Treatment of Organic Waste from SA/PA on the expressway using Ozone Nanobubbles for Zero Emissions

The service areas (SA) and parking areas (PA) on the expressway are important facilities that provide meals and rest to drivers and passengers. The service provision entails a large amount of waste generation that is loaded to the environment. The treatment of this waste involves also a huge operation costs. Therefore this research proposes a system for zero emission of waste in SA/PA.

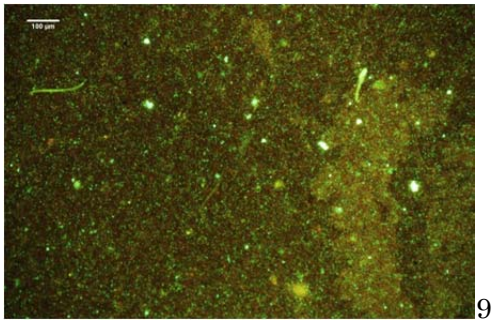
Most of the organic waste generated from SA and PA is mainly derived from the restaurants and excess sludge from septic tanks. Organic waste is crushed by the disposer and then treated by the septic tank. However, biodegradability of excess sludge is expected to be low because excess sludge contains a large amount of fibers from toilet paper. It is important to develop strategies to reduce the excess sludge produced during wastewater treatment at SA/PA in an economic, environmentally safe and practical manner.

There are several methods for the excess sludge treatment. The ozonation for enhancement of sludge biodegradability has been extensively studied and characterized. In addition, it has accepted as a promised technology for attaining consistent and for reliable excess sludge reduction. However, sludge reduction using ozone was not quantitatively evaluated at before, the quantitative evaluation of sludge ozonation is necessary for its farther improvement. In the sludge ozonation for reducing excess sludge, increasing ozone utilization for solid sludge, i.e. not for dissolved organic matter, will contribute to reduce cost due to decrease the amount of the required ozone. In recent years, micro-bubble (MB) and ultra-fine bubble (UFB, nano-bubble) technologies have drawn great attention in a wide variety of fields. MB and UFB have a large interfacial area and high bubble density, low rising velocity in liquid phase and high inner pressure compared to common milli-size bubbles. In this study, we developed quantitatively evaluating method using as the LIVE/DEAD BacLight viability kit with fluorescent microscopy an indicator of bacterial inactivation by sludge ozonation. Furthermore, in order to increase the efficiency of the sludge ozonation by using UFB instead of milli-bubble or MB, we study the performance of the UFB ozonation for bacterial inactivation and degradation.

UFB generator


Observation of UFB using Tyndall scattering, Left: control(tap water), right: UFB water (made from tap water),


Excess sludge treatment using ozone-nanobubble



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Result of staining the sludge after ozonation using live/dead bacterial viability analysis (Live bacteria: green fluorescence (SYTO®9 staining), Dead bacteria: red fluorescence(PI staining))