

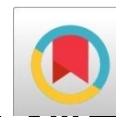
DISPOSAL OF BIOMEDICAL INCINERATION ASH BY ITS APPLICATION IN CONCRETE

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Abstract: Advancement in Medical field is an active part of development in science and technology. With the continuous increase in population and increase in use of medical facilities there is sharp rise in generation of medical waste. These wastes are hazardous in nature and have the greatest potential to have impact on living being and environment. One of the important methods of treatment of such waste is incineration but this method also produces ash which is a subject of land filling. This causes wastage of large area of land also leaching of contaminants in ashes cause contamination of ground water. The purpose of this project is to find some alternative for land filling of incineration ashes.

Keywords: Biomedical waste, incineration ash, cement, concrete, environment

I. INTRODUCTION

Overview of Problem:

Medical care is vital for human beings. Population is increasing very fast & with this rapidly increasing population need of medical facilities is arising at rapid rate. Also, with this increase in medical facilities, generation of wastes is rising sharp. Such types of wastes are termed as bio-medical waste. These wastes are considered to be highly hazardous and have a great potential to imply adverse effect on environment as well as living beings. The methods to dispose off this biomedical waste include incineration, autoclaving, microwaving, shredding. etc. But these methods lead to the generation of final treated (bottom ash) waste which are subject to disposal and landfill.

About Industry:

BIOCLEAR SYSTEMS PVT.LTD

Barshi Road, Solapur. Bio clean Systems (India) Private Limited is a private company incorporated on 21 April 2003. It is classified as Non-Government company and is registered at Registrar of Companies, Pune. Its authorized share capital is Rs.1,000,000 and its paid-up capital is Rs. 980,000. This organization has biomedical waste incineration plants established in Satara, Kolhapur, Sindhudurg, Solapur and Ahmednagar. The hospitals in these cities transport their biomedical waste to the respective Bio clean Plant situated in their city.

II. LITERATURE REVIEW

Ankur chauhan Amol Singh.[1]: they have Studied healthcare waste management. Surachi Pandey, Rajiv Divekar. [2]: have done overview of Biomedical waste management which describes a review of practices adopted by hospitals in Pune city.

Arif wulansari, Sudarno and Fuad Muhammad [3]: have worked on medical waste management at community health centre. A. Rajor, Kunal. [4]: Have done overview of Biomedical waste incinerator ash. This paper describes characterization, utilization and leachate analysis of biomedical incineration ash. Fang Liu, Rui Zhang.[5]: have studied on characteristics and treatment methods of medical waste incineration fly ash.

III. METHODOLOGY

REPLACING OF CEMENT BY BIOMEDICAL INCINERATION BOTTOM ASH IN CONCRETE:

In this method, cement content is reduced by a certain percentage and is replaced by incineration bottom ash in concrete. The other components of concrete are taken as per the mix design. Three cubes are Casted and their average compressive strength is considered as a result.

ADDING BIOMEDICAL, INCINERATION BOTTOM ASH TO CONCRETE WITHOUT REDUCING CEMENT CONTENT:

In this method, the required cement content for the specified grade of concrete is taken as per the mix design and only a certain percentage of incineration bottom ash is added to concrete. Thus, the cement content in this method is not reduced and the desired percentage of bottom ash is added. As mentioned in the previous method, three cubes of certain percentage of added incineration bottom ash are casted and their average compressive strength is considered as a result.

Left = Right = 19mm (0.75")

IV. DETAILS OF DESIGNS, WORKING AND PROCESSES:

DETERMINATION OF STERILITY OF THE BIOMEDICAL INCINERATION BOTTOM ASH:

COLLECTING THE SAMPLE OF INCINERATION BOTTOM ASH:

In order to study and use the biomedical incineration bottom ash in concrete, a sample of 20kg was collected from BIOCLEAR PLANT, BARSHI ROAD, SOLAPUR on 27/12/2019.

For the same purpose we met the Senior Manager of BIOCLEAR PLANT, SOLAPUR, Mr. BHIMASHANKAR LONI and explained to them about our thesis project.

Following request application was given to BIOCLEAR PLANT, SOLAPUR requesting to provide us a 20kg sample of incineration bottom ash for analysing and making its application in concrete.

COMPOSITION OF THE BIOMEDICAL INCINERATION BOTTOM ASH:

In order to use the biomedical incineration bottom ash in concrete, it was necessary to the analyse the composition of the bottom ash so that its suitability could be determined. Following are the major components of the biomedical incineration bottom ash:

SiO₂ - (39.74%)
CaO - (27.77%)
Na₂O - (9.13%)
Al₂O₃ - (5.16%)
Fe₂O₃ - (4.53%)

THE EXPECTED CONSTRAINT: TOXICITY OF THE BIOMEDICAL INCINERATION ASH:

The presence of siliceous and argillaceous substances in biomedical waste incinerator ash shows the chances of its use in construction activities. However, presence of toxic substances such as dioxins and furans and presence of heavy metals such as mercury (Hg), arsenic (As), lead (Pb), cadmium (Cd), silver (Ag), iron (Fe), zinc (Zn) etc. also pose obstruction for the same. So, reducing or eliminating the adverse effect of toxins and leaching of heavy metals is the first step in finding the alternative to disposal of biomedical waste incinerator ash which would help to overcoming this constraint.

OVERCOMING THE CONSTRAINT:

In order to overcome the constraint of determining the toxicity of the bottom ash we gave a sample of bottom ash to POTDAR PATHOLOGY LABORATORY, SOLAPUR for carrying out Bacteria Culture Test.

A bacterial culture is a test used to determine whether bacteria or fungi are present in the given sample. Bacteria culture tests are used to help diagnose certain types of infections. Following request application was given to POTDAR PATHOLOGY LAB, SOLAPUR for Sterility Test (Bacteria Culture Test) on 27/12/2019.

Since it was seen that there was no growth or presence of bacteria or contaminants after carrying out the bacteria culture test and keeping the sample of incineration ash in incubation for 72 hours, we could conclude that the incineration bottom ash is totally STERILE and FREE FROM CONTAMINANTS.



DR. POTDAR LABORATORIES
PATHOLOGY • MICROBIOLOGY • IMMUNOLOGY

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Lab-2 : "Golden Heights" 1st Floor, 1, Arand Nagar, Near I.T.I., Vijapur Road, Solapur. Tel.: 0217 - 2346127

Name : Report Of Sterility Testing Date : 31/12/2019
Age/Sex : /
Reff. By : S.C.S.Polytechnic, Solapur.

BACTERIOLOGICAL EXAMINATION

**STUDY PERFORMED ON FULLY AUTOMATED CULTURE SYSTEM
(Bact/ALERT 3D 60 BY BIOMERIEUX FRANCE)**

Material : Incineration bottom ash.
Date of collection : 28/12/2019
DIRECT SMEAR : No organisms seen.
Growth Pattern : No growth observed in 72 hours incubation .

CULTURE REPORT : **STERILE**

Culture kept for further incubation for total 5 days.
Identification & antibiotics sensitivity performed on Fully automated system VITEK 2C with ADVANCED EXPERT SYSTEM (AES) by Biomerieux, France.

END OF REPORT

Dr. Mrs. Shubhangi N. Potdar
M.D. (Microbiology)

Dr. Nilkanth V. Potdar
M.D. (Pathology)

Fig. 1 Bacteriological Examination Report

REPLACING CEMENT BY INCINERATION ASI IN CONCRETE:

In this method, cement content was reduced by a certain percentage and was replaced by incineration bottom ash in concrete. The other components of concrete were taken as per the mix design. Three cubes were casted and their average compressive strength was considered as a result. The concrete cubes were casted by replacing cement by incineration bottom ash by 3%, 4% and 5%.



Fig. 2 Cube Casting

Firstly, cement and sand were mixed in the dry stage by the shovels on a clean hard impermeable platform. The mixing was continued until the mixture attained uniform colour. After this, the mix is spread on the measured stock of coarse aggregate in required quantity and these were mixed again to have a uniform colour. The incineration bottom ash was added at the same time at the same time.

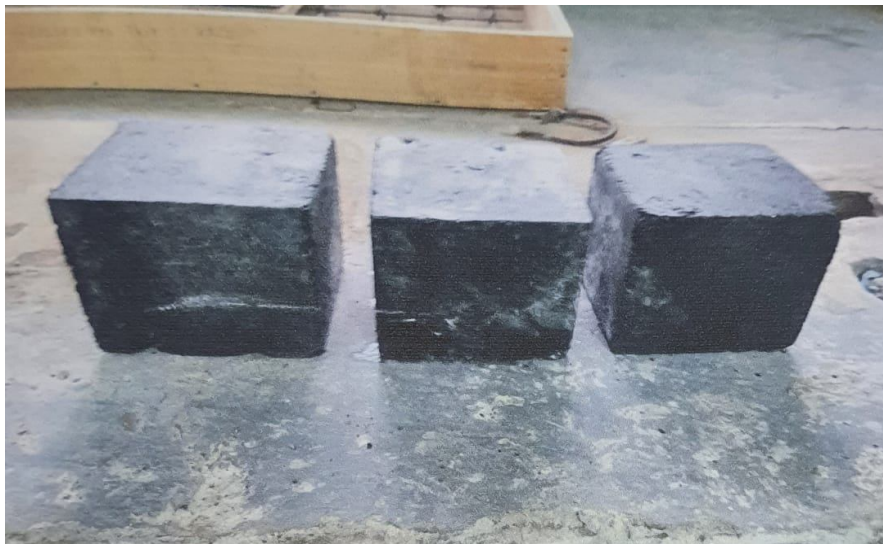


Fig. 3 Cubes after 7 days of curing

Water was added gradually according to the mix design and mixture was mixed uniformly. The concrete was filled in IS size cubes of 15x15x15.

Three cubes of each of the percentage were casted and the average of their compressive strengths in N/mm² was considered as the strength achieved by that particular percentage of cement replaced by bottom ash.

Each of the cubes were kept for curing in water for 7 days.

ADDING BIOMEDICAL INCINERATION BOTTOM ASH TO CONCRETE WITHOUT REDUCING CEMENT CONTENT:

In this method, the required cement content for the specified grade of concrete is taken as per the mix design and only a certain percentage of incineration bottom ash is added to concrete. Thus, the cement content in this method is not reduced and the desired percentage of bottom ash is added. As mentioned in the previous method, three cubes of certain percentage of added incineration bottom ash are casted and their average compressive strength is considered as a result.

The incineration bottom ash was added to concrete by 3%, 4%, 5%. Firstly, cement and sand were mixed in the dry stage by the shovels on a clean hard impermeable platform. The mixing was continued until the mixture attained uniform color. After this, the mix is spread on the measured stock of coarse aggregate in required quantity and these were mixed again to have a uniform colour. The incineration bottom ash was added at the same time.



Fig. Cubes after 7 days of curing



Fig. 5 Cube casting

Water was added gradually according to the mix design and mixture was mixed uniformly. The concrete was filled in IS size cubes of 15x15x15. Three cubes of each of the percentage were casted and the average of their compressive strengths in N/mm² was decided to be considered as the strength achieved by that particular percentage of bottom ash added to concrete. Each of the cubes were kept for curing in water for 7 days.

TESTING OF CUBES:

Each of the cubes were tested on Compression testing machine after 7 days of curing.



Fig. 6 Compression testing on cubes

IV. CONCLUSIONS AND FUTURE SCOPE:

The results brought us to the conclusion that the biomedical incineration bottom ash is a sterile material as it showed no growth of bacteria or any toxic substances in the culture test. It was a green signal by the pathology lab declaring the ash as sterile. Hence it can be used in concrete.

Secondly, its application in concrete by replacing the cement content with incineration bottom ash gave us the result that 5% is the ideal percentage of cement content to be replaced by incineration bottom ash as it gave a strength of 18.46 N/mm² at 7 days of M25 grade which is more than normal concrete at 7 days of M25 grade. (18.46 > 17) Hence, the incineration bottom ash can be replaced by 5% of cement content in concrete to achieve ideal strength. Thirdly, adding incineration bottom ash to concrete without reducing the cement content gave us the result that adding 3% and 4% are the ideal percentages of incineration bottom ash which yielded us a strength of about 19 N/mm² which is greater than normal concrete. (19 > 17) Hence the incineration bottom ash can be added up to 3% to 4% to achieve ideal strength which is indeed greater than normal concrete.

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