EvoCrete®
Soil solidifier & ConCrete modifier

Construction site report

Construction of a jetty for K 5 oil centre on the Island of Bioko, Equatorial Guinea - Africa with EvoCrete®



1. Situation

In Equatorial Guinea, it was planned to enlarge the K5 Oil Centre nearby the capital city of Malabo on the Island of Bioko. The expansion of the project area had to be carried out by means of a land reclamation process. For this, ocean sand had to be flushed into the area of the dock with hydraulic pumps. The used material was ocean sand of volcanic origin. Due to the loads expected, an EvoCrete® stabilisation was planned for the foundation layer. For the dimensioning of the EvoCrete® base course, soil samples of the material to be used were provided for the geotechnical laboratory. Laboratory examinations had to be carried out on the soil samples delivered, to clarify whether hardening with the cement additive EvoCrete® was possible or not. In the course of the necessary suitability check, the essential soil-mechanical characteristic values of the EvoCrete® soil mixtures were ascertained through a project-specific laboratory examination was carried out on the EvoCrete® soil mixtures, on the basis of TP BF-StB part B11.1. The results of the soil-mechanical laboratory examinations and the execution requirements is the objective of the following report.



Fig. 1: K5 Oil Centre on the Island of Bioko, Equatorial Guinea, Africa (Copyright: Google Earth, 7/16/2015).

2. Documents

The suitability test was based on the following norms and regulations:

1. Results of the laboratory-technical examinations
2. DIN 18 196 “Earth-moving and foundation work soil classification for structural purposes”
3. DIN 4022 “Naming and description of soil and rock”
4. DIN 18 121 “Water content”
5. DIN 18 123 “Determining of the grain-size distribution”
6. DIN 18 127 “Proctor test”
7. DIN 18 130 “Determining of the permeability value”
8. DIN 18 136 “Determining of the single-axis compressive strength”
9. ZTVE-StB 94 “Additional technical contractual conditions and guidelines for earthworks in road construction”
10. ZTVT-StB 95 “Additional technical contractual conditions and guidelines for base courses in road construction”
11. TP BF-StB part B 11.1 “Suitability tests in soil hardening with cement” issue 1986
12. Data sheet for soil improvement and soil hardening with cement, issue 1984
13. DIN 1048 Sheet 1: Test procedures for concrete.

3. Geography

The island of Bioko belongs to the national territory of Equatorial Guinea and is located in the Gulf of Guinea. The Gulf of Guinea is the part of the Atlantic Ocean that is bordered by the coasts of West Africa in the North and East. In the Gulf of Guinea, lie the islands of Sao Tome and Principe, which form an independent state, and the islands of Bioko and Annobon, which belong to Equatorial Guinea. These islands were created by a volcanic hot-spot that also brought forth Mount Cameroon on the African mainland. The islands lie in a seismically active zone due to their genesis and the volcanic surroundings.

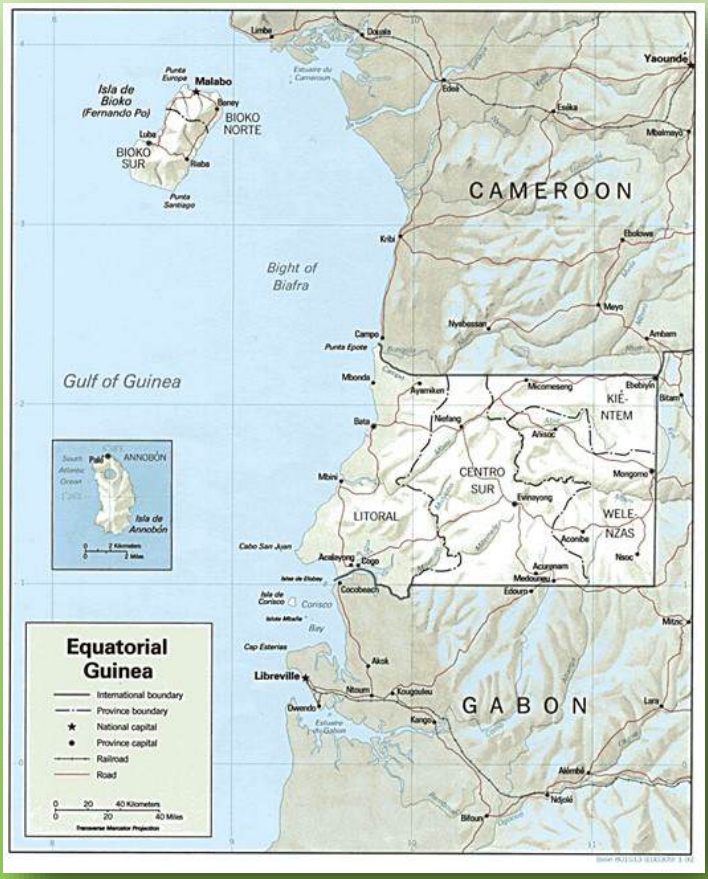


Fig. 2: Geographical map of Equatorial Guinea.

4. Laboratory Test

The soil sample was brought into the soil mechanic laboratory for further processing.

4.1 Grain-size Distribution according to DIN 18 123-4

The grain-size distribution of the soil was ascertained in accordance with DIN 18 123-4 and the natural water content was ascertained in accordance with DIN 18 121.

Sample	Natural water content W_n %	Non-uniformity coefficient $U = d_{60}/d_{10}$	Curvature factor C_c	Component < 0,063 mm %	Soil classification DIN 18 196
EG 1	10,2	12,8	0,9	8,00	SU

Tab. 1: Soil classification according to DIN 18 196.

According to the laboratory tests that were carried out, sample EG 1 was a sand-silt mixture (DIN 18 196: SU) according to DIN 18 196.

4.2 Proctor tests according to DIN 18 127

In order to ascertain the optimum dry density and the optimum water content a Proctor test in accordance with DIN 18 127-P 100 X was carried out on the soil at issue.
The optimum water content of the sample EG 1 was determined at 11.4%. With this water content, the Proctor density reached was 2,137 g/cm³. 8.4% EvoCrete® cement premix (=180 kg/m³ binding agent) was then added to the soil. In this process, the water content was increased to approx. 2% above W_{Pr}.

Sample	Sample 1
Optimum dry density D_{Pr} 100 % in g/cm³	2.137
W_{Pr} in %	11,4
Humid density in g/cm³	2.347

Tab. 2: Results of the Proctor test in accordance with DIN 18 127.

4.3 Testing of compressive strength according to DIN 18 136

The compressive strength tests were carried out on cylindrical test specimens with dimensions of H = 120 mm (approx.) / D = 100 mm with a content of 8.4% of EvoCrete® cement mixture. The test samples were produced in accordance with Proctor test DIN 18 127-P 100 X with an optimum water content of approx. 13.5%.
The compressive strength tests were carried out on the basis of "TP BF-StB Part B11.1 suitability tests with soil hardening with cement" carried out on test samples aged 7 and 14 days, in order to be able to determine the binding agent content necessary for soil stabilization. The results of the compressive strength tests are shown in Table 3.

Sample	Cement in %	EvoCrete in %	Age in days	Breaking load in kN	Compressive strength in N / mm²
8	8	2	7	25,10	3,20
12	8	2	14	42,63	5,43

Stabilisation parameter: Location: Malabo, Area: 60,000 m², construction time: 4 weeks, Mixing: 180 kg/m³, EvoCrete®: 2 % = 90.000 kg, Milling depth: 40 cm



Fig. 3: Sketch with dimension of the K5 oil centre jetty at Malabo, Island of Bioko, Equatorial Guinea. (©2017 by K5 Oil Centre, Malabo)

5. Photo documentation











Fig. 4 to 8: The jetty was constructed by dredged marine sand from Atlantic ocean. A sheet pile wall was erected and behind this wall the black volcanic sand was pumped and filled up the jetty area. The whole project was a land reclamation project The Island Bioko was created by a volcanic hot spot. The recent position of the hot spot is characterized by Mount Cameroon.















Fig. 9 to 15: Cement packed in 1 ton big bags was unloaded by a backhoe loader. A grader was used to even out the cement powder over the whole stabilization area. Finally a tractor pulled fertilizer spreader distributed EvoCrete® on top of the cement. The stabilization process included five steps: mixing, irrigation, compaction, leveling and curring.








Fig. 16 to 21: Photos of the jetty after stabilization work was finished.

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Thank you for your interest!

This EvoCrete® brochure has been presented to you by:

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