Department of Architecture and Civil Engineering

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Treatment and resource recovery of wastewater and solid wastes

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Main research themes and their characteristics

「Energy and resource recovery from wastewater and solid wastes」

A change is now desired from a consumer society to a sustainable society. Anaerobic digestion (or methane fermentation) is a useful technology for the sustainable society, because it can reduce the amount of bio-waste that needs to be disposed, and produce biogas, a source of renewable energy. It also can recover valuable resources such as hydrogen and nutrients.

Anaerobic digestion has been widely employed for bio-waste treatment, including wastewater, sewage sludge, municipal solid waste, and agricultural wastes. Therefore, anaerobic digestion can be a core technology for bio-wastes produced in the particular area.

The aim of this study is to improve anaerobic digestion of those wastes, in particular, higher solids destruction and methane recovery. Iimportant nutrients, such as nitrogen and phosphorus, are also attempted to recover or converted to fertilizer.

Ammonia is generally produced using natural gas which is reacted with nitrogen to form liquid ammonia through a process called the Haber-Bosch process. However, the process is operated at high pressure and temperature, and thus consumes a huge amount of energy, i.e., more than 1% of energy consumption in the world. Therefore, the recovery of ammonia from bio-wastes can be advantageous from an energy-saving point of view. As a carbon-free asset, ammonia has several potential applications, including long duration renewable storage, a transport fuel for fuel cells vehicles, a feedstock as green fertilizer, and an industrial energy source.

Phosphorus is an essential element for all living matter, and its main industrial use is in the production of fertilizers. However, phosphate rock, an inorganic mineral from which the majority of phosphorus products are derived, has been concerned about its scarcity in the future. As there are no substitutes for phosphorus in agriculture, phosphorus today is regarded as a critical global resource. Phosphorus flows into sewage from human urine and excrement, food wastes, detergents and certain industrial waste streams, accounting for one third of the total phosphorus flux to surface waters. In Japan, 100% of phosphorus for industrial use is imported from other countries. Phosphorus in sewage thus represents a significant renewable resource.

Experimental devices shown below are applied to treat bio-wastes in this study. When sewage sludge was fed, high recovery efficiency was achieved; about 60% as methane for organics, about 20% as ammonia for nitrogen, and about 70% as phosphate for phosphorus.

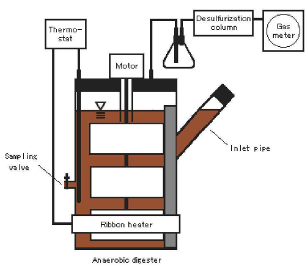

Fig.1 Anaerobic digester system

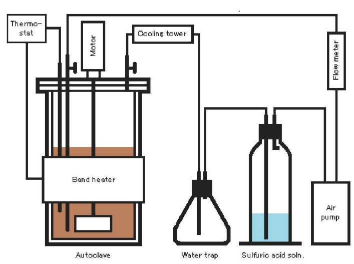

Fig.2 Ammonia stripping device

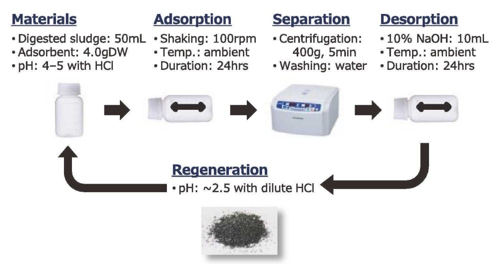

Fig.3 Procedure for phosphate adsorption

Major academic publications

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“Treatment of eutrophic lake water and phosphorus recovery by reusing alum sludge and/or wood”
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