STOCKS OF NATURAL SAND BETWEEN BENEFITS AND HARMS

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ABSTRACT

In arid and semi-arid countries, there are high concentrations of sand as isolated dunes, as accumulations to banks of rivers (called Nebka) and as barriers making the beauty of some beaches. These accumulations are terrigenous sediments (of earthly origin) transported by wind or water.

Over geological time and through weather and tectonic factors, the nature shapes and reshapes the earth, for benefits used by the man in various sectors.

In this article, the sand as detrital sediment is taken as an example. This sand can be used in construction, in glass works and in the production of silicon. And in some saharian regions, this natural commodity is used as a remedy for healing joint diseases and rheumatism, by taking sand baths during seasonal periods. The use of sand has longtime been known.

The nuisance of sand to these stocks is due to their anarchic use from beaches and rivers for various purposes. This leads to a serious depletion of beaches and rivers in sand, which causes disfigurement of coastlines and the deterioration of the natural beauty of the environment. On the other hand, these barriers reduce sometimes the ocean currents that erode the land, and they are in opposite to fluvial currents during high floods.
In this article, the benefits and the harms of sand stocks are exposed with recommendations to safeguard the natural ecosystem.

Keywords: Sand, Granulometry, Fineness modulus, Benefit, Harm

INTRODUCTION

In this article we try to define the term sand of geological point of view; it indicates both a granulometric and a lithological facies.

From granulometric point of view, the grain size is between 0,063 mm (silt) and 2 mm (gravel); and from lithological and facies perspective, it is also a solid stone like granite, which disintegrated into small grains under the effect of erosion and tectonic agents, constituting a loose rock, which can move and flow through the fingers like a fluid.

Erosive agents are the external meteorological factors : wind, water, freezing and thawing, diurnal and seasonal temperature variation; and the tectonic agents, which are the faults, the cracks and the joints.

By this definition, we also try to give the training mode of this material, these different varieties, these places and geographic localities, its use and finally the negative consequences of its misuse.

So before entering the use of this natural commodity, it is imperative to provide an overview on the training mode, varieties and localities where these granular materials exist.

SAND FORMATION MODE

Sand is a granular material consisting of small particles from the degradation of other rocks, having a size between 0,063 and 2 mm. Its composition can be up to 180 different minerals (quartz, mica, feldspar, iron oxides, etc.), as well as remains of shells and coral (see Figures 1 and 2).

The origin of sand is multiple by its geographical location; either open land or in the sea, or on the banks of rivers. Sandy beaches are the product of materials, which are discharged from mouths of rivers and end their journey at sea.

The sand may come from dismantling of land near the shores and also from products carried by the wind sometimes over very long distances. As example of sand of Sahara, which may sediments on the beaches of the south of France, so the sea plays a dual role; both as a wind erosion and as a sediment. Geological studies of these sands can indicate their training environments.

We can thus trace their origins based on the lithology of the land area beside odds and shorelines, or those deltas of rivers, which flow into the sea. For sands and dunes of the Sahara, their origins are the ancient massifs which form the Hoggar, back

Reguibat and the Tassili, where granite and sandstone are in abundance.

Fig. 1: Nature and size of sand grains.

Fig. 2: Sand dune in the desert of Namibia.

The sand can be differentiated through a color that varies depending on predominant component. We can identify at least six colors: yellow, pink, gray, green, black and white. Figure 3 shows the colors of sands from the same region Taghit.

Fig. 3: Colors of sand from Taghit.

Sand can also be different due to the shape of the grains. Most round grains are transported by wind and those transported by water are more ovoid. It can also be differentiated by the appearance of the grains, which varies from the blunt shiny to matte, depending on their mode of transport (water or wind).

GEOGRAPHICAL DISTRIBUTION OF SAND

The sand accumulates to form beaches and dunes, as well as in desert areas like the great western erg and the great eastern erg in southern of Algeria; and some small dunes oasis in the Hoggar and the highlands. In coastal areas, it can be found in sandy beaches.

The photos below in Figures 4, 5, 6 and 7 show the different geographical locations of the sand.

Examples are the Massif of Hoggar in Algeria, the Death Valley in California and the Pyla beach in France.

Fig. 4: View of the Hoggar.

Fig. 5: The Red Tadrart in Djanet, in southern Algeria.

Fig. 6: Sand Dunes in Death Valley of California.

Fig. 7: Dune of Pyla (France).

THE USE OF SANDS

The sand can be a natural ecosystem for the life of fauna and flora, both at sea than land. It is used in various branches:

- it is used as masonry mortar with cement;
- it is found in the concrete, which supplies at rate of two tons per year and per person, a gigantic stock in the urban areas;
- it is also found in computer chips, in the paper, in the plastics, in paints, in the detergents and in the cosmetics;
- it is used as foundry molds;
- it is used in cooking for meat preservation;
- it is used in glassware;
- it is used in the trenches of power stations, in drinking water and gas stations, as sand bed for laying of pipelines;
- it is used as filter (pool water and wastewater);
- it is used as protection against bullets and explosives;
- it is used as an abrasive to clean metal parts;
- it is used in tourism field as sand beaches and dunes for recreation;
- it is used to protect coastlines against erosive effects, and to protect the river banks against devastating floods;
- it is also used for healing purposes in some oasis, by taking a bath of hot sand to cure joint diseases.

But there are some problems due to abusive use of sand:

- Environmental problems: the desert sand is too round and too thin to be used in construction. So, the use of beach sand and seabed in constructions damage the natural beauty and cause serious ecological problems due to the erosion and the degradation of the habitat of some living species.
- Problems due to erosion: the coastal coast sand cords are also natural barriers to reduce erosion of the continent near the shores surges in waves. The same effects can reproduce at the level of river banks which sometimes attends sand barriers that can hinder the strength of some very violent floods during rainy periods and in arid and semi arid areas where the canopy plant is thin or absent.

PHYSICAL CHARACTERISTICS OF SOME ALGERIAN SANDS

For comparative particle size study, we conducted a representative systematic sampling of sand from different Algerian geographical areas: in the south (Taghit, Oued Souf), in the highlands (Naama) and in the north (Coralaise, Oran coast). View geographic map of different localities of these sands is shown in Figure 8.

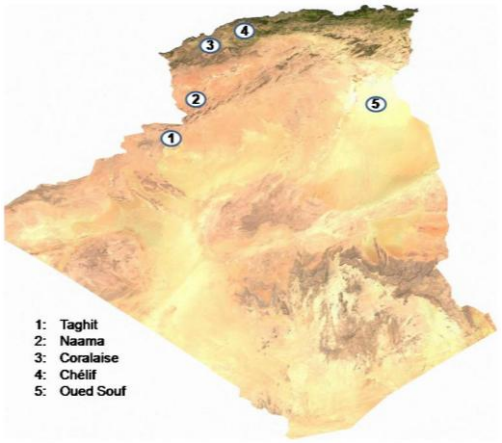

Fig. 8: Geographic locations of collection of the sand samples.

Following Figures 9, 10 and 11; show microscopic views of these varieties of sand.

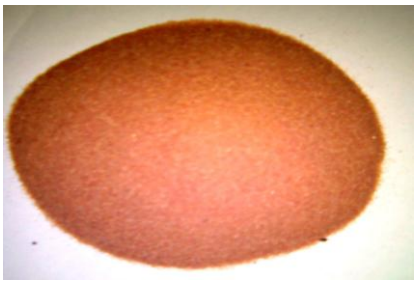

Fig. 9: Sample of sand dunes from the oasis Taghit (South West of Algeria).

Fig. 10: Sample of sand dunes from the Oued Souf (South East of Algeria).

Fig. 11: Sample of sand from Coralaise (Oran coast).

The used method to study the size of these samples of sands is described in four steps :

- The first step of the process is the systematic sampling of sands in representative geographical sites of Algeria namely the south, the highlands and the Sahel.
- The second step relates to the cleaning of sample impurities, which are waste (grass, plastic, etc.).
- The third step involves the preparation drying under constant temperature ovens for the removal of moisture.
- The last step is to classical sieving through sieves with diameters of 0,08; 0,125; 0,16; 0,20; 0,25; 0;315; 0,40; 0,5; 1,00 and 1.25mm.

The results are shown in particle size distribution curves. The x-axis concerns the diameter of the sieve in logarithmic scale, and the ordinate is the percentage of sand passing (Figures 12 to 16).

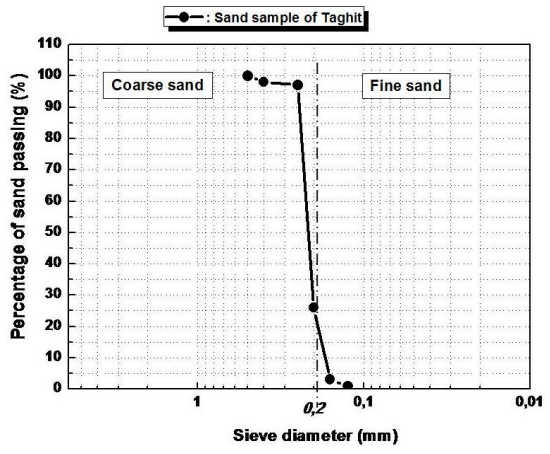

Fig. 12: Granulometric curve in the case of sand of Taghit.

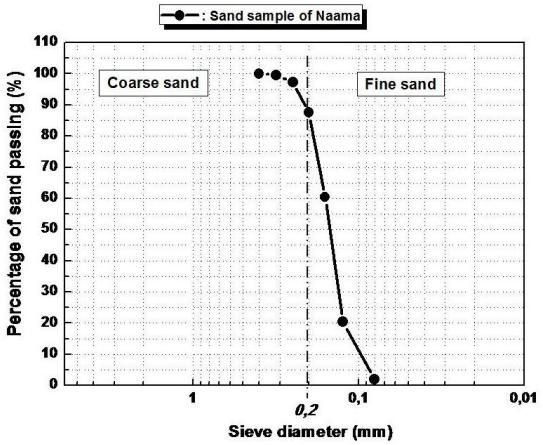

Fig. 13: Granulometric curve in the case of sand of Naama.

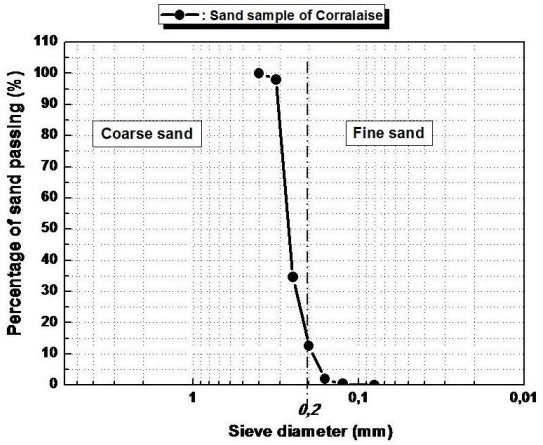

Fig. 14: Granulometric curve in the case of sand of Coralaise.

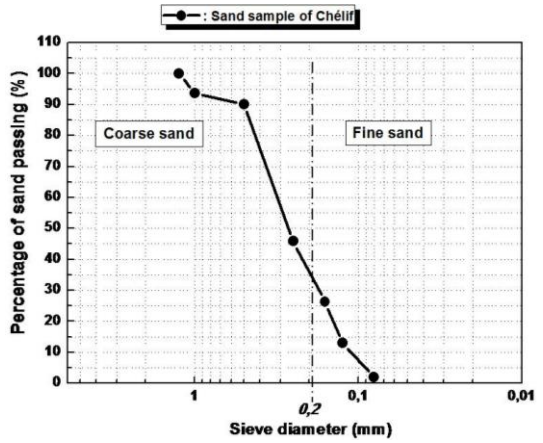

Fig. 15: Granulometric curve in the case of sand of Chélif.

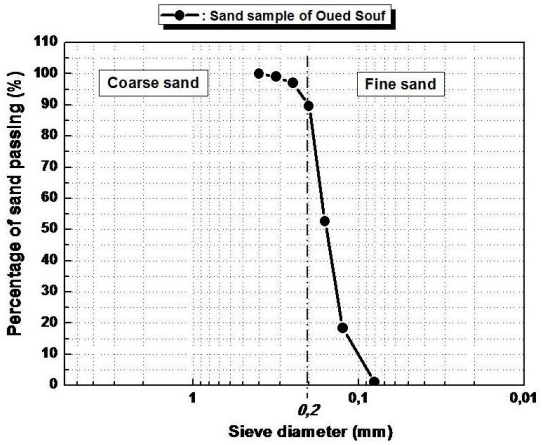

Fig. 16: Granulometric curve in the case of sand of Oued Souf.

In geology, the particle size analysis is used to define different classes of materials regardless of their chemical nature. Table 1 below corresponds to the French Standard NF P18-560 used particularly in the road sector.

Table 1 Maximal and minimal particle size, [1]

Maximal particle size	Appellation	Minimal particle size
200 mm	Peebles	20 mm
20 mm	Gravels	2 mm
2 mm	Coarse Sand	0,2 mm
0,2 mm	Fine Sand	20 µm
20 µm	Stringers	2 µm
2 µm	Clays	

The obtained results indicate according to the fineness modules, that these sands are fine sands of uniform diameter (see Table 2).

Table 2 Values of fineness modulus

Sand	Fineness modulus
Chélif	1,2
Taghit	1
Corralaise	1
Oued Souf	0,5
Naama	0,4

The fineness modulus *Mf* is obtained by :

$$Mf = \frac{1}{100}\sum cumulativerefusal \quad (1)$$

$$(sieves\ 5;\ 2{,}5;\ 1{,}25;\ 063;\ 0{,}315;\ 0{,}16)$$

according to the Norm French Standard [1].

These values of *Mf* are better presented in the following histogram (Figure 17).

In conclusion, the use of these fine sands in the building requires a high quantity of water that is a negative factor for their resistance. These sands will be mixed with sand quarries in order to increase their resistance and their adhesion.

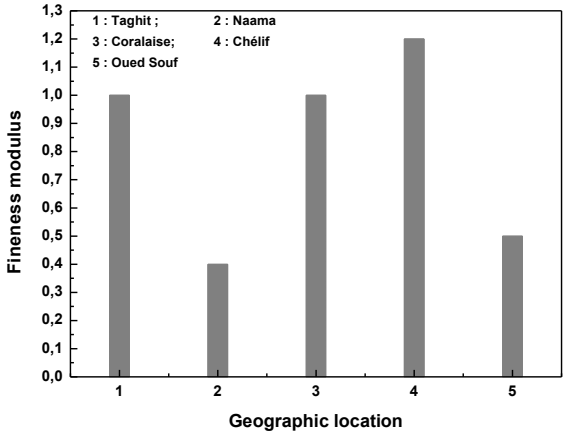

Fig. 17: Fineness modulus vs. Geographic location.

CONCLUSIONS

Following methods to counteract the problems related to the misuse of sand are proposed:

- We have to dredge the funds during the process of silting of dams and periodically after major floods to avoid depletion of the seabed, of rivers and of natural beaches.
- Modern technology also enables to crush hard rock for the manufacture of sand in distant places of urban and rural settlements. This method is expensive, but alleviates the depletion in vital areas.
- We can also use the granitic sand where the weathering of rocks is well advanced.
- We can also have recourse to the use of materials like wood, composite materials, steel, extracts lenses of other materials where the sand is sufficient, as the ergs of the Sahara, as well as recycling, ...
- The use of solar power plants can be, sand smelters may be erect to make glass bricks from sand to sandy deserts, which would again become green and build greenhouses in colder areas with glass legos.

Sand is an essential component in the balance of the natural ecosystem for plants and fish and wildlife. The rush to this material has become very important like the black gold (oil). The abuse of the use of the seabed and rivers can be an imbalance detrimental to the biological balance. It is time to monitor the consumption of these materials.

On the other hand, the use of recycling and composite materials made of iron, wood and glass extracted outside the beaches and marine and fluvial funds; can provide adequate solutions to its

deficiency because the sand plays a vital role in coastal protection and in the balance of marine ecosystems.

Statistics are alarming providing huge figures, around 70% of beaches are eroded to build cities and engulf other (Indonesia and the Maldives).

The disappearance of certain species of fish and amphibians is due to the impact worsened by pollution and the erosion of their natural habitats.

Finally we recommend to the authorities to implement laws governing the use of this material at a rational pace, to respect nature, which is the common good of all living beings on land and at sea.

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