



Grain Shape and Its Liquefaction Potential

Why in News?

Recently, the Scientists have studied and highlighted the **important effects of shape of Sand Grain on the liquefaction potential of granular soils.**

- Liquefaction of sand is **a phenomenon in which the strength and stiffness of soil is reduced (Decreases Cohesive Forces) by [earthquake](#) shaking** or other rapid loading and leads to the collapse of structures resting on the liquefied ground.

What are the Findings?

- There is a strong relation between the grain shape of sands and its liquefaction potential,
 - Liquefaction potential of sand is one of the major **factors behind the collapse of structures during earthquakes.**
- In the study conducted, the **glass beads, which have regular shape** with higher roundness and sphericity, **liquefied first**, while **river sand, whose roundness and sphericity fall between glass beads and manufactured sand, liquefied next**, followed by manufactured sand, **whose shape is relatively irregular.**
- As **natural sand with regular shape liquefies easily**, the natural sand used in structures like slopes and retaining walls **can be replaced with irregular manufactured sand to improve stability and sustainability.**

Why Irregular Grain Shape Improves Stability and Sustainability?

- **More Shear Force Required:**
 - This is because the shear force (unaligned forces pushing one part of a body in one specific direction and another part of the body in the opposite direction) required to break the inter-particle locking is **more for the grains with relatively irregular shapes.**
- **Interlocking of Particles:**
 - As the shape of the particles becomes irregular, they **get interlocked with each other during shearing.**
 - Interlocking provides **additional resistance to shear**, and hence the tendency to get separated from each other to float in the fluid becomes lesser for particles with irregular shapes.
- **Deviation in Fluid Path:**
 - Tortuosity or the **deviation in the fluid path increases with the irregular shape** of the particles.
 - **Greater tortuosity** decreases water flow through the pore network and **decreases the chance for water to separate** the particles, thus preventing collapse of structures/buildings.

What is Earthquake?

- An **earthquake** in simple words is **the shaking of the earth.** It is a **natural event.**
- It is caused **due to release of energy, which generates waves** that travel in all directions.
- The **vibrations called seismic waves** are generated from earthquakes that travel through the

Earth and are recorded on instruments called seismographs.

- The location below the earth's surface where the earthquake starts is called the hypocenter, and the location directly above it on the surface of the **earth is called the epicenter.**
- **Types of Earthquake:** Fault Zones, Tectonic Earthquakes, Volcanic Earthquake, Human Induced Earthquakes.

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims

Q. Which of the following is/are the possible consequence/s of heavy sand mining in riverbeds? (2018)

1. Decreased salinity in the river
2. Pollution of groundwater
3. Lowering of the water-table

Select the correct answer using the code given below.

- (a) 1 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

Ans: (b)

- Sand mining is the process of extracting sand from the river bed or from the coastal region.
- Excessive sand mining results in pollution of river water by lowering the pH value of water, mixing of various metal oxides, reduction of oxygen and thus, increasing the Biological Oxygen Demand (BOD). Polluted river water causes pollution of ground water. **Hence, 2 is correct.**
- Due to increased metal oxides and their mixing in river water, the salinity of the water increases. **Hence, 1 is not correct.**
- Volume of water flow in the river is decreased, thus it results in lowering of the water table. **Hence, 3 is correct. Therefore, option (b) is the correct answer.**

Source: PIB

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