Studying the Phenomenon of Bulking the Iraqi Sand and its Effects on Construction

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ABSTRACT

Construction In the construction and pavement industries, sand is a primary raw material. These materials combine with gravel to form "aggregate" in concrete, Portland cement, asphalt, mortar, and plaster. Sand is mostly made up of tiny fragments of decomposed rocks, corals, or shells, which form when water or other environmental factors are present. Building materials like asphalt and concrete are bulked up with sand to give them more density, strength, and durability. It's also a decorative element in landscaping. Metal casting molds are made with molds made of specific types of sand, just as glass is made with particular types of sand. Sand is one of the most widely used natural resources because it is used in many industries, such as construction, electronics, and plastics. The research examines the effects and consequences of the sand bulking phenomenon on construction. The bulking effect is greatest when the moisture content of sand is between 6 and 8 percent. Moisture content has a diminishing effect on this effect, and at around 15-20 percent, it becomes insignificant. All things being equal, fine sand (particles with a size range of 0.25 mm to 0.15 mm) bulks more quickly than coarse sand (particle size around 2mm). According to the sand's fineness, bulking up to 30% of the original dry sand volume may be possible, but only 15% of the original wet volume.

Keywords: Construction, raw material, Sand

1- Introduction:

Concrete, also known as artificial stone, is the most widely used building material worldwide. With today's technology, concrete is commonly used in a wide range of construction projects, from houses and offices to highway construction and sewerage systems. A blend of fine and coarse aggregate, binding materials, and water is used to create it. Concrete's compressive strength is an essential and practical property. It is, therefore, necessary to understand concrete's compressive strength, which depends on the properties of its constituent materials like sand, brick, and binding substances [1, 2].

Over thousands of years, rock erosion creates sand as a natural aggregate [3]. Sand has been used as an aggregate for civil construction projects since antiquity [4]. Mortar made by the Romans two thousand years ago (a combination of limestone and volcanic sand) played a critical role in the long-term preservation of the structures, according to Jackson et al. Today's situation isn't all that different, as sand is still heavily utilized in the construction industry. Still, it is now also used by a wide range of other industries. It's essential for water filtering, chemicals and metals processing, and the plastic industry because sand is critical in many construction materials like cement and mortar. Because of population growth and rising living standards, this exponential growth in consumption is exapected to continue [5, 6].

Construction, glass manufacturing, foundry industry, metal production, chemical production, ceramics and refractories, paint and coatings, filtration and water production, oil and gas recovery, recreational products, etc. all use different types of sand, each with unique properties. The cement industry, according to the IMF, is the largest consumer of sand and gravel [7]. China, the world's ninth-largest sand importer, used more cement between 2011 and 2013 than the United States did during the entire 20th century. Apart from that, sand is used in land reclamation, and Singapore, the world's largest sand importer, is expanding its territory by importing more of this valuable natural resource. Large amounts of sand are also used for land reclamation in countries like the Netherlands, Belgium, and Japan (the three following largest sand importer countries, respectively)

2- Bulking of Sand:

More moist fine aggregate is added to bulk up the dry mass. The moisture's surface tension separates the particles, increasing the volume as a result. When shoveled or otherwise moved, even well-consolidated, damp-condition moved sand can bulk up. As can be seen in Figure 1, bulking of fine aggregate varies depending on moisture content and grade. Bulking occurs more frequently with fine aggregate than with coarse. Figure 2 displays weight data for a specific fine aggregate in the same way. Because fine aggregates are typically delivered damp, batch quantities can vary greatly [8]. The best practices thus recommend weighing aggregate and adjusting moisture content. when preparing concrete mixtures.

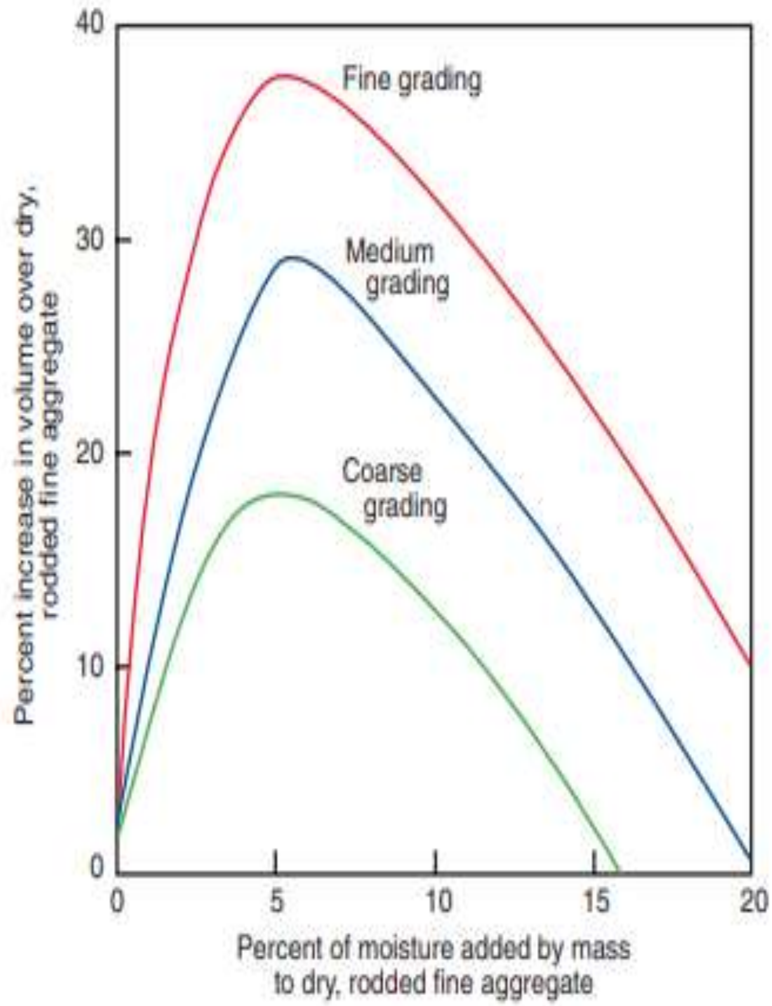

Fig.1 Surface moisture on fine aggregate can cause considerable bulking; the amount varies with the amount of moisture and the aggregate grading

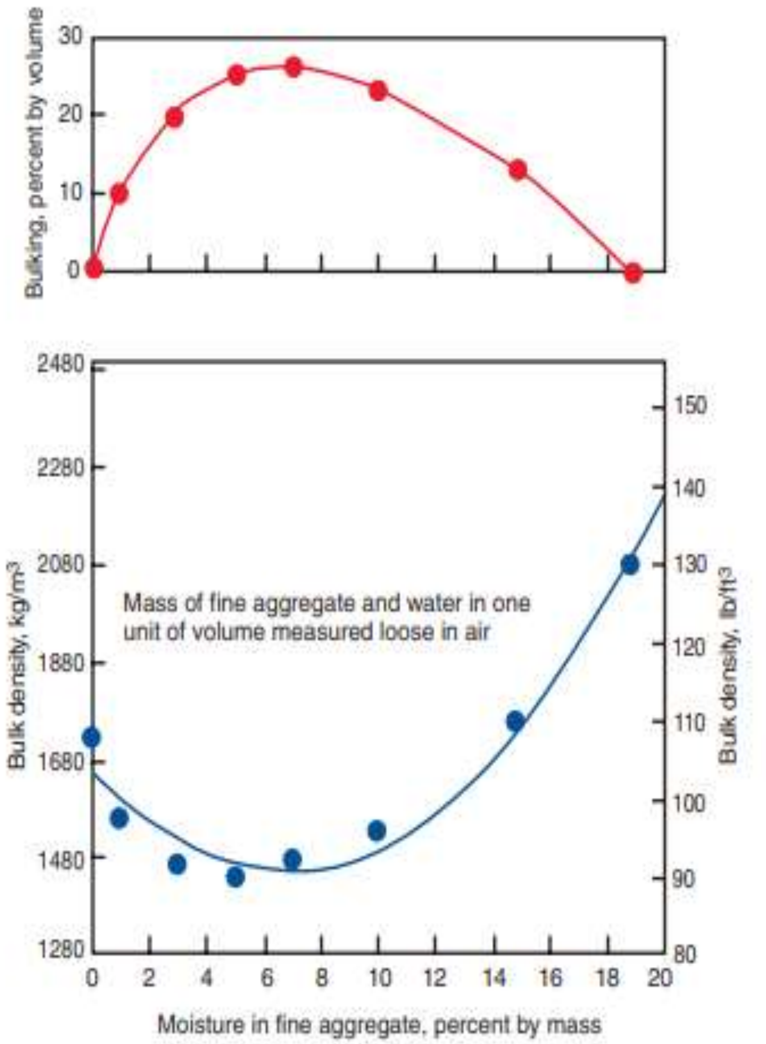

Fig. 2: Bulk density is compared with the moisture content for a particular sand

This is due to the high free moisture content of fine aggregate. There are a few theories as to why people get bulges:

A thin film of unbound moisture protects each particle from exposure to the outside world.. Neighboring particles cannot interact with the moist film due to surface tension. The force exerted by surface tension similarly prevents particles from interacting. Consequently, it is impossible for any particle to make direct contact with another Consequently, the volume is more clumsy. Depending on the moisture content percentage and the fine aggregate particle size, surface tension and the distance between adjacent particles will be determined. When the moisture content reaches saturation, the fine aggregate shows no bulking. It's interesting to see that bulking goes up with moisture content until a point, but then it decreases in volume. Fine sand is more common, as evidenced by Figure 1, which shows that the latter is less common. However, the bulking of the coarse aggregate is so minimal that it is not taken into account. Produced fine aggregate, especially with ultra-fine sand, bulks up to about 40% [8,9]

Bulking gives fine aggregate an unrealistically high volume. This means that when figuring out concrete volume proportions, the bulking effect must be considered. Without considering the effect of volume bulking, the resulting concrete is likely to be coarse and unpleasantly sanded. Concrete production will be reduced for the same cement content. You can find out how much bulking has occurred with a simple field test. When using a measuring cylinder, a wet sample of fine aggregate is typically placed inside. For instance, take note of the sand's depth.

Percentage of bulking $=\frac{h1-h2}{h2}*100\%$

Adding wet sand to a watertight measuring box and then adding enough water to completely submerge it is another way to figure out the bulking factor. After that, figure out what percentage of the land has sunk due to subsidence. This depiction is more accurate of the process of bulking up. To find out how much bulking is needed, a quick field test could be done, with results used to figure out how much fine aggregate is needed to make up the difference in volume. Using this technique as a field control method is critical for producing high-quality concrete. It's not necessary to know the moisture content percentage when using controlled concrete because it doesn't use volume batching You can experiment with the amount of water by looking at the mixture and visually inspecting it. It is not necessary to determine and correct the free moisture content percentage when using weight batching to produce high-quality concrete [10].

2-1 bulking of loose, moist sand in the increase in its volume as compared to dry sand:

For concrete proportioning, clumping is a common occurrence in the aggregate trade. This phenomenon has been studied by Feret at the French School of Bridges and Roads since 1892 when he first discovered it. It is thought that moisture hulls or films, which surround the sand particles, are to blame for the bulking up phenomenon. Moisture surface tension forces adsorb contact moisture films to sand particles, causing the sand particles to take up more volume than they would in their dry state.

As sand particle size decreases, bulking of sand generally increases. This is because the sand's surface area has increased. Bulking diminishes as the moisture content in sand increases to the point where the bulking volume increases to its maximum. When the sand is inundated, the surface tension forces are removed, and bulking is reduced to its bare minimum. Consequently, the sand particles have changed their packing density and rearranged themselves

Water content rises, and then the volume of construction sand increases. This phenomenon is referred to as "bulking." When water or moisture is added to dry sand, the volume expands. The bulking process is explained by moisture hulls or films that surround sand particles. Saturated sand particles expand due to the surface tension forces caused by contact moisture films adhering to them, increasing their size relative to their dry state. As sand accumulates bulk, the volume expands while the particle size contracts. Water increases sand volume to inundation, where surface tension forces are neutralized and bulking is minimized by adding additional moisture or water. The result is compacted structures made of more densely packed sand particles. [9].

Table 1: Bulking of sand

Moisture Content % age	Bulking % age (by Volume)
2 %	15 %
3 %	20 %
4 %	25 %
5 %	30 %

3- Bulking Factor of sand

Fill a mixing pan with 6 liters of dry, compacted sand, weigh it, and then dump it in. Add a specific amount of water to the dry sand, based on the sand's weight. To get a uniform color, combine the ingredients quickly and thoroughly. Then, without tamping, add the wet sand to the container. Now, take a hammer to the top layer of sand and weigh it to get an idea of its weight.

Increase the amount of water in the experiment from 0% to 20% and try it again.

Let W1 represent the weight of one cubic meter.

W2=the weight of dry sand contained in one cubic meter of compacted sand. When it comes to damp, sloppy sand,

W3 is the weight of one cubic meter of wet loose sand, and x is the water addition rate.

W3=weight of dry sand + weight of water.

.: W3= W2+ (x /100)W2

.: W3= W2 (1+x/100)

.: W2= W3 / (1+x/100)

% of bulking= 100(W1 - W2)/ W2

Bulking Factor= W1/ W2 [12].

Discussion:

In this study, literature was reviewed, and a survey of a sample population was conducted. Facts and literature have led me to this conclusion: Because it is so scarce, construction sand is a critical building material that needs to be managed properly by everyone involved, from quarry operators to building contractors to the people running the washing plants. When sand is packed loosely, its bearing capacity is greatly reduced. Compacting sandy soils tend to have low densities due to bulking.

Bulking begins when the water content reaches a certain level. When the amount of moisture in a substance increases, it bulks up and loses density over time. Because bearing capacity is influenced by density, a reduction in density lowers bearing capacity.

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