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Comparison between the Material Improvement of the Megarok and San José Quarries, Applying the AASTHO Standards

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Abstract

Comparative analyzes were carried out between the materials of the Magarok and San José quarries, taking into account AASTHO standards with the objective of being used as a base / sub-base in the pavement structure. The asphalt emulsion material was stabilized to increase the strength and give the material sub-base and / or base characteristics, with a suitable mixing design, obtaining results with suitable characteristics to be used in the pavement structure composed of a 65 % Asphalt AC 20; 34.30% water and 0.70% ASFIER 121 emulsions, with good resistance to the stability of the materials.

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1. Introduction

In ancient times the roads were traced by the passage of animals, one of the great drivers of the construction of roads and aqueducts was the Roman Empire (Asociación Americana de Autoridades de Vialidad y Transporte, 2002). The most important legacy left us by Roman civilization was the Law And public works. The importance of Roman law lies not only in having constituted a perfect legal system of antiquity but especially in the fact that all the legislation of the West has followed its steps. With respect to public works, they built ports, aqueducts, baths, theaters, circuses and especially the long causeways that facilitated the displacement of soldiers, civilians, and merchandise throughout the empire.

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The roads are the most frequented areas today, where more people are transiting daily, in Portoviejo are different quarries that could be used in the construction of these roads, but for this, it is necessary to do studies that allow knowing the characteristics of the material.

Asphaltic mixtures used in road construction (Flores, 2015), either in thread layers or in lower layers, are now used and their function is to provide a comfortable, safe and economical bearing surface to road users, facilitating the circulation of the vehicles, besides sufficiently transmitting the loads due to the traffic to the esplanade so that they are supported by it (Gabela, 2013).

The construction of roads in Latin America has increased in this last stage due to the increase of transport these are closely related, there are governments like those of Mexico that incorporate in their investments a large amount of money for these purposes, with that they achieve Modernize roads and reduce risk indices.

In recent years in Ecuador there has been a significant growth in terms of infrastructure, especially in road infrastructure, which is why it is necessary to have strategies to preserve the communication channels and keep them operational in optimum Conditions of functionality, since the investment that represents the construction of a highway is very high and it is expected to comply with the useful life for which it was designed, the most used technology in the maintenance and construction of pavements (Muñiz, 2016).

In the province of Manabí, especially Portoviejo in its territory has different quarries to extract material for the construction of roads; the objective of this work is aimed, at characterizing the clays of the quarries, of Megarok and San José and compare them with material mixed with asphalt for Determine the characteristics of these for the construction of resistant roads.

2. Materials and Methods

The proposed research involves a process of experimental analysis, which covers the characterization of the material in a natural form and the material already mixed, using the deductive hypothetical method, given that it will give validity and reliability to the research. It is important to indicate that this study has a diversity of approaches: theoretical, practical and applicable.

A laboratory study was conducted to characterize the material selected in the study quarries, experimented with different mix designs and tests were performed to evaluate their performance. The methodology used during the investigative process was laboratory research using a deductive method of hypothesis, which through the soil studies we obtained the results of the research, in order to create the conclusions and recommendations. The importance of this study is paramount since it is focused on the use of a lower resistance material from one of the two aforementioned quarries which, when stabilized with an aggregate, works as a better resistance material in road construction in the Manabí province.

3. Results and Discussions

Quarries currently used in Portoviejo are: Megarok and San José are in the Picoazá parish of the Portoviejo Canton. The granular material is formed by a set of solid particles of different sizes, where its coarse particles from a mineral skeleton once compacted and whose resistance depends mainly on the internal friction. Internally this type of material presents in its composition the three states: solid, formed by the material coming from the stone; Liquid, due to the presence of water; And gaseous, by intergranular spaces filled with air.

An important feature is that granular matter tends to rapidly dissipate the energy of its particles due to the frictional force, which gives rise to phenomena of great importance as the avalanches. The bases and sub-bases of flexible road pavements are formed by non-agglomerated granular materials. When it is required to improve the behavior of these materials, due to their placement on high traffic roads, the agglomerated or treated materials are used. It is known as the treatment of soils or granular materials to the set of procedures that allow improving some of the properties of these materials, by means of the incorporation of an additive that can be an asphalt emulsion, the cement or a chemical compound.

This research is diagnostic or propositive, which corresponds to the area of materials, construction procedures and improvement in the quality of life. Its importance lies in providing possible solutions to the problems of materials that exist in our Canton, including the analysis of the cost of improving materials for use on the roads. The use of the treatment of granular materials contributes to the development of the city and province, by the reduction of thicknesses of pavements and the increase of life time of the asphalt folder, as well as a greater security for the user.

The research work comprises the characterization of the materials used within the canton for the construction of the roads and that form part of the bases and sub-bases of the pavements, with the objective of identifying the possible quality problems and non-compliance of the specifications. It will be analyzed later how these characteristics improve and the behavior of the materials when small contents of cement or asphalt emulsion are added to form the treated bases

Two types of evaluations were made based on the selection of material from the selected quarries. These were mixed to determine if they were compliant with the standards to be used on the pavement of the city of Portoviejo as a base or sub-base. These mixtures were obtained by joining the following product: asphalt emulsion (Rodríguez, 2013), because the clay of these quarries did not meet the base and sub-base grading specifications applied in the AASTHO (American Association of Roads and Transport Authorities, 2002). 6000 grams (g) of clay and the same quantity of San Jose were taken from the quarry Megarok to mix them with the material that they observe in table 1

Table 1
Amount of clay mixed with different material

Quarry	Clay (g)	Material	Asphalt emulsion (g)
Megarok	6000	Mejoamiento	7%
San José	6000	Mejorramiento	7%

Sieves of different sizes (76.2, 50.4, 38.1, 4.75, 0.425, 0.075 mm) were used to study the sub base to see if the clay met the standards for bases and sub bases. They were divided into three classes to know the maximum and minimum values and to be compared with the results obtained from the mixtures for the sub-base. The table 2 shows the grain size specifications of the AASTHO standards and the graph of figure 1 shows the results obtained for class 1, where the values in maximum and minimum percent are compared with the samples passed in each sieve.

Table 2
Sub-base sizing specifications

Sieves	Class 1		Class 2		Class 3	
	Maximum (Max)	Minimum (Min)	Maximum (Max)	Minimum (Min)	Maximum (Max)	Minimum (Min)
76,2					100	100
50,4			100	100		
38,1	100	100	100	70		
4,75	70	30	70	30	70	30
0,425	35	10	40	15		
0,075	15	0	20	0	20	0

It can be seen that the samples from the clays of the studied quarries do not comply with the AASTHO regulations demonstrating that other procedures must be performed for use in the pavement structure

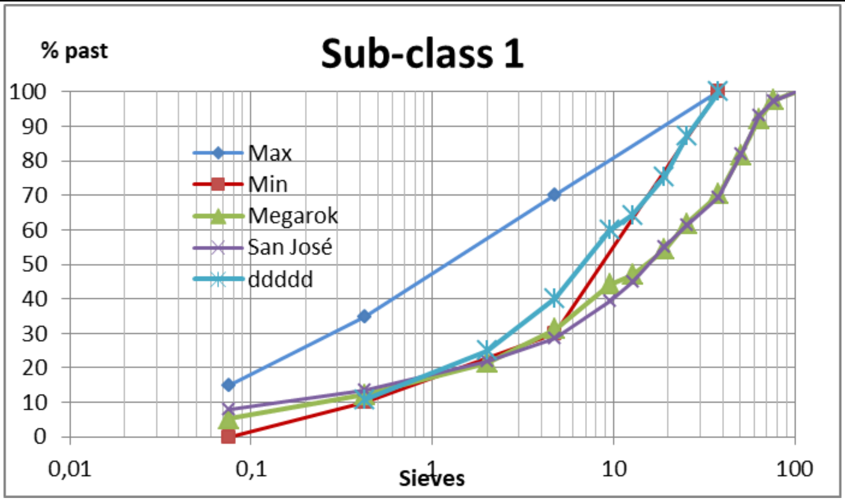

Figure 1. Maximum and minimum values obtained in the class 1 sub base

Figure 2 (A) shows the results for Class 2 and Figure 2 (B) for Class 3. With thicker sieves, it also does not comply with AASTHO standards.

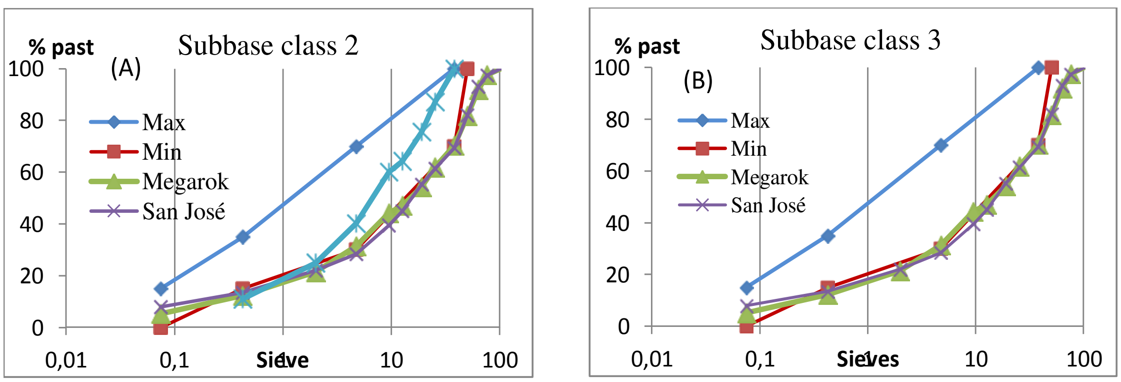

Figure 2. Results obtained in class 2 (A) and class 3 (B).

Figure 3 shows the three classes of the subbase and the AASTHO rules noting that they do not meet the specified percentages.

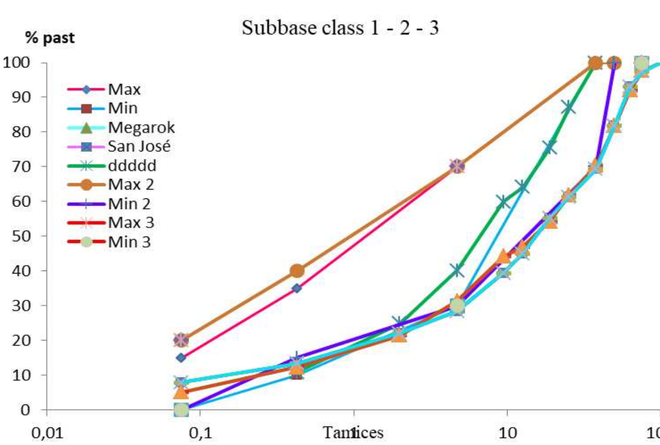

Figure 3. Normatives and the three classes of sub bases

Table 3 shows the different granulometric specifications of the base, due to its proximity to the surface it must have high resistance to deformation to withstand the high pressures it receives

Table 3
Base sizing specifications

Sieves	Class 1			
	Type A		Type B	
	Maximum	Minimum	Maximum	Minimum
101,6				
76,2				
63,5				
50,4	100	100		
38,1	100	70	100	100
25,4	85	55	100	70
19,05	80	50	90	60
9,525	60	35	75	45
4,15	50	25	60	30
2,0	40	20	50	20
0,425	25	10	25	10
0,075	1	2	12	2

The results for type A and figure 4 (B) for base type B are shown in figure 4 (A). With thicker sieves, it also does not comply with AASTHO regulations.

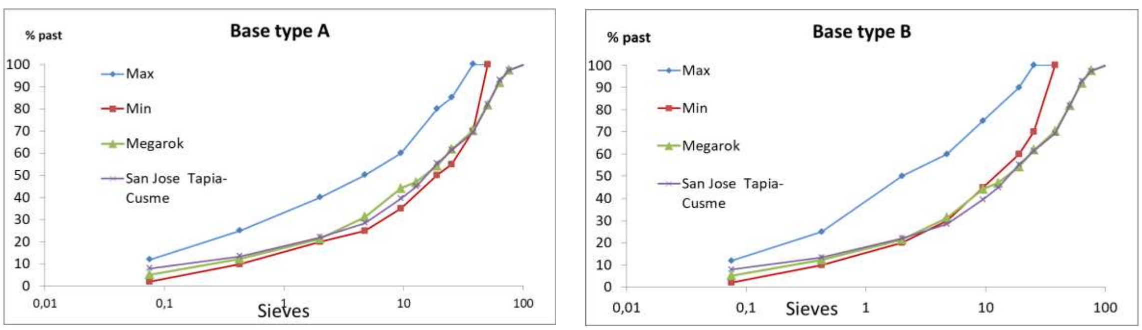

Figure 4. Maximum and minimum values obtained in the base type A and B

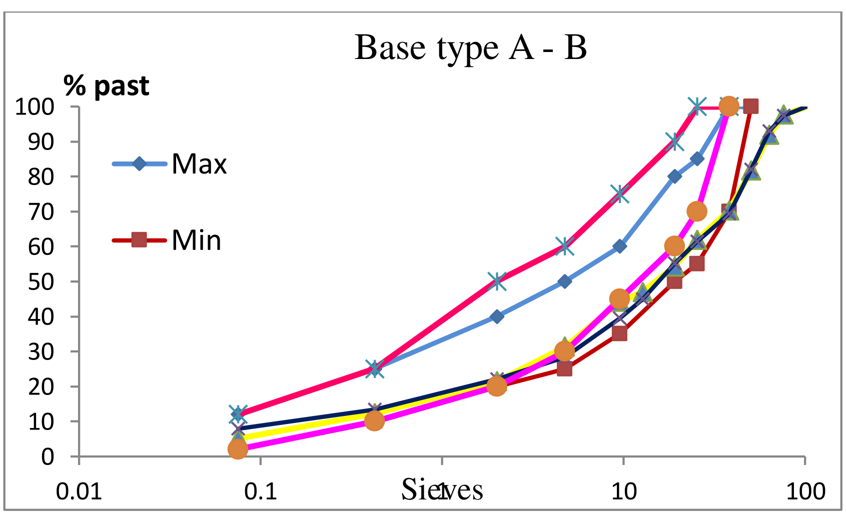

Figure 5. Normative and the two types of bases

At the beginning of the investigation, the granulometry of San José and Megarok show that both cases are not compliant with the specifications of sub-base material for the different classes (1, 2, 3). In the sub-base class 1 the observed values of both quarries coincide approximately with the minimum value of the granulometric use for size inferior to the sieve 3/8pulg. (9.525mm), the past percentages being much lower than what was required by the user, but as can be seen in figure 5, the evaluations have had a good result, being able to verify their usefulness in the construction of the bases and their bases of the roads.

4. Conclusion

a) Tests were carried out on the improvement material with application of asphalt emulsion of 5% 7% 9%; determining an optimum percentage of asphalt emulsion of 7%, in compliance with the specifications proposed by the MTOP for the operation of a sub-base.
b) Asphalt Emulsion used in the mixture made is composed of 65% of Asphalt AC 20; 34.30% water and 0.70% ASFIER 121 emulsifiers, giving good resistance results in the stability of the materials.

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Statement of authorship
The author(s) have a responsibility for the conception and design of the study. The author(s) have approved the final article.

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