Incineration of municipal solid waste (MSW) is common for energy recovery, and management of municipal solid waste incineration (MSWI) ashes has received a growing attention around the world. In the U.S., generation of MSW has increased up to 65% since 1980, to the current level of 250 million tons per year with 53.6% landfilled, 34.7% recycled and composted, and 11.7% incinerated with energy recovery. In the process of incineration, MSWI ash is being produced as byproducts; about 80 to 90% of the MSWI ash of bottom ash and 10 to 20% of fly ash by weight. The current practice of the U.S. is to combine both bottom and fly ashes to meet the criteria to qualify as non-hazardous, and all combined ashes are disposed in landfills.

European countries have utilized MSWI bottom ash as beneficial construction materials by separating it from fly ash. The fly ash is mostly limited to landfill disposal as hazardous material due to its high content of toxic elements and salts. Bottom ash has been actively recycled in the areas of roadbed, asphalt paving, and concrete products in many of European and Asian countries. In those countries, recycling programs (including required physical properties and environmental criteria) of ash residue management have been developed so as to encourage and enforce the reuse of MSWI ashes instead of landfill disposal. Moreover, many studies have demonstrated the beneficial use of MSWI ashes as engineering materials with minimum environmental impacts.

On the other hand, the U.S. has shown a lack of consistent and effective management plans, as well as environmental regulations for the use of MSWI ashes. Due to persistent uncertainty of engineering properties and inconsistency in the Federal and State regulations in the U.S., however, the recycling of the MSWI ashes has been hindered and they are mostly disposed in landfills.

In this research work, current management practice, existing regulations, and environmental consequences of MSWI ashes utilization are comprehensively reviewed worldwide and nationwide with an emphasis of the potential area of its utilization in asphalt paving and concrete product. This research also entails a detailed chemical and microstructural characterization of MSWI bottom and fly ash produced from a Refuse Derived Fuel (RDF) facility in Florida so that the MSWI ash is well characterized for its beneficial uses as construction materials. The material characterization includes Scanning Electron Microscopy (SEM), Energy Dispersive X-ray Spectroscopy (EDS), and X-ray Diffraction (XRD) techniques. In addition, leaching experiments have been conducted to investigate the environmental properties (e.g. leachate concentration) of bottom ash and ash-mixed hot mix asphalt (HMA) and Portland cement concrete (PCC). Leaching results reveals the reduced leaching potential of toxic material from MSWI ashes while incorporated in HMA and PCC. Lastly, a preliminary experimental approach has been devised for the vitrification of fly ash which is a promising thermal process of transferring material into glassy state with higher physical and chemical integrity to reduce toxicity so that utilization of fly ash can be possible.

Approved for distribution by Dr. Boo Hyun Nam, Committee Chair, on April 30, 2014.
The public is welcome to attend.