ENCAPSULATED USE OF COAL BOTTOM ASH IN CONCRETE

Research by

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Outline of Presentation

- Problem statement
- Aim and Objectives
- Methodology
- Results
- Outcomes

Problem Statement (1)

- Coal -single largest fuel source for the generation of electricity worldwide- 38% of yearly electricity generation.
- Environmental impacts associated with disposal of CCBP (coal ash).
- In Mauritius, year 2008- 45% of the total energy generated - over 105,000 tonnes of coal ash.
- With prospective setting up of coal power plants, quantity of coal & thus coal ash will be greater.

Problem Statement (2)

- Leveling of cane field tracks /dumped on private land / a little for agricultural purposes.
- Environmental problem-Possible ground water contamination due to leachate of heavy metals (e.g Hg, Ar, Cd, Zn, Ba)
- Recognition of need for sound management- in line with MID concept.
- Identify applications requiring high volume of coal ash e.g in road construction and cement/concrete production.
- Investigate technical feasibility & assess environmental impacts.

Aim & Objectives

- Aim – investigate the encapsulated use of coal bottom ash in concrete as controlled low strength material and assess the environmental impacts of that application
- Specific objectives –
  - Determine the physical and chemical properties of coal bottom ash
  - Assess the main engineering properties of the concrete e.g compressive strength and elastic modulus
  - Assess the environmental impacts of the concrete with respect to leachability of heavy metals
  - Provide specifications and recommendations for the safe encapsulated applications of coal bottom ash.

Literature Review (1)

- Coal Ash
  - incombustible materials left after combustion of coal in combustors.
  - Fly ash (70%-90%) and bottom ash (10-30%).
  - Fly ash –spherical particles(1 um- 1 mm in size).
  - Bottom ash - Angular in shape. (75um -25 mm).
  - Contains heavy metals.

Sample No.	Lead (mg/kg)	Nickel (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Zinc (mg/kg)	Cobalt (mg/kg)
1	77.0	83.0	ND	30.7	73.5	308.3	31.7
2	9.0	77.3	ND	189.6	73.2	222.0	29.1

Literature Review (2)

- Encapsulated uses -partial substitute for cement (blending with cement), aggregates for concrete products (low cost material for projects requiring backfill, concrete surrounds, parking areas, erosion control), mineral filler in asphalt and pavements.
- Un-encapsulated uses of coal ash -fills below roads/buildings/pavements/parking areas, soil stabilization and material for pipe bedding.
- Coal ash contains heavy metals. Though encapsulated applications do not pose significant risks, both require leachability tests and hydrogeologic evaluation to ensure ground water protection.

	Zn	Cu	Hg	Ba	Cd	Cr	Ni	Pb
Israel	173	7.8	0.3	735	0.4	8.8	30	3.8
Drinking Water Stds-Israel	5000	1400	1	1000	5	50	50	10
Mauritius	32	ND	ND	7598	ND	8.3	11	ND
Drinking Water Stds-Mauritius	3000	1000	1	No Std	3	50	20	10

Concentrations of Trace Elements in the Extraction Solutions of Coal Bottom Ash in Israel and Mauritius (parts per billion)

Methodology

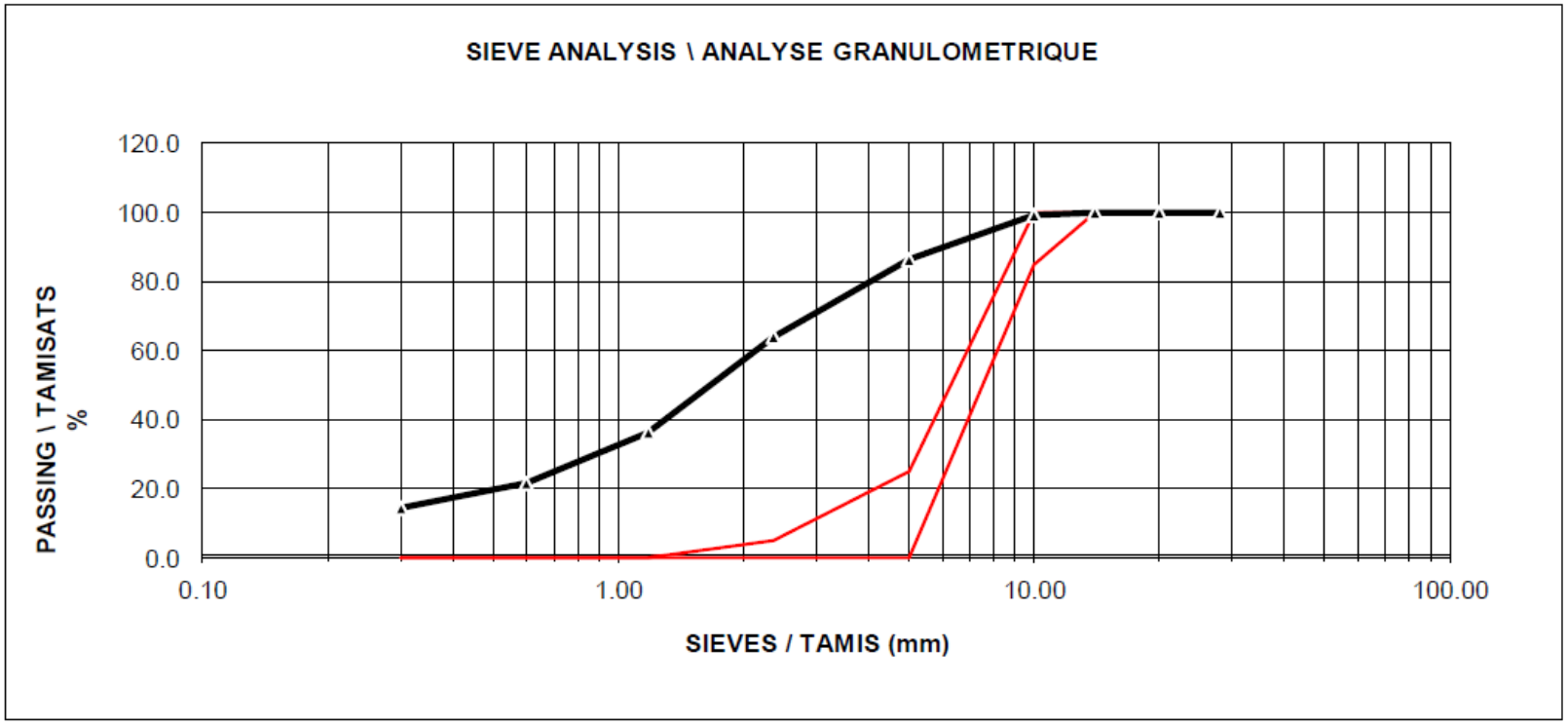
- Grade 30 concrete mix.
- A continuous grading established using the DOE Method
- Natural aggregates were substituted Bottom Ash by substituting the sand (0/4mm) and coarse aggregates 6/10mm.
- 5 cubes for each mix-1@ 7d, 1@28d, 3 for leachability test
- Leachability test as per BS EN 12457-1:2002
- Results to be compared with BS 6920:2000-Materials in Contact with Drinking Water and Drinking Water Standards in Mauritius

Schedule of Activities

	September				October				November				December	
Week	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
Start Project														
Litterature Review														
Define Methodology														
Testing														
Analysis														
Write Up														
Submission														

Results

1. Grading Curve-Bottom Ash



2. Compressive Strength

Mix Reference	Cement Content	% Replacement of Natural Aggregates by Bottom Ash	7days strength (MPa)	28 days strength (MPa)
Grade 30-CM	350 kg	0	28	Pending
Grade 30-CM1	350 kg	7	24	Pending
Grade 30-CM2	350 kg	10	21	Pending
Grade 30-CM3	350 kg	16.5	19	Pending

Outcomes

- Scientific method to the sound management of coal ash in Mauritius.
- Develop research expertise for the use of secondary materials in the local construction industry.
- Provide specifications for the safe use of coal ash in concrete production.
- Valuable for future government policy decisions such as “Green Procurement”.
- It is expected that utilisation of coal ash will result in
  - decrease in the demand for landfill space and therefore lower maintenance costs.
  - Conservation of natural resources (less extraction of raw materials for aggregates).
  - A cleaner and safer environment.(less gaseous emissions associated with extraction and grinding processes).
  - Economic savings for end users.