INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student : Mandefrot Dubale
Roll Number : 186104020
Programme of Study : Ph.D.

Thesis Title:

Demolition and filtered legacy waste as a resource in the manufacturing of fired bricks and its optimization

Name of Thesis Supervisor(s) : Prof. Laishram Boeing Singh and Prof. Ajay Kalamdhad
Thesis Submitted to the Department/ Center :

Date of completion of Thesis Viva-Voce Exam : July 7, 2023
Key words for description of Thesis Work : Fired bricks; alluvial soil; laterite soil; compressive strength; optimization; commercial bricks; water absorption.

SHORT ABSTRACT

Brick is the most widely used and oldest type of building material in the history of the construction industry. It is considered the mother of all building and construction materials due to its physical, chemical, environmentally friendly, aesthetic, and mineralogical properties. Brick production is around 1,500 billion tonnes per year on a global scale, and Asia accounts for 87% of all fired bricks manufactured in worldwide. India is the second biggest producer of bricks in the world, accounting for around 13% of total output. Brick manufacturing uses up a significant amount of one of the world's most valuable natural resources: fertile agricultural soil. The manufacture of bricks requires 3 kg of soil for each brick, totaling 720 billion kilograms of fertile soil each and every year. Waste management and resource utilisation in the construction and building materials industries is currently receiving a lot of attention.

This doctoral research investigates utilization of waste as a resource in construction and building industry. Construction and demolition (C&D) waste and filtered legacy waste recycling in fired brick manufacture into alluvial and laterite soils. The research aims to figure out the actual impact of waste integration in burned bricks, as well as the most effective approach to utilize waste by characterizing both the raw materials and the fired bricks. The research is divided into five phases, each of which serves a purpose in the thesis project. The first phase of the work is collecting the raw materials. In the second phase, the processing of waste for use in the production of fired clay bricks is done, and the trash is sorted. In the third phase, the raw materials are identified using a wide range of different characteristics, and in the fourth phase, the analysis of the fired brick takes place. In ending, it finds the optimum waste incorporation by Tagichi method and how the waste was included into the manufacturing process of fired bricks on a commercial scale.

The raw material characterization was conducted by: X-ray fluorescence (XRF) spectroscopy, Micro-structural analysis: Fourier transformer infrared, X-ray diffraction, and scanning electron microscope, thermogravimetric analysis, and Toxicity Characteristics Leaching Procedure are used to analyse. Brick characteristics were measured on all of the pieces, and 6 samples of brick were produced for each different mixing percentage of alluvial and laterite soil. The manufacturing of fired bricks of commercial

size can only take place after an investigation of laboratory-sized bricks has been carried out, and the product is evaluated using specified analysis.

The results showed that there the highest achievable level of waste utilisation is reached by adding 40wt.% demolished floor and wall tile waste to laterite soil at a temperature of 900 ℃. At 700 °C temperature, the minimum weight percentage for waste integration is 10% for three independent wastes (asphalt waste, mix C&D waste, and legacy waste). At a temperature of 700 ℃, the addition of 10 weight percentage on three different wastes (asphalt waste, mixed C&D waste, and legacy trash) reveals the minimal water absorption value that may be observed. The most influential independent factors are mix ratio, temperature, type of waste, type of soil, and firing temperature. The increase in mix ratio reduces compressive strength, firing linear shrinkage and bulk density but increases water absorption. The addition of waste has a significant influence on compressive strength ranging from 5 to 20wt.%, with the maximum significance value in water absorption ranging from 25% to 45wt%. In terms of compressive strength, the waste consists mainly of floor and wall tiles has been found to have the greatest significance value, while the waste consisting of asphalt and filtered legacy debris has been shown to have the lowest significance value. Laterite soil has been revealed to be more significant than alluvial soil, however there is no difference between the two in terms of water absorption. Both linear shrinkage and bulk density change significantly at temperatures of 900 and 850 ℃, although the change at 700 ℃ is negligible.