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Research Article

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Valorization of Materials from Road Waste: Case of Laterite Seat Layers

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Abstract This work focuses on the characterization and improvement of materials based on road waste (existing roadway). Thus, the main objective of this study is to see to what extent it is possible to valorize a material derived from road waste: the case of laterite seat layers.

Public works produce 100 million tons of surplus and scrap every year. Of the 100 million tons, 95% is inert and non-polluting waste. And in view of the growing demand for road construction materials and the scarcity of materials meeting specifications, it is urgent to initiate study programs on the possibility of using existing materials to anticipate the total exhaustion of careers.

The studies are made on road waste from the Louga-Dahra road section (in Senegal) then on mixtures of this waste with contributions of raw laterite at rates of 10%, 20% and 30%,

The results of these tests revealed that:

- Recycled material alone can be used as a shape layer.
- Following the addition of raw laterite, the new material meets the requirements of the specifications for seat layers.

Keywords characterization, laterite, recycled material, road waste, valorize

Introduction

The demographic and economic growth of Senegal requires a considerable evolution in the road network through the construction of new roads and motorways and the rehabilitation of several degraded sections. In addition, the costs of road construction have skyrocketed in recent years, and budgets have not always increased at the same rate.

Indeed, the scarcity or depletion of conventional materials (laterite), of good quality, close to new road construction projects impacts on the costs of road construction in Senegal. It is up to road engineers to find materials that can be substituted for more economical conventional ones while keeping the quality, hence the idea of reusing road waste [1-2].

Inert waste (for example, in the form of ballast, cuttings and road materials) is a source of material which the road must be able to exploit and recover [3].

The evolution of environmental acceptability is a topic that has been the subject of discussion and working group to develop a methodological guide for the acceptability of alternative materials. Alternative Materials are defined as "any material elaborate from waste that is intended to be used alone or mixed with other materials, alternative or not" [4].

With a view to continuous improvement of its road network, the Government of Senegal has undertaken the rehabilitation of the Louga-Dahra road section (Senegal). This opportunity was taken to explore options considering the recycling of waste from this section, which were improved to compare the CBR values obtained with the regulatory specifications [5-7].

Materials and Methods

The road waste used in our study was collected at the Louga Dahra section, 187 km from Dakar (Senegal).

The following tests were made on this material, based on the standards [8-9]:

- The particle size analysis that processes the identification for the classification of a material from the grain size [10].
- The Atterberg limits, which define the liquidity limits and the plasticity limits. [11-12].
- The Proctor test that determines the compaction characteristics of a material: water content and density [13].
- The CBR test which describes test methods for measuring CBR indices [14].

Results & Discussion

Particle size analysis of the material showed 2.32% gravel, 56.18% coarse sand, 17.5% fine sand and 11.38% of the grains mass pass the sieve 80 µm (Figure 1).

The Atterberg limit test (Figure 2) showed that the liquid limit is 19.60% and the plasticity index is 10.82%.

The modified Proctor test allowed the determination of the dry density of the material equal to 2.203 g/cm^3 with an optimal moisture content equal to 7.8% (Figure 3).

The CBR test, after 96 hours of immersion, yielded a CBR of 28 at 95% compactness (Figure 4).

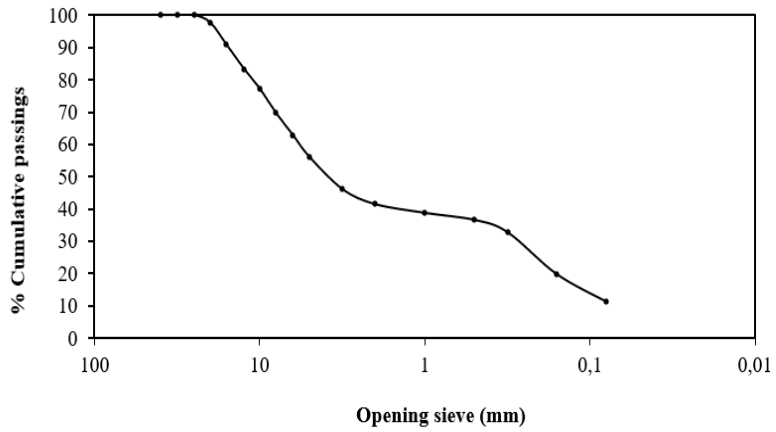
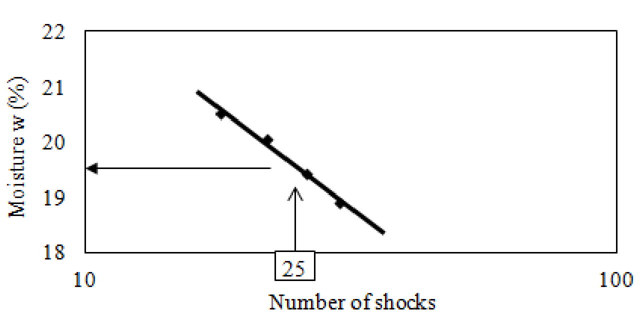


Figure 1: Size analysis

	Limit Liquidity				Limit Plasticity	
Number of shocks	18	22	26	30		
No tare	B5	B6	B7	B8	A	B
Total mass wet (g)	49.72	51.6	51.62	51.56	39.82	51.17
Total dry mass (g)	48.45	50.53	50.65	50.27	39.28	50.49
Mass of the tare (g)	42.26	45.2	45.66	43.45	33.09	42.8
Mass of water (g)	1.27	1.07	0.97	1.29	0.54	0.68
Net dry mass (g)	6.19	5.33	4.99	6.82	6.19	7.69
Moisture w (%)	20.52	20.08	19.44	18.91	8.72	8.84



LL = 19.60%

LP = 8.78%

IP = 10.82%

Figure 2: Atterberg limits

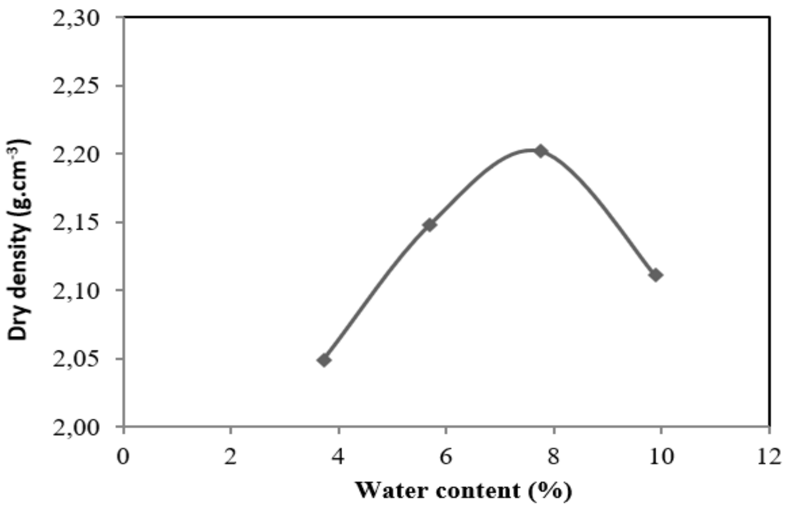


Figure 3: Compaction curve Proctor

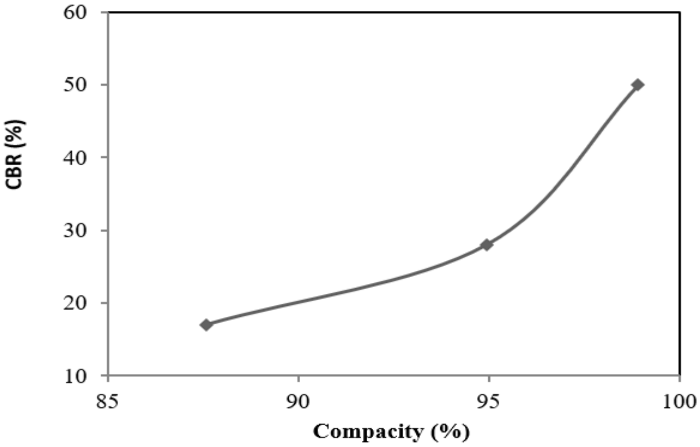


Figure 4: CBR of the waste

According to the results obtained, this road waste can, without treatment, be used as a shape layer [15]. But it cannot be used as a seat layer. However, with raw laterite from a quarry that has a CBR of 73, the treatment of this waste with:

- 10% raw laterite resulted in a CBR of 36 for 95% compactness (Figure 5).
- 20% raw laterite resulted in a CBR of 61 for 95% compactness (Figure 6).
- 30% raw laterite resulted in a CBR of 81 for 95% compactness (Figure 7).

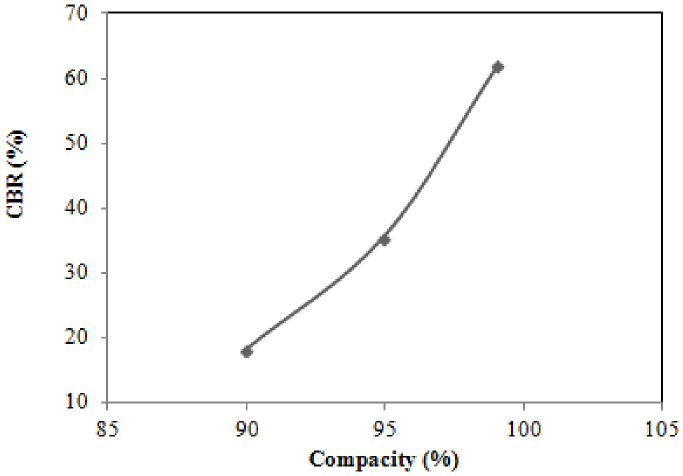


Figure 5: CBR of the waste mixed with 10% laterite

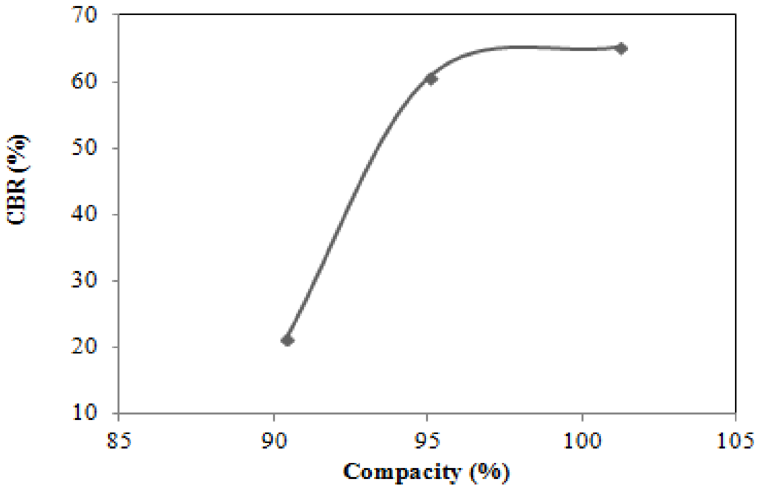


Figure 6: CBR of the waste mixed with 20% laterite

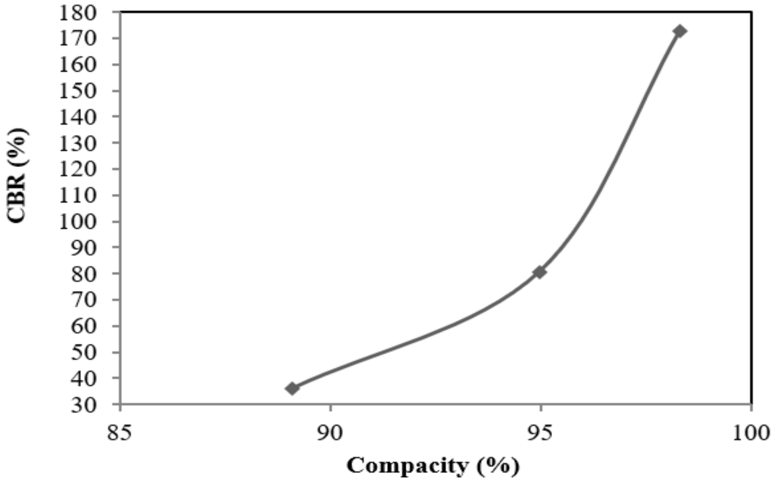


Figure 7: CBR of the wastes mixed with 30% laterite

Conclusion

At the end of the tests, we note that with intakes of raw laterite at percentages of 10%, 20% and 30%, we were able to obtain respective CBR values of 36, 61 and 81 for a compactness of 95%.

Thus, this material from the layers in place of the Louga-Dahra road to be rehabilitated can be reused for the seat layers thanks to an improvement of the CBR values by raw laterite.

Therefore, additions of raw laterite improved the properties of the waste for use in pavement layers.

At final analysis, we can say that this work makes it possible to valorize road waste and save money on road construction projects.

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