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Short Communication

Experimental Study on the effect of Wood Sawdust and sand on the Clay Slabs Resistance to Compression

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Abstract

In this study, we manufactured clay slabs mixed with wood sawdust ignited at 1050 °C. We used two species of wood and sand: the limba and the kambala on the one hand and on the other hand the crushed sand and the white one. Diffraction by X-Ray allowed to determine the mineralogical composition of the clay material and showed that its clayey fraction is mainly made of 95% of kaolinite and 5% of smectite and /or interstratified chlorite/smectite. Mechanical tests lead to the determination of the slabs resistance to compression. The achieved results showed that for the best resistances to compression were obtained for the combinations (clay stabilized at 4% of cement mixed with 4% of kambala sawdust and 5% of white sand and clay stabilized at 4% of cement mixed with 4% of limba sawdust and 5% of crushed sand).

Keywords: Clay slab, Wood sawdust, Limba, kambala, Sand, Resistance, Compression, X-ray diffraction.

Introduction

The timber industry constitutes an important source of pollution. Indeed sawmills produce wood wastes which, are for the most part of them, burnt generating carbon dioxide which damage the ozone layer. Many studies[1-5] have been conducted on the recycling of wood wastes in the manufacturing of composite materials. Several researches[4-6] have demonstrated that the incorporation of wood wastes reduce the compressed terracotta brick slabs resistance to compression. The present survey is a contribution to the valorization of local materials. It focusses on the mixing of cement-stabilized clay, wood sawdust (limba or kambala) with sand (white or crushed) in order to produce resistant brick slabs according to the nature of the wood, the content and the nature of the sand.

Methodology

The clayey material (AMK1) was taken during the rainy season in the city of Makoua (Congo Republic). The site where it was taken from was a quarry located at approximately 50 m away from the Likouala - Mossaka river. The sands white and crushed were collected respectively from the Bilolo and Kombé quarries located at 25 km North and at 15km South of Brazzaville. The Limba and Kambala sawdusts where came from the local carpentry workshops. The mineralogical analysis of the clayey sample AMK1 was made on an automated Siemens D5000 Diffractometer using the cobalt K ray of λ = 1,789 Å wave length. The data were recorded with a diffraction 2θ angle ranging from 4 to 84°. The clayey fraction of the sample is determined by means of Diffractometry of X-rays from normal oriented sheets, glycoled for 12 h under steam tension then heated at 490°C for 4h. In order to make the slabs we used sieve fall-out of 2mm diameter for the clayey material and the 1mm diameter ones for the sand material. The brick slabs we made of 160 mm × 40 mm × 40 mm were achieved according to many formulations namely: i. Clay + cement+limba sawdust, ii. Clay + crushed sand + cement+ limba sawdust, iii. Clay+ crushed sand + cement + kambala sawdust, iv. Clay +White sand + cement+ limba sawdust, v. Clay + white sand + cement + kambala sawdust. The compaction was realized using the modified ASTM D698 method. The baking temperature was 1050°C. The resistance to simple compression was determined according to the NF EN 191-1 standard. The compression test was made using the IGM (General Measurement Engineering) machine linked to a computer to control the hydraulic crush. The maximal load value F_c (in kN) of the break and the resistance to compression one Rc (in N/mm^2) appear directly on the computer screen.

Results and Discussion

Mineralogical analysis by X-Rays diffraction: The mineralogical analysis of the sample AMK1 showed the clayey fraction consists essentially of 95% of kaolinite, 5% of smectite and/or interstratified chlorite/ smectite.

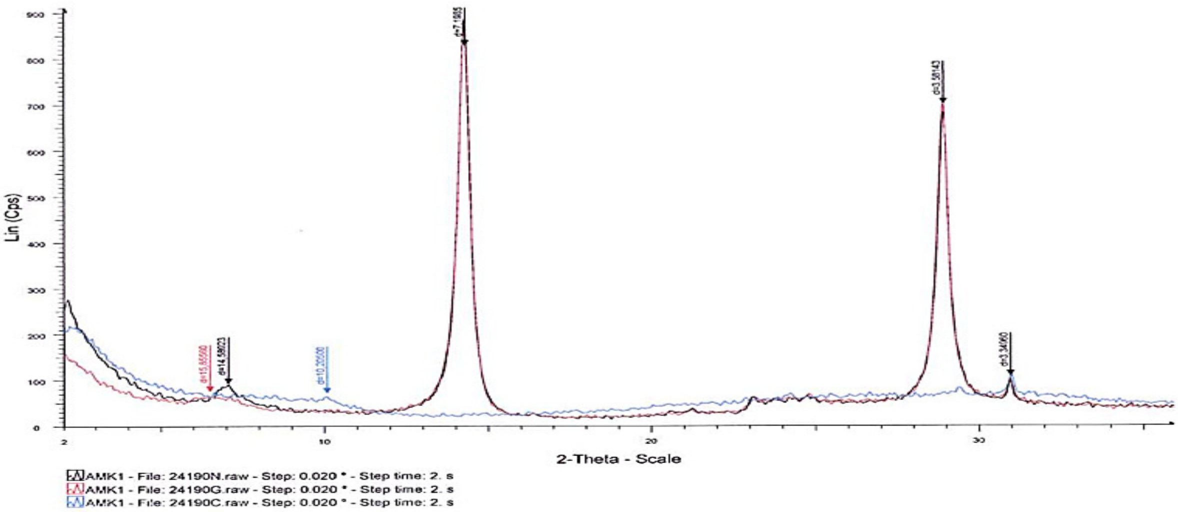

Figure-1
Diffractogramme on normal oriented sheets (N), glycoled (G) and heated (C) of the clayey sample

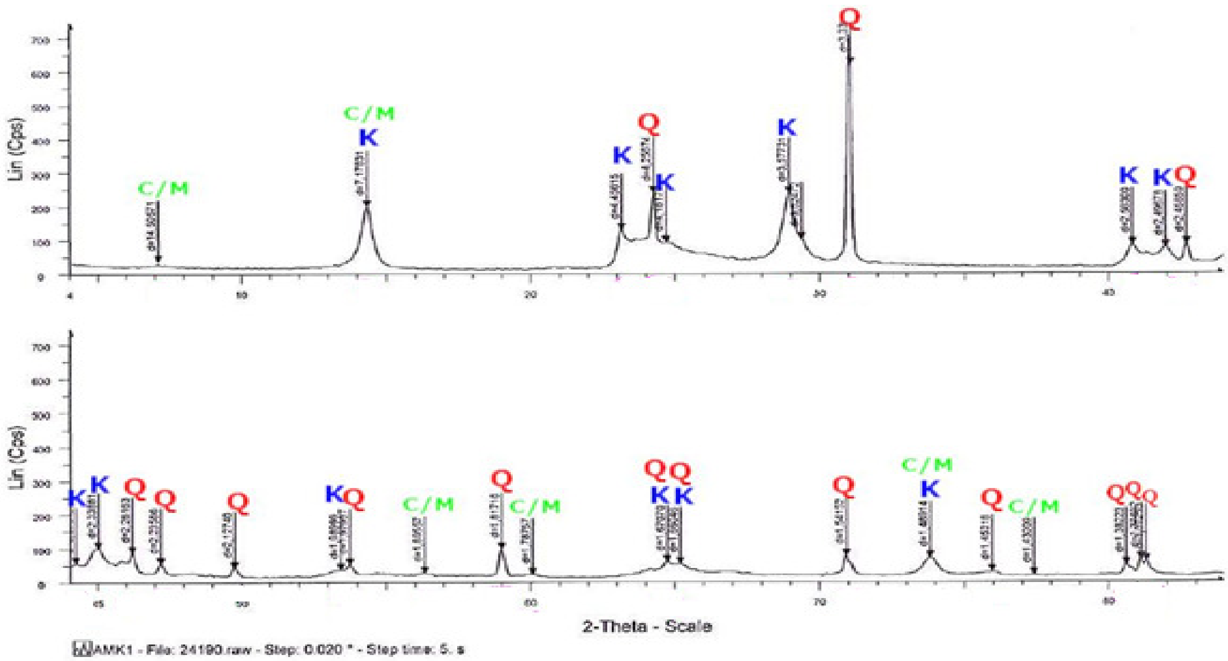

Figure-2
Diffractogramme on the clayey sample powder after the identification of crystalline phases

The analysis of the diffractogramme by means of X-rays of the non-processed clay sample showed that it is made of kaolinite (d = 7,17831 Å ; d = 4,450015 Å ; d = 3,57731 Å), of quartz (d = 4,26 Å ; d = 3,56143 Å ; d = 3,33 Å). The presence of a ray at d=14,50571 Å might indicate the presence of a smectite and/ or of interstratified minerals smectite/chlorite. The Diffractogramme analysis of the sample processed by means of ethylene glycol (G) showed out an increase of the inter-reticulardistance from d= 14,589 Å to d = 15,85660 Å. This result confirms the existence of the montmorillonite and/or of the montmorillonite/ chlorite. On the contrary the disappearance of the peaks located at d = 7,1783 Å ; d = 4,450015 Å ; d = 3,57731 Å was noticed after thermic treatment at 490 °C. That result may be due to deshydroxylation of the kaolinite; which might correspond to the drying out of the constitution water and to the forming of the métakaolinite which is an almost amorphous phase[7,8].

The influence of the nature of the wood and the sand on the resistance to compression: The Figures-3 and 4 shows the resistance to compression according to the nature of the wood and of the sand content.

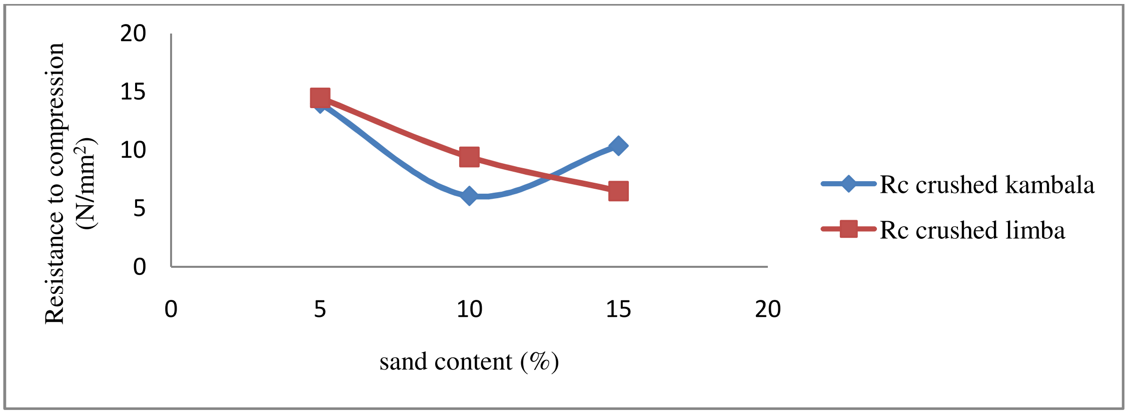

Figure-3
Influence of the wood species on the resistance to compression

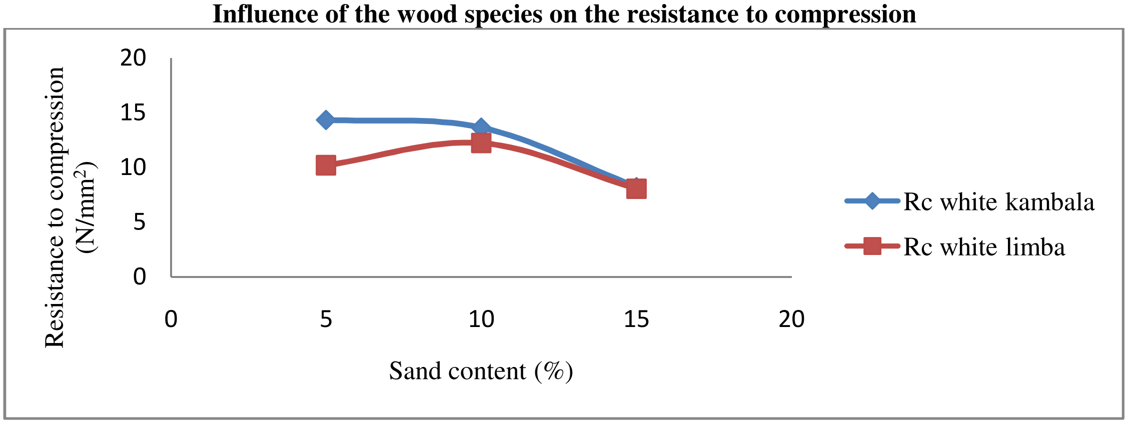

Figure-4
Influence of the wood species on the resistance to compression

The Figures-3 and 4 show that the nature of the sand has a significant influence on the resistance of the brick slabs to compression. That resistance to compression is stable at 10% of the crushed sand and equal to 6,099 N/mm^2 when the latter is mixed with the kambala sawdust. The highest resistances to compression are 13,99 N/mm^2 and 14,35 N/mm^2 respectively reached at 5% of the sand (crushed and white). With the limba sawdust, the resistance to compression varies from 9,43 N/mm^2 to 12,24 N/mm^2 when one changes from white sand to crushed sand for a content of 10%. On the other hand we noticed that the nature of the wood (kambala or limba) has an influence on the resistance to compression only when the crushed sand is used. When the white sand is used, the resistance to compression shows the same performance whatever the nature of the wood. The result is in line with the one achieved[5]. These changing performances might be due to the different interactions between thealcalin elements of the crushed sand and the cement with the different chemical elements which constitute the wood species[1].

Conclusion

In the present study, we have determined the mineralogical composition by means of X-rays diffraction of the clayey material and we have studied the resistance to compression according to several blendings of plant and mineral components. The results we have achieved show that the clayey fraction of the clay material is made essentially of kaolinite. The combination of plant and mineral wastes improve the resistance to compression. The highest resistances were reached for the combination (clay stabilized at 4% of cement mixed with 4% of kambala sawdust and 5% of the white sand and clay stabilized at 4% of cement mixed with 4% of limba sawdust and 5% of crushed sand).

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