Erection of a Waste Earthen Dike the Kipushi Valley, DR Congo

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Abstract: ***The former Kipushi Concentrator (ACK), which has been operating for several years, has three artificial basins constructed by erecting earth dikes for the decantation of water contained in huge quantities of pulp-drained discharges for the purpose of storing solid discharges in these basins. It happens that currently the first two basins are filled and the third is 80% saturated. There is therefore a need to consider the construction of a fourth tailings pond by erecting a dike in earth; hence the study of erection of a fourth dike which is the subject of our study. Our study focuses on the design of the fourth basin, the dimensioning of the accessories of the dike, the study of the soils used as foundation and erection of dikes, as well as the choice of the compactor and the method of compaction (method of construction). Although there are several studies on the construction of tailings dikes, ours being a punctual case of the former concentrator of Kipushi, it will bring him an economic gain, following the recovery in the future of the residual metals by storage of the rejects in this fourth basin.***

Keywords: Settling ponds, Dyke, compaction, Erection, floods

1. Introduction

The operation of a hydraulic concentrator in the preparation of ores requires the use of settling ponds for the treatment of discharges, in the form of pulps to constitute a storage of solids (rejects) at the bottom of the basin and return treated water in a natural or artificial waterway created by design. And the solids stored in the basin can be recovered in the future to be valued. The former Kipushi concentrator (A.C.K) has been operating for several years with three artificial basins constructed for the decantation of water contained in huge amounts of discharges drained as pulp [1]. It happens that currently the first two basins are filled and the third is 80% saturated. There is therefore a need to consider the construction of a fourth basin. In fact, the choice of this type of dike (earth dike) is that it has a high quality to accommodate movable foundations that would be unable to withstand a concrete structure and is a type of dike feasible and even recommended if one has to do to a valley of wide type, if one has a suitable material in the immediate vicinity in sufficient quantity, which is the case of our work. In this preliminary study of erecting a settling basin using dikes we would like to answer the following concerns: what will be the location of our work? What will be the volume of our artificial basin created? What will be the source of the building materials and their geotechnical characteristics? What will be the evacuators of the flood? And what will be the mode or procedure of construction of the work?

2. Material and Method

2.1. Dike Location and Study Site Characteristics

The proposed study site is located 30 km from the city of Lubumbashi in the mining city of Kipoushi 11 ° 45'54 " South and 27 ° 18'00 " East. It is located precisely in the Kipushi Valley where the Kipushi River runs in the form of a minor bed. The study area is on the west side just at the entrance to the city referring to the Lubumbashi-Kipushi road. Indeed, the study section comes just after the third dike in the Kipushi Valley. The site we are working on is a wide valley because the L / h ratio is greater than 6 . In wide valleys, all types can be built except vault type dikes. And in our case the erection of the dike will accommodate, as we are in the presence of a deformable terrain seated alluvial layers.

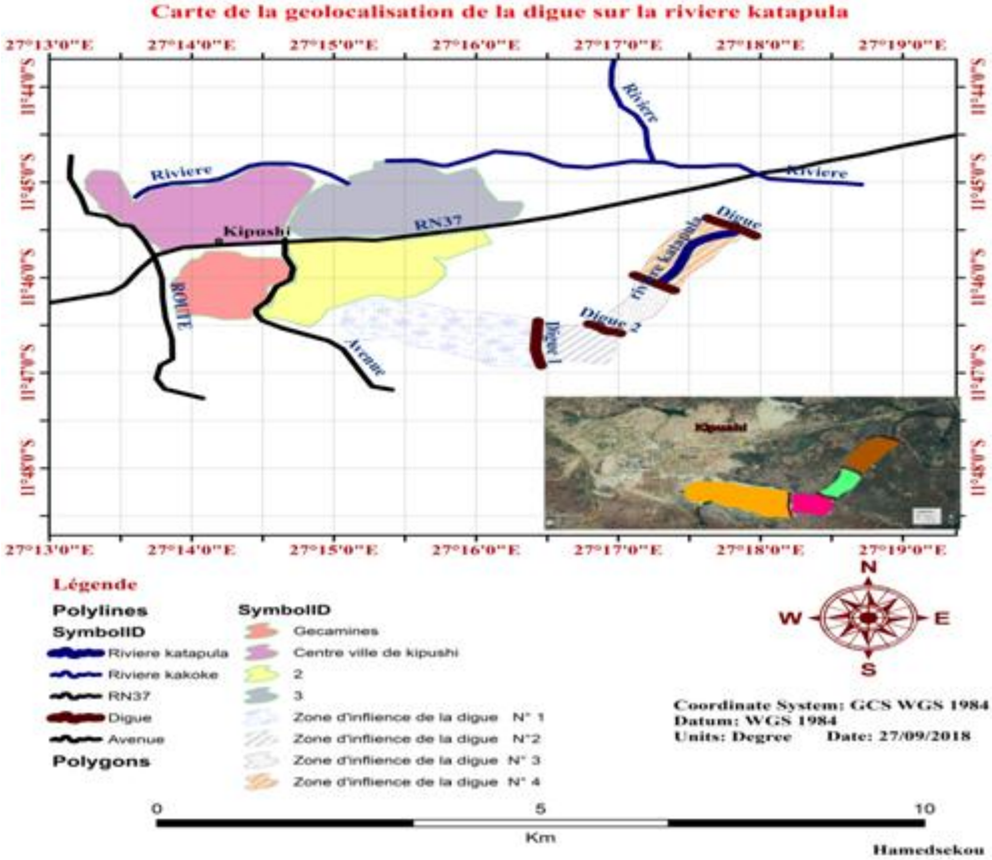

Figure 1: Map of the geolocation of the dike on the Katapula River

2.2. Dimensioning of the dike

The dimensioning of the dike will include, firstly the height of the dike "HD", which will be defined by: HD = HRN + H + R; With: HRN: the height of the normal restraint; H: the maximum load on the spillway and R: Revenge (the rematch prevents the dike from being submerged by the waves and compensates for the settlement of the dike and is determined by the relation: R = Rv + Rt; with Rv: the revenge due to the action of the wind; Rt: the revenge due to settlement. The foreseeable settlement does not exceed 1% of the height of the dike. Secondly, the width and the length of the peak of dike. For a good circulation of the machines and to allow the maintenance of the structure, the width in crest Lc will be calculated from the formulas below: L = 1, 95 Hl / 2 or L = (3, 9Hl / 3) - 3. [3] With H the height of the dyke, and thirdly the determination of the volume of the pond (disposal pond) which will be created by the erection of the dike, this volume will be calculated on base of three dimensions namely its length which will correspond to the height of the dike, its width always of the dyke as well as the length corresponding to the arrow of the Kipushi River.

Figure 2: Top view of the dike site

2.3. Source of building materials and their characteristics

As for all embankment dikes, this type of earth dike, accommodates foundations less efficient than for concrete dikes. The design of these structures is highly dependent on the amount of fill of sufficient quality available on site or in the immediate vicinity (the volumes are such that a distant deposit would greatly increase the price of the dike because of transportation costs) [4]. One of the great advantages in the construction of our dike is that we have the materials around the site of implantation of the dike, so in situ. Only one type of material is available, that is laterite of the gritty and sandy type. Laterites or lateritic soils are a large family of soils that form in the humid tropical regions [5] in the case of DR Congo and result from a particular process of alteration. Some classes of lateritic soils are used in pavements (basecoats and subbases, etc.), applying rules that have been defined by country, based on general rules of soil suitability for compaction. About two hundred years ago the term "laterite" appeared in the scientific literature. Despite various vicissitudes, this term is still widely used. The word "laterite" was first coined by Buchanan in 1807 [6] for a material used for construction and operated in the mountainous regions of Malabar, India. Buchanan (1807) indicates that "this material has the appearance of a ferruginous deposit with vesicular morphology. It is apparently unstratified and is shallow in soils. When cool, it can be easily cut into regular blocks using a sharp instrument. Exposed to the air, it hardens quickly and resists remarkably weather agents. Lateran of Buchanan has been commented in great detail by Bud and Gunnell (2005). These properties of laterites explain their frequent use as building material, a job comparable to that of bricks. In local languages, these formations are called "brick earth". The name "laterite" is therefore only the Latin translation of a vernacular terminology. Laterite has a later root, which means brick in Latin, and this only by reference to the use of these blocks [7]. We note that laterite or lateritic soil is a soil that forms in the humid tropics and results from a particular weathering process under forest cover, ferralitization or laterisation (ferralitic soil). The laterisation phenomenon is a process of formation of soils specific to hot and humid tropical regions. This is an alteration of the parent rock whose essential characteristic lies in the dissolution and then the departure of the silica. This leaching phenomenon is accompanied by an enrichment of iron and alumina in the form of oxides Fe_2O_3 and Al_2O_3. Some factors have a predominant influence on the alteration of rocks and subsequent formation of lateritic soils, these are: the climate (rainfall, temperature, water balance); topography (erosion and drainage); vegetation (organic matter, bacteria, humic acids) and bedrock. We will use laterite of gravelly type. The representativeness and the characteristics of our material will be determined on the basis of the geotechnical study. These identification tests will allow us to be fixed on the mechanical behavior of our soil. This is granulometric analysis; the ATTERBERG limits as well as the Proctor test as well as the unconsolidated and undrained triaxial tests for our case.

The particle size analysis will serve us to determine the weight distribution of the particles of our material (lateritic soil) according to their dimensions. This analysis is carried out by two different processes: sieving and sedimentometry [8]. For our study, we will use sieving in order to know the distribution by weight of particles of dimensions greater than or equal to 80 microns. For particles smaller than or equal to 80 microns, particle size analysis is used by sedimentometry [8]. The purpose of this test is to plot a particle size curve which will illustrate the evolution of the percentages by weight of the sieves (or refusals) accumulated as a function of the mesh size of the sieves. From this curve we will assign a nomenclature allowing a first identification of our material. The principle of this analysis is to split the material into several categories of grains of decreasing size by means of a series of sieves. Each sieve is characterized by the dimension of the mesh (opening) of the canvas which constitutes its bottom. One will say refusal on sieve: the fraction of soil which will be retained; sieve: the fraction of soil that will pass through the sieve. As material, we will use a standard screen sieve column, the sieves are nested in each other according to their mesh openings decreasing from top to bottom. The upper sieve with, usually, a 5mm mesh opening. The sieve column is completed by a lid placed on the upper sieve and a closed bottom container to recover the last sieve. ; A vibro-sieve; bins; a scale sensitive to the nearest centigram; an oven with thermostat and a wire brush. To find the results, we take the mass of the soil to be analyzed Ms which must depend on the maximum size of the large particles. It is recommended, [9]: $200 Dm < Ms < 500Dm$; with Dm representing the diameter of the largest particles, expressed in millimeters; Ms expressed in grams. This limitation of the mass is intended, on the one hand, to carry out the test on a fraction sufficiently representative of the soil, and, on the other hand, to carry out the successive sieving operations with a limited quantity of the particles in each sieve [8]. According to our material, the sieving will be carried out by dry way because our material is of the type powdery soils (pebbles, gravel, sand). According to the Congolese geotechnical standards [10] if one has 40% and more fine particles in the sample, one concludes that one is in the presence of a bad ground.

The behavior of a fine soil varies greatly with the amount of free water existing in the voids (pores), and also the amount of water absorbed that coats its particles [8]. The Atterberg limits are conventional water content values that mark (Test procedure Atterberg limits, 1963): the transition from solid state without shrinkage to solid state with shrinkage, it corresponds at the withdrawal limit; the transition from the solid state with shrinkage to the plastic state, it corresponds to the limit of plasticity; the transition from the plastic state to the liquid state, it corresponds to the limit of liquidity. Then the index of plasticity IP defined by the difference of the limit of liquidity and the limit of plasticity will tell us about the extent of the plastic domain of the material. The test will be carried out in two stages, namely the determination of the limit of liquidity using the Casagrande apparatus and the determination of the limit of plasticity by the formation of rolls or rolls. The determination of the Atterberg limits will be practiced on a fraction of the material called mortar which will group the particles that will pass through the 0.4mm opening sieve. Here sieving will be done wet. The material will then be dried at a temperature of less than or equal to 60 ° C until a pasty state ready for carrying out the test. Finally, depending on the value of IP, or may then adopt a classification for our material.

L'essai Proctor a pour but de déterminer la teneur en eau optimale et le poids volumique maximale du matériau sec, pour réaliser le meilleur compactage du matériau. L'essai va consister à compacter dans un moule normalisé, à l'aide d'une dikee (mouton) normalisé, selon un processus bien déterminé, un échantillon du matériau auquel on va ajouter une quantité d'eau donnée. Après compactage, on détermine le poids volumique sec de l'échantillon du matériau compacté et sa teneur en eau. L'essai est répété plusieurs fois de suite sur des échantillons compactés à des quantités d'eau croissantes. Puis on trace, la courbe qui représente un maximum dont l'abscisse est la teneur en eau optimale et dont l'ordonnée est le poids volumique maximale du matériau. L'essai Proctor peut être réalisé avec deux énergies de compactage différentes. Selon l'énergie fournie, il s'agit de l'essai Proctor Normal et l'essai Proctor Modifié. Pour notre étude nous utiliserons l'essai Proctor Normal où l'énergie de compactage est modérée, et c'est un essai recommandé pour le compactage de volumes de matériau importants (corps de remblais, digues,...) soumis notamment à l'action de la pesanteur et éventuellement à des charges modérées.

Les essais triaxiaux non consolidés non drainés, nous permettent d'obtenir les caractéristiques dites non drainées : cohésion et frottement interne. Comme pour notre cas du site, en fondation, la couche est meuble, donc médiocre, saturée ou presque et donc le frottement interne égale à 0 ou très faible) a une valeur de cohésion non drainée de 20, 40, 60, 80, 100 kPa (des valeurs supérieures à 100 kPa sont peu courantes), on peut respectivement construire un barrage de hauteur 5, 10, 15, 20, 25 mètres sans avoir à élargir sensiblement sa base, par rapport au même ouvrage qui serait fondé sur du rocher [4].

2.4. Mode of construction of the dike

2.4.1. Constructive arrangements

These constructive provisions being simple and practical, we will achieve two goals: Facilitate the work during the execution of our work by the performer for it to be done well; and concretize the assumptions made based on a calculation. On the other hand, it will not suffice to provide adequate constructive arrangements, but must then be checked during the execution of the work.

2.4.1.1. Foundation excavation

- Protection of the site against the waters of the watercourse.Our work, which is a dike (earth dike), lends itself to deformable foundations. To allow dry work, it is generally preferred to divert the water through a tunnel that diverts the normal course of the river bypassing the location of the dike and the excavation will be dried for a long time.
- Preparation of excavationsAfter examination of the backfill and the sealing key, further studies may be necessary. Before setting up the embankment of the dike it will be necessary: Sanitize and clean the bottom surface of the excavation; Perform a detailed survey; Perform the reception of the excavations.

2.4.1.2. Treatment of the foundation of the structure

The seating area of the dike should always be stripped at least 0.50 meters to remove topsoil. However, we know that the mechanical characteristics of the foundation's loose materials, especially (alluvium) for the case of our base course, are often sufficient to support an embankment with a height of less than ten meters (case of our dike) [4].

2.4.2. Construction of the dike

The construction of our dike will use the general techniques of earthworks and compaction conducted judiciously to obtain in all points the necessary properties in terms of particle size, cleanliness, degree of compaction ...We will proceed to the construction of the dike in successive layers of 0.20m with our material (laterite) by compaction.

2.4.2.1. Embankment design

The embankment design: the embankment of our embankment is of the homogeneous type according to the materials found on site. The design itself will be based on:

a) The profile which fixes the choice on the inclination to be given to the two faces of the embankment resulting from the calculation of the breaking conditions in the most unfavorable hypotheses and the application of a factor of safety Fs, proposes the following figures concerning the factor of safety Fs:
   - For both facings, at any stage of construction, $Fs \geq 1.5$;
   - upstream facing (empty retention) and downstream facing (full retention) $Fs \leq 1.5$; Be aware that the recommended maximum slope slope is 1/2. Anyway, steeper slopes are possible in the case of embankments in coarse materials without fines (gravels, pebbles, blocks ...).
b) The width of the Ridge,
c) The thickness of the ridge, which will be found by differentiating between the height of the dike and the height of the normal reservoir (the height of the flood discharge structure).

After the development of the possible treatment operation, the compaction test will be carried out on a board whose minimum dimensions will be, in length: 30 to 40 meters and in width: 4 to 6 meters. Indeed, the right-of-way surface must be properly prepared beforehand: it will be the stripping of the topsoil (a task mentioned in the treatment paragraph of the dike foundation), the removal of clods, dewatering, scarification on 0.15 meters.

2.4.2.2. Technical and construction material of the dike

The technique to be applied will be the compaction technique. It is known that, irrespective of the method used for grounding, passing machinery, rollers, manual or mechanical tamping, clamping by static load, ..., the final density of the soil thus transformed depends on the water content . This will be done by placing a layer of 0.20 meters of material and compaction by 10 passes. On this, it will be recommended to then perform at least three layers of embankment in order: To overcome the phenomena of sitting; to control the adhesion of the layers and to test two or three different layer thicknesses. With regard to the measures of effectiveness of the compactor, it is a question of determining the adequate thickness of the layers and the corresponding number of passages of the compactor. For a given thickness, the whole board will receive compaction considered minimal, 6 passes, then will be divided into 3, 4 or 5 parts which will each receive additional compaction compared to the previous, so as to obtain a section of 6 passes, another of 8 passes, the next of 10 passes, the last of 12 passes (one pass will be a single trip of the compactor). The optimal number of passes will achieve the desired dry density which will be between 6 and 12; to obtain an embankment compact enough homogeneous and optimize the use of gear. As material, we will use a compactor, that being, we must distinguish three main categories of compactors:

- Tire compactors that are suitable for compaction of almost all soils but if the use of heavy rollers presents the risk of foliage, the lighter rollers may have insufficient depth action;
- Rollers with tamping feet, preferably mounted on a self-propelled cylinder, are suitable for compacting fine soils;
- Smooth vibrating rollers, usually self-propelled, are preferably reserved for granular soils (sands, dry gravel) to rocky materials. Their action is important in depth, but not on the surface, on the first 2 to 5 centimeters.

What we are looking for in the case of our dike, is to use a compactor that will cause hardening of the soil after a certain number of passes that must be neither too large, for economic reasons, nor too small for ensure a good connection between neighboring compacted areas. The heavier the roll, the larger the ground contact area, the deeper it acts, the thicker the compacted layers will be; and it is the smooth rollers or tire rollers that are most suitable for our dike.With regard to the collection and transport of materials, the two commonly used methods are:

- The self-propelled scraper (motor scooter);
- The hydraulic excavator associated with dump trucks, which favors the mixing of several horizons and is more suitable when the borrow area is far from the dike.

For our dyke, we will use a crawler excavator taking into account the power, the capacity as well as the height of loading and dumping of the bucket, the force of penetration and the force of tearing for a good performance of the works. One type of machine works all types of soil, from muddy to stone quarry. The hydraulic excavator also guarantees comfort, safety, ergonomics and intuitive control for the user.

2.4.2.3. Siding and Crest Protection

The dike at the end of construction poses the thorny problem of infiltration through the body of the dike. To create the seal, we will place a layer of concrete or bitumen on the upstream face of the dike to prevent infiltration. The installation of a layer of bass on the ridge will in particular prevent the formation of ruts due to the passage of vehicles and desiccation of the last compacted clay layers. For the downstream slope of the embankment of the dike, it will be protected against the effects of runoff of rainwater. The layer of topsoil approximately 0.50 meters thick will be placed in the excavator and / or the bulldozer.

2.5. Adjoining organs of the dike: Flood evacuator: the spillway and the monk

Natural causes can also be the cause of breakage of our dyke. This is the case with exceptional floods, of greater intensity than that used for the design of the evacuation works, called project flood. Embankment dikes do not withstand prolonged long-term flooding, and the inevitable flow of water through the dike poses risks of internal erosion (entrainment of the material particles by the flow) [4]. For this we must implement a spillway, which will allow us to release downstream all or part of a flood occurring upstream, so that the safety of the dike is not questioned during this episode. The flood we are talking about here is the volume of water retention above the normal level of the reservoir. The spillway is a simple weir or overflow, which will start to let the entire volume of the flood that could not be temporarily stored in the basin. The flow after crossing the spillway, will be led downstream by a system of evacuation by monk. The monk is an evacuator who will be implanted at the foot of the dike, he will have the role of launching the water as far as possible from the downstream foot of the dike; this system is called Ski Jumping. As a type of spillway, we will take the evacuator in the shape of a rectangular chimney. Because it is better in terms of reliability, simplicity, safety, construction costs and maintenance. They do not require any human intervention for their operation and are therefore unlikely to fail in case of flood, or to open unexpectedly during normal periods [4]. Thus, one will determine its flow by the formula of DUBUAT [12].

3. Results and Discussions

3.1. Dimensioning of the dike

a. The height of the HD dike that is defined by HD = HRN + H + R
With: HRN = 6.00m; H = 2m; R = R = Rv + Rt.
with Rv = 1.06m and Rt = 0.09m
The total height of the HD dike is 9.15m.

b. The width and length of the ridge: The peak width Lc is calculated from the formulas: L = 1.95 Hl / 2 and L = 3.9 Hl / 3 - 3 ; with H = 9.15m; L = 8.9m or 9m.The crest length is 350m.The length corresponds to the Kipushi River spit is 2000m.

c. The volume of the basin (rejection park) . The volume of the basin is easily calculated from its three dimensions: its length, its width and its height. V = HD (Height) * D (distance) * L (length) = 9,15m * 350m * 2000m = 6.405.000 m^3

3.2. Characteristics of building materials

3.2.1. Characteristics granulometric

As part of our study, we attribute the first nomenclature from the granulometric analysis of a sample of our material (laterite) from the surroundings of the construction site. A sample weighing 3000grams. However, the nomenclature of a material is given on the basis of all the results of the identification tests [13]. Knowing the mass of the material to

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be analyzed depends on the maximum size of the large particles. For our study, the percentage of sieves was 27%, with a sieve diameter of 200 mm (see Table 1). On this, as we are in the nomenclature such as: percentage of sieve> (30% to 40%): the category appearing in the nomenclature of material [8]; according to the Congolese geotechnical standards [10], if one has 40% and more fine particles in the sample, one concludes that one is in the presence of a bad ground; materials that contain more than 30% of elements less than 80 µ are probably watertight; with less than 15%, they probably are not [4]. We have 27% of fine particles, so the material is good.

Table 1: Granulometric Analysis

N° Tamis	Ouverture en mm	Refus cumulé en gr.	Refus cumulé en %	Tamisats
3"	76,200			
21/2"	63,500			
2"	50,800			
11/2"	38,100			
1"	25,400			
3/4"	19,050			
1/2"	12,700	0	0	100
3/8"	9,525	35	1	99
1/4"	6,350	310	16	84
4	4,760	790	26	74
8	2,380			
10	2,000	2000	67	33
16	1,190	2110	70	30
18	1,000			
20	0,840			
30	0,590			
35	0,500			
40	0,420	2135	71	29
50	0,297			
60	0,250	2145	72	28
80	0,210			
100	0,149	2155	72	28
140	0,130			
200	0,074	2200	73	27

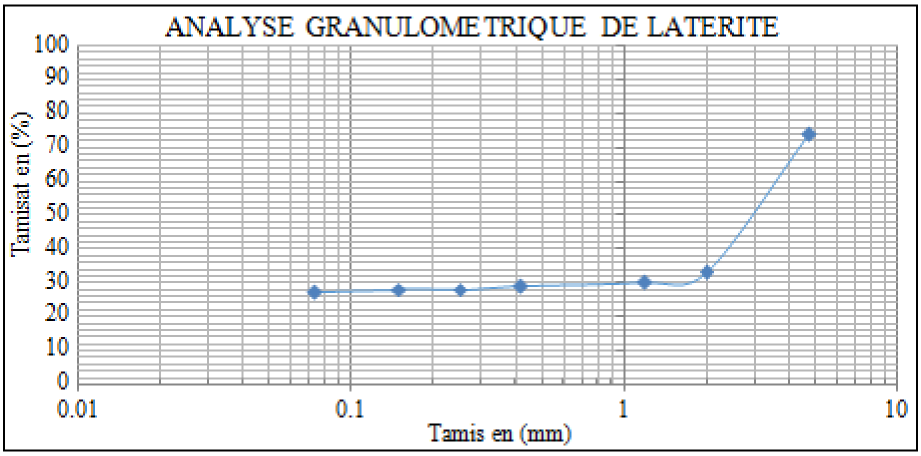

Figure 3: Granulometric curve

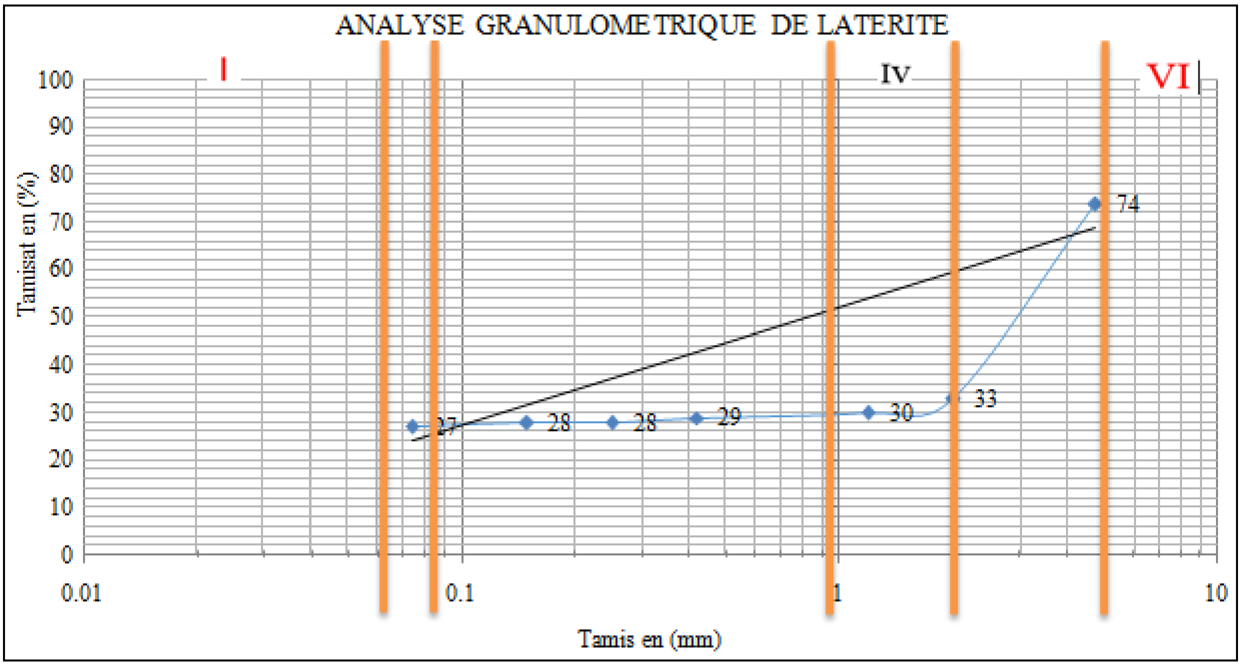

Figure 4: Trend curve

3.2.2. The limits of Attreberg

Regarding the ATTERBERG limits, we have a liquidity limit (W.L) of 29.4 and a plasticity limit (W.P) of 16.1; hence a plasticity index of 13.3; This is satisfactory because the Congolese geotechnical standards recommend the use of lateritic gravel with a plasticity index between 10 and 25. [10]. Depending on the IP value found, we can adopt the classification of the material such that: <IP <30: a moderately plastic material [8] A moderately plastic material will allow a good work to the compacting machine and materials whose plasticity index is greater than 35 not only pose problems of stability but also of settlement, swelling and implementation [4].

3.2.3. The Proctor test

For the Proctor test there are two sizes, namely, the optimum water content (W) of 10 and the maximum dry density (dmax) of 2.15. (Table 2 and Figure 2).

Table 2: Proctor Trial

ESSAI PROCTOR-NORMAL-MODIFIED										
Eau ajouté	6%		2%		2%		2%		2%	
Poids total humide	13235		13495		13880		13835		13650	
Poids du moule	8420		8420		8420		8420		8420	
Poids de l'échantillon humide	4815		5075		5460		5415		5230	
Volume moule	2317		2317		2317		2317		2317	
Densité humide	2,08		2,19		2,36		2,34		2,26	
Ph + Tare	143	152,14	140,02	144,83	174,03	181,1	160,18	154,33	160,85	158,27
PS + Tare	136,66	154,51	133,26	137,24	162,03	168,57	147,95	141,08	145,95	143,94
Poids de la tare	22,53	35,04	40,66	40,67	36,67	39,8	43,22	28,66	34,96	39,89
Poids de l'eau	6,99	6,63	6,76	7,59	12	12,53	12,23	13,25	14,9	14,33
Poids sol sec	114,13	110,47	92,6	96,57	126,97	128,77	104,73	112,42	110,99	104,05
Teneur en eau %	6,1	6	7,3	7,9	9,5	9,7	11,7	11,8	13,4	13,8
Teneur en eau moyenne	6,1		7,9		9,6		11,8		13,6	
Densité sèche	1,96		2,04		2,15		2,09		1,99	

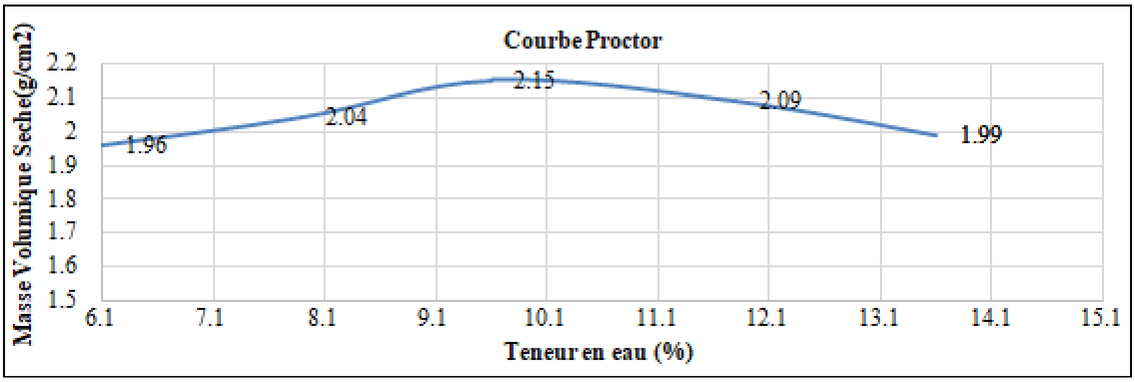

Figure 5: Proctor Curve

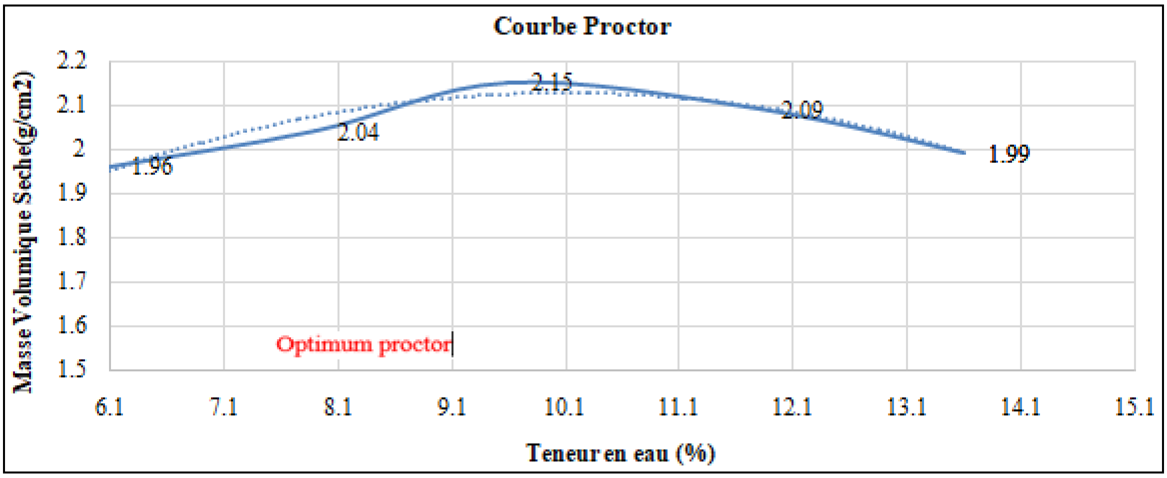

Figure 6: Proctor Trend Curve

3.3. Building elements of the dike

The embankment profile of our embankment, for both facings, at any stage of construction we have Fs ≥ 1.5; the upstream facing (empty retention) and downstream facing (full retention) Fs ≤ 1.5; Be aware that the recommended maximum slope slope is 1/2. Anyway, steeper slopes are possible in the case of embankments in coarse materials without fines (gravels, pebbles, blocks ...). The width of the ridge, Lc = 9 m; The thickness of the crest: 3.15m.

3.4. Calculation of the flow of the spillway: the spillway and the monk

The discharge of the weir is calculated by the empirical formula of DUBUAT. $Q = m * B * \sqrt{2g} * (h)^{3/2}$; with: m: coefficient (dimensionless) = 0.385 (horizontal slab) at 0.50 (normal spillway, good shapes) at 0.54 (optimum), h: height of the water above the threshold, measured upstream, where the water level is not yet disturbed by the flow. Then the flow coefficient is allowed at m = 0.54. Having opted for a form of maximum flow, m = 0.54; the width of the chimney-shaped weir, B = 3.50 m; the height of the threshold, h = 6m, and with g = 9.8m / s. Putting all these values in the equation, we have: Q = 122.66 m3 / s .

4. Conclusion

Indeed, the discharges generated by the former Kipushi concentrator being the subject of a subsequent recovery of the residual materials, it is envisaged a storage of these discharges by creating an artificial basin by the construction of a dike. The objective pursued in our work is the construction (erection) of a fourth disposal dike in the Kipushi Valley for reasons of efficiency of the former Kipushi concentrator. The dike will be located in the Kipushi Valley with a height of 9.15m, a crest length of 350m and a peak width of 7.8m. The volume of the artificial basin thus formed will have a volume of 6.405.000 m3 of capacity. The dike in question will be clay, with the material of gravelly lateritic. The tests, such as granulometric analysis, Atterberg limits and Proctor test were carried out on our material, to have good information on the identification of our material. For particle size analysis, we found a percentage of 27% of the sieve, which makes our material a good one. As a matter of plasticity of our material, the limits of Atterberg give a plasticity index of 13.3, which makes our material a moderately plastic material, good for compaction. And for the optimum dry density test of our material, the optimum water content of 10 and the maximum dry density of 2.15 were found. The Proctor curve found is flat, making the material a good one. As for the method of construction of our dike, we will apply the compacting technique in successive layers of 0.20m thick; we have opted for our embankment, a profile with two facings and at any stage of construction we have an $Fs \geq 1.5$; for the upstream face (empty retention) and the downstream face (full retention) an $Fs \leq 1.5$. The recommended maximum slope slope is 1/2. The width of the ridge found is Lc = 9 m and the thickness of the crest is 3.15m. As for the safety of our dike in the event of overflowing floods, the structure will be equipped with ancillary works (the spillway with system per monk) to evacuate the flood which represents the overflow water whose flow calculated by the formula of DUBAT gave: Q = 122.66 m3 / s. This work opens a door to future research we think in the near future to the economic study of the erection of the dike.

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