

## **Recovery of Sewage Sludge Incinerator Ash by Geopolymerization**

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## **Sludge Generation & Incineration**





Increasing population & Increasing amount of sludge

#### Incineration: gained attention as a common disposal method

«Nothing vanishes, everything transforms»

Gas (Er

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Liquid (Water

Solid (ASH)

### Volume of the sludge decreases, ashes are generated.

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## **Incineration Plant & Sludge Ashes**

# Fluidized bed incinerator of Bursa









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## **Objective of the Study**

To develop a recovery strategy for the sewage sludge incinerator ashes





# Geopolymers



Cementitious materials that do not require the presence of cement to harden 3d network of Si & Al mineral molecules linked through covalent bonds with oxygen Synthetic alkalialuminosilicate material Physical & chemical properties comparable to cementitious binders

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## Geopolymers









### Alumino-silicate source

# Source

- Ground granulated blast furnace slag
- Silica fume
- Coal combustion fly ash

### Alkali

 Alkalis and alkaline activators, e.g. NaOH, KOH, sodium/potassium silicates Geopolymer paste Siddge incinerator Siddge incinerator fly ash was used as fly ash was used as geopolymer geopolymer precursor in this precursor in this study.

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### **Materials and Methods**



### emical composition of the materials



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## Heavy metal leaching from the sludge ash (EN12457)

 Parameter	mg/L	
Silver (Ag)	< 0.003	
Aluminum (Al)	0.053	hing was
Arsenic (As)	< 0.012	Leaching the
Boron (B)	0.030	lower that
Cadmium (Cd)	<0.003	limits:
Total	1.629	Hazarde
Chromium (Cr)		Waste Maste
Copper (Cu)	< 0.003	
Total Ferrous	< 0.004	
(Fe)		
Manganese	<0.005	
(Mn)		
Nickel (Ni)	<0.005	
Lead (Pb)	< 0.012	
Antimony (Sb)	0.018	
Tin (Sn)	< 0.009	
Zinc (Zn)	0.052	
Selenium (Se)	0.026	



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#### Content of the samples prepared

#### **Samples without cement**



#### **Samples with cement**





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### **Unconfined Compressive Strength, MPa**



CEM: Portland cement, SA: sludge ash, FA: fly ash, MS:

marble sludge al conference on sustainable solid waste management, 28-29 June 2019, Crete

### **Unconfined Compressive Strength, Mpa**

without cement



# Conclusions

- Combined influence of sludge ash, fly ash, and marble sludge was positive although the influence of sludge ash alone was negative.
- UCS of SA+FA+MS = 40.56 MPa

 Heavy metals leaching confirmed that sludge ash does not possess any toxicity leeaching.

Sludge incinerator fly ashes have the potential to be used as a supplementary cementitious material in geopolymerization.

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