

# Lime-red mud binders for repair of heritage structures and for CO<sub>2</sub> sequestration

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## Abstract

Lime is an ancient building material used in the construction sector which was replaced by cement due to its superior properties. India is rich in heritage structures and they were majorly built with bricks, stones and lime mortars. The rising concern about repairing these structures has led to the revival of lime as modern materials are observed to be incompatible with traditional materials. The slow-setting properties of lime led to a sharp decline in the use of this sustainable material. Air lime sets by the process of carbonation and accelerating this process can lead to faster setting, superior properties and CO<sub>2</sub> sequestration. This work focuses on accelerating the process with the addition of an industrial waste residue. Red mud is a waste residue from the aluminium industry that possesses disposal difficulties and is a CO<sub>2</sub> sink due to its basic nature. The current study puts forward a novel idea of combining the two materials for effective carbonation and checking its potential to be categorised as a repair material for heritage structures. The present work will focus on substituting lime with 10, 20, 30, 40 and 50% of red mud and analysing its physical, mechanical as well as CO<sub>2</sub> uptake under natural exposure. The applicability of the developed binder can be checked by employing it as a plaster as it can provide higher thermal comfort due to its porous nature.

**Keywords:** lime; red mud; heritage structures; carbonation; CO<sub>2</sub> sequestration.

## 1 Introduction

Lime was one of the most prominent building materials used. The introduction of cement led to the decline in use of lime. The major reason for this change is the slow setting and strength properties of lime [1]. The current rise in concern of conserving heritage structures has led to the reintroduction of lime in construction sector. Use of cement for the repair of lime based heritage structures has been observed to be more damaging [2]. The further damage can be

attributed to the low porosity, dense and higher strength of cement than ancient materials [2]. The major disadvantage associated with lime is its slow setting that can be avoided with the use of mineral admixtures, particularly industrial waste materials. Air lime sets by the process of carbonation and can mineralise decent amount of CO<sub>2</sub>. Any potential waste material that can capture CO<sub>2</sub> or support lime in carbonation can be used to make a binder. In the present study an industrial by-product red mud is used a replacement material for lime. This will reduce the