Stabilization Of Sludge Using High Temperature Melting Method

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Introduction

The increasing volume of sewage sludge produced in Malaysia create problems in handling and disposal. New approaches in treatment of sludge using thermal techniques and utilization the product are very promising not only in reducing the quantity of waste but also able to produce a valuable by-product for use as construction material. Different thermal treatment techniques would produce different types of molten slag.

Thermal treatment normally comprises three important components; heating temperature, cooling rate, and holding time. Different heating temperatures lead to different properties of the end products. Holding time determines whether the required temperature has reached the entire material, and thus allowing changes to the entire body of the sludge material. Cooling rate affects the resulting properties of the material 1. Melting process achieves higher volume reduction and produces more stable rock-like product than incineration, which may increase the reuse opportunities2.

Incinerated ash and melted slag have physical and chemical properties suitable for use as an aggregate substitute in construction application 3. The environmental assessment of treated materials, to be considered for utilization, is normally associated with the extent of contaminant release, expected to occur during the life time of the product itself, or the facility in which it will be used 4.

The objective of the study was to investigate the treatment of sewage sludge using high temperature melting to produce a residual material which is stable and safe for disposal. The study also evaluates the potential use of treated sludge as construction and building material

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Materials and Methods

Sewage sludge collected from septic tanks were characterised for physical and chemical composition. A laboratory scale melting furnace was used for melting study. The temperature used in the study varied from 900 to 1500°C. Investigation of the physical and chemical properties of finished product were carried out, including hardness, water absorption, specific gravity, chemical composition and leaching. Emission studies during incineration step were also carried out to evaluate air pollution potential at different temperatures. Gas analyzer was used to detect SO_2, NO, NO_2, CO and CO_2.

Results and Discussion

Using incineration and melting, the sewage sludge were converted into inorganic ash and finally as molten slag products which do not generate odour and they are in stable form. The volume of molten slag is about 1.9% of that of the original dewatered cake and about 40 % of that of incinerated ash.

During incineration process, Hg and Pb were the highest vaporizing metals, whereas Al, Fe, Ca, Cr and Cd were stabilized in the bottom ash with a low proportion of evaporation. During melting process, Hg could not be detected in the molten slag due to its highly vaporizing behaviour, Cr, Cd and Pb also were highly vaporized during melting process, whereas Al, Fe and Ca remained stabilized in the molten slag with very low proportion evaporating.

Scanning electron microscopic examination was carried out to examine the microstructure of the different molten slag products. Results show that molten slag with a lower heating temperature above the melting point without holding time and slower cooling rate showed some crystalline boundary structure, whereas the other different melting procedures products were amorphous.

Leaching test conducted for the molten slag confirmed that the leachate quality complied within the standard limit prescribed for many applications.

Molten slag produced from sewage were found to be more superior in quality compared to commercially available crushed stone. It is be better in quality than natural marble and granite.

In terms of gaseous emission, CO was found to diminish at elevated temperature above 800°C, but recorded a value of 80ppm, 50 ppm and 15 ppm for SO2, NO and NO2 respectively at incineration temperature of 800°C. The minimum gas emission can be achieved at 850 to 900°C.

Conclusions

The sewage sludge can be destroyed using high temperature melting (up to 1550°C) to produce useable end product. The physical and chemical properties of molten slag are very superior in quality than many commercially available building material. Stabilised sewage sludge in the form of melted slag are found to be non-leachable and therefore they are safe for ultimate disposal. Possible reuse of melted sludge for construction materials is highly recommended.

Benefits from the study

The process for stabilization of sewage sludge using incineration followed by melting is found to be environmentally viable as the end products are no longer posing a health threat. The achievement is direct conversion of unstable organic material into inert, non-leachable crystal-like slag which can be utilized to make construction material. The direct benefit will be cost saving in terms of achieving very high sludge volume reduction (more than 90%) and saving enormous landfill area

Patent(s), if applicable:

Nil

Stage of Commercialization, if applicable:

scale up to pilot scale plant is required for commercialization

Project Publications in Refereed Journals

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5. **Azni Idris**, Katayon Saed, Mahmoud Alkilani, Leong Jin Hoong, Stabilization of Rubber Sludge Using High Temperature Melting Process, LUCED-I&UA International Conference 2003-International Conference On Environmental Management And Technology, IOI Resort, **Putrajaya**, Malaysia, 4-6 August 2003

Graduate Research

Name of Graduate	Research Topic	Field of Expertise	Degree Awarded	Graduation Year
Mahmoud AlKilani	Melting of agro- based sludge using high temperature melting	Environmental Engineering	M.S.	2003
Omran M. Alkilani	Emissions of gaseous from combustion of sewage sludge	Environmental Engineering	M.S.	2003

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