【Grant-in-Aid for Scientific Research (S)】

Science and Engineering (Engineering)

Title of Project : Innovative Water Treatment System Combining Pretreatments and Membrane Separation for Sustainable Supply of Safe High-quality Water

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Research Project Number : 16H06362 Researcher Number : 00173790
Research Area : Engineering, Civil and Environmental Engineering
Keyword : Water and Wastewater Systems

【Purpose and Background of the Research】

To address water-related issues, a need is recognized for advanced water-supply technologies that would allow safe and secure use of even low-quality water resources at a reduced cost and with greater energy efficiency and could be managed and maintained simply. Toward this, we apply superfine adsorbent particles produced with a nano-milling technology and pore surface control; metastable regions of polyvalent metal salts to polymer technologies, thereby improving coagulation performance; vacuum ultraviolet (VUV) light-accelerated oxidation. We combine these and membrane separation, and develop innovative water treatment system, which offers high separation and decomposition capabilities.

【Research Methods】

We start with examining elemental technology of adsorption, coagulation and oxidation, and develop prototype materials and equipment and then apply a variety of assessment methods, including direct measurement and model estimations, to evaluate the basic characteristics of these materials and equipment. Further, we consider synergistic effects from their combinations.

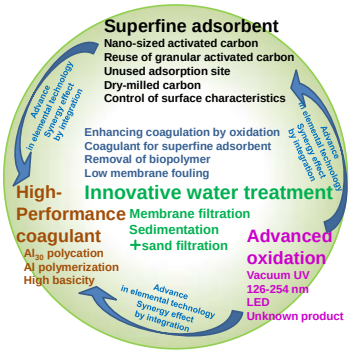

Fig. 1 Research plan.

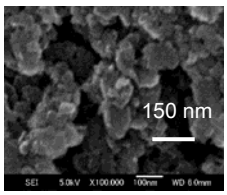

Fig. 2 Superfine powdered activated carbon.

1) We attempt the production of super-fine particles of activated carbon by milling and consider the agglomeration properties and change in adsorption capacity, along with the potential for reuse of spent granular activated carbon. 2) By optimizing production conditions such as reaction temperatures, we produce ultra-high basicity coagulants that better removes, arsenic, viruses, and bio-polymers that lead to membrane fouling. 3) Applying VUV light of various wavelengths accelerates the OH radical oxidation reaction, allowing investigation of non-biodegradable substance decomposition and the impact on coagulation improvement. 4) We investigate the affinity of superfine powdered activated carbon (SPAC) and ultra-high basicity flocculants to membrane, as well as their residual features, for application to the development of membrane separation and sedimentation with sand filtration.

【Expected Research Achievements and Scientific Significance】

The combination of membrane separation with SPAC, ultra-high basicity coagulant, VUV-accelerated oxidation, and their component technologies will bring about innovation to the separation and reaction process. This will produce innovative water purification systems that can be applied to low-quality water resources, at low cost and with little energy. This represents a significant contribution toward a stable supply of water that is safe for consumption and daily use.

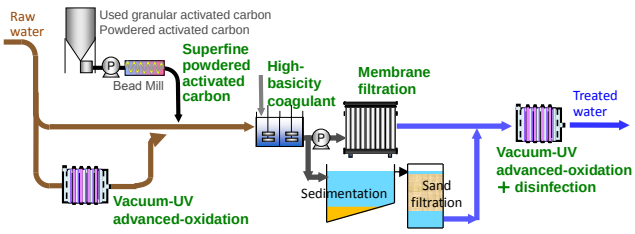

Fig. 3 Combined use of superfine powdered activated carbon, high-basicity coagulant, vacuum-UV advanced-oxidation and membrane filtration.

【Publications Relevant to the Project】

・Kimura, M., et al, N., Minimizing residual aluminum concentration in treated water by tailoring properties of polyaluminum coagulants, Water Research, 47(6), 2075-2084, 2013.
・Matsui, Y., et al., Characteristics of competitive adsorption between 2-methylisoborneol and natural organic matter on superfine and conventionally sized powdered activated carbons, Water Research, 46(15), 4741-4749, 2012.

【Term of Project】

FY2016-2020

【Budget Allocation】

100,800 Thousand Yen

【Homepage Address and Other Contact Information】

http://www.eng.hokudai.ac.jp/labo/risk/