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Made on Land, Ends Up in the Water "I-Clare" Intelligent Remediation System for Removal of Harmful Contaminants in Water using Modified Reticulated Vitreous Carbon Foam

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Abstract : The circular economy of water presents a pressing environmental challenge in our society. Water contains various harmful substances, such as drugs, antibiotics, hormones, and dioxides, which can pose silent threats. Water pollution has severe consequences for aquatic ecosystems. It disrupts the balance of ecosystems by harming aquatic plants, animals, and microorganisms. Water pollution poses significant risks to human health. Exposure to toxic chemicals through contaminated water can have long-term health effects, such as cancer, developmental disorders, and hormonal imbalances. However, effective remediation systems can be implemented to remove these contaminants using electrocatalytic processes, which offer an environmentally friendly alternative to other treatment methods, and one of them is the innovative iCLARE system. The project's primary focus revolves around a few main topics: Reactor design and construction, selection of a specific type of reticulated vitreous carbon foams (RVC), analytical studies of harmful contaminants parameters and AI implementation. This high-performance electrochemical reactor will be build based on a novel type of electrode material. The proposed approach utilizes the application of reticulated vitreous carbon foams (RVC) with deposited modified metal oxides (MMO) and diamond thin films. The following setup is characterized by high surface area development and satisfactory mechanical and electrochemical properties, designed for high electrocatalytic process efficiency. The consortium validated electrode modification methods that are the base of the iCLARE product and established the procedures for the detection of chemicals detection: - deposition of metal oxides WO3 and V2O5-deposition of boron-doped diamond/nanowalls structures by CVD process. The chosen electrodes (porous Ferroterm electrodes) were stress tested for various parameters that might occur inside the iCLARE machine–corosis, the long-term structure of the electrode surface during electrochemical processes, and energetic efficacy using cyclic polarization and electrochemical impedance spectroscopy (before and after electrolysis) and dynamic electrochemical impedance spectroscopy (DEIS). This tool allows real-time monitoring of the changes at the electrode/electrolyte interphase. On the other hand, the toxicity of iCLARE chemicals and products of electrolysis are evaluated before and after the treatment using MARA examination (IBMM) and HPLC-MS-MS (NILU), giving us information about the harmfulness of using electrode material and the efficiency of iClare system in the disposal of pollutants. Implementation of data into the system that uses artificial intelligence and the possibility of practical application is in progress (SensDx).

Keywords : waste water treatement, RVC, electrocatalysis, paracetamol
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