gram (wet mass) zooplankton sample; • b) *Escherichia coli* less than 250 CFU in 100 ml; • c) Enterococci less than 100 CFU in 100 ml.
- Laboratory work
- Pilot plant construction

# Sludge hygenization + biogas

## Strategy –laboratory and industrial site research.

- Directive 91/271/EEC on urban waste water treatment Sludge arising from waste water treatment shall be reused whenever appropriate. Disposal routes shall minimise the adverse effects on the environment • Art. 96.4 Act from 14 December 2012 (law on waste) Usage of municipal waste is possible only if they're stabilised and prepared directly to its purpose and way of use, especially by biological, chemical, thermal or any other treatment that decreases tendency to rotting or eliminates threat for human health and environment.
- **Laboratory work**
- **Additional projects on biogas production**
- **Basic engineering for pilot plant in frame of Task 12.2:** Design of advanced electron accelerator plant for biohazards treatment (INCT, STU) Task concerns a critical step in the development of an advanced electron plant for biohazards treatment, the preparation of the processing line design and the development of specifications for the accelerator unit construction. STU will provide advice on recent accelerator technology which may be applied
- **PhD student**

# Funding project for environmental technologies development

## R & D work

- POIR.04.01.02-00-0022/17-00 „DEZMETAN“ Development of technology for preparation of substrates used in methan eco-digestion using disintegration methods”(NCBR)
- •INNOship „Eko dok” POIR.01.02.00-00-0007/18" Design and verification on a pilot scale, environmentally friendly, integrated with the floating dock, the system of collection and treatment of ballast water and sludge from the ship and technological waters from the ship hull cleaning process, using ionizing radiation for the utilization of pollutants”(NCBR)
- •POIR.04.01.04-00-0078/17”BBNawOrg” “Zero-energy technology for the manufacturing of biologically safe organic fertilizers based on sewage sludge”(NCBR)
- „Innovative biogas plant” no 98/20/PU/P80 (NCBR)



## Task 12.1 - Sub-Task 6: Barriers to accelerator adoption by industry / M1 – M48 (INCT, STU)

12.1.6 -Barriers to accelerator adoption by industry (INCT, STU): will study the barriers which are discouraging some companies from benefitting from accelerator technologies. These include financial concerns, legal barriers, security concern and lack of specialized knowledge. It will use experience from companies that have successfully introduced their use to address these concerns

- Environmental applications of electron beams
- Industrial applications introduced into new countries



# Task 12.1 - Sub-Task 6: Barriers to accelerator adoption by industry / M1 – M48 (INCT, STU)

## 1. Identification of barriers:

- financial
- legal
- security
- *public opinion*
- lack of educated staff

STU experience from companies that have successfully introduced accelerators : **EB Trencin SK** for industry

## Task 12.1.6

- Field of Applications
- Economic and Environmental Impact
- Equipment Trends
- Market Prospects
- Market Challenges

A.J. Berejka, PROSPECTS AND CHALLENGES FOR THE INDUSTRIAL USE OF ELECTRON BEAM ACCELERATORS

## Sub-Task12.1. 6: Environmental applications of electron beams (Market Challenges)

- The need to address the market in a coherent manner
- The need to be more astute in the selection of areas for applications development
- The need to emphasize energy efficiency
- The need to develop trained professionals
- The need for enhanced industry wide communication

# Points for consideration in developing an iia strategy that meets the needs and expectations of the scientific community.

## Collaboration with iiA

- “Accelerators for America’s Future” <http://www.acceleratorsamerica.org/>
- Whilst many companies have their origins in science/engineering most are now owned and managed on a financial basis further supporting the idea that more effort is required to create the required relationships between science and commerce.
- Regulators place a heavy reliance of input from this community. Academia therefore has an important impact on, and is an important influencer of, new laws and regulations. It is therefore in the interests of commercial companies that they share information and knowledge with the scientific community. The iia should recognise the importance of communicating the operational needs, concerns and challenges that commercial organisations face as this could impact on future research, law and on regulations.

# iFAST

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