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Study of the Effect of Bulk Density, Void Ratio, Water Content, Porosity, and Saturation Percentage on the Hydrological Cycle

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Abstract: *Groundwater hydrology is the science that treats the waters of the Earth, their occurrence, distribution, movement, and their chemical and physical properties, and their reaction with environment, including the relation to living things. Geo-hydrology has an identical connotation, and hydrogeology differs only by its greater emphasis on geology. Utilization of groundwater surface water dates from ancient times, although an understanding of the occurrence and movement of subsurface water as part of the hydrologic cycle is recent. Groundwater is commonly understood to mean water occupying all the voids within a geologic stratum. The occurrence of the groundwater necessitates a review of where and groundwater exists; subsurface distribution, in both vertical and areal extents, needs to be considered. The geologic zones important to groundwater must be identified, as well as their structure in terms of water- holding and water-yielding capabilities. If hydrologic conditions furnish water to the underground zone, the subsurface starta govern its distribution and movement.*

Keywords: *Physical properties, Saturation zone, Instauration zone, Porosity, particle size distribution.*

I. Introduction

1.1 Hydrological Cycle

A hydrologic system is defined as a structure or volume in space, Surrounded by boundary, that accepts water and other inputs, operates on them internally, and produces them as output. The structure (for surface or subsurface flow) or volume in space (for atmospheric flow) is the totality of the flow of the paths through with water may pass as through put from the point it enters the system to the point it leaves. The boundary is a continuous surface in three dimensions enclosing the volume or structure. A working medium enters the system as input, interests with the surface and other media and leave as output. Physical, chemical, biological processes operate on the working media within the system; the most common working media in hydrologic analysis are water air and heat energy.

Table: Proximate analysis of Chemical compositions of bauxite (wt%).

	Al_2O_3	SiO_2	Fe_2O_3	CaO	MnO_2	TiO_2	P_2O_5	LOI
Bauxite	58.0	3.0	2.0	2.0	0.1	4.0	0.3	32.0

1. Objective

- To study the bauxite ore compressive strength and average particle size distribution.
- To study the effect of different parameters (Bulk Density, Void Ratio, Water Content, Porosity, and Saturation Percentage) on the Hydrologic cycle.

2. Aim

The aim is to know the compressive strength of bauxite ore and its effect on the particle size distribution that can be used to improve Groundwater in the Hydrologic Cycle.

3. Experimental Setup For Hydrology Cycle

Figure: Component of Hydrologic Cycle in an one side open system.

4.1 Hydrologic Budget

A hydrologic budget, water budget or water balance is a measurement of continuity of the flow of water, which hold true for any time interval and apply to any size area ranging from local scale areas to regional scale areas or from any drainages area to the glass as a whole. The hydrologist usually most consider an open system for which the quantification of the hydrologic cycle for that system became a mass balance equation in which the change of storage of water (ds/dt) with respect to time within that the system is equal to the inputs (I) to the system minus the output (O) from the system. Considering the open system in the fig4.1., the water balance equation can be expressed for the surface water system and the ground water system in unit of volume per unit time separately, Or for a given time period and area, in depth.

Surface Water System Hydrologic Budget

$$P + Q_{in} - Q_{out} + Q_g - E_s - T_s - I = \Delta S_s$$

Where p is the precipitation, Q_{in} is the surface water flow into the system, Q_{out} is the surface water flow out the system , Q_g is the ground water flow into the system, E_s is the surface evaporation, T_s is the transpiration , I is the infiltration, ΔS_s is the water storage of the surface water system

Ground Watr System Hydrologic Budget

$$I + G_{in} - G_{out} + Q_g - E_g - T_g = \Delta S_g$$

Where, G_{in} is the ground water flow into the system, G_{out} is the ground water flow out of the system and ΔS_g is the change in ground water storage. The evaporation, E_g, and the transpiration , T_g, can be significant water if the water table is near the ground surface.

System Hydologic Budget

The system hydrologic budget is the developed by adding the above to budget together:

$$p + (G_{out} - G_{in}) - (E_s - E_g) - (T_s - T_g) - p + (G_{out} - G_{in}) = \Delta(S_s + S_g)$$

Using net mass exchanges, the above system hydrologic budget can be expressed as

$$P-Q-G-E-T=\Delta S$$

The global hydrological cycle can be represented as a system contains three subsystems: the atmospheric water system, the surface water and the sub surface water system shown in the fig. Another example is the strong – rainfall runoff process on a watershed, which can be represented as a hydrologic system the input is rain fall distributed in time and space over the watershed and the output is extreme flow at the watershed outlet. The boundary is define by the water shed and divide and extends vertically upward and downward to horizontal planes.

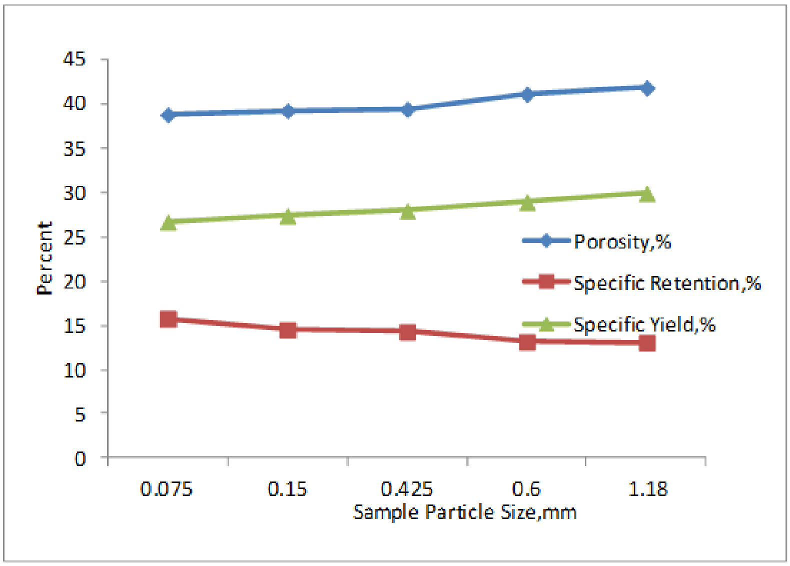
Drainages basins, catchments, watershed are three synonymous terms that refer to topography area that collects the discharge surface extreme flow through one outlet or mouth. Catchments are typically referred to as small drainages basin but no specific area limits have been stabilized.

II. Results

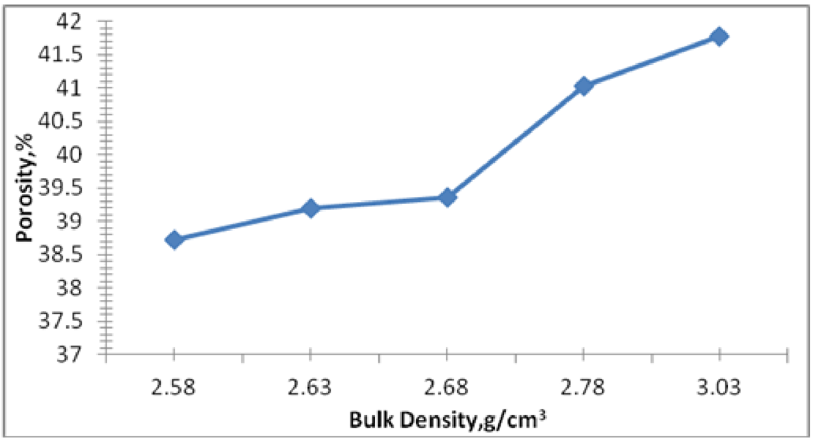
In this experiment it is found that the bauxite ore average particle size distribution is mostly dependent on the strength. The relationship between the particle size of the grinded powder and compressive strength of bauxite ore. The strength increases with increasing particle size of the grinded powders. The increase of strength may come from three hands. The first is the decreasing porosity. The second is the well distribution of pore size. The last and most important is the all properties of grinding powder of bauxite ore is also play important role in the hydrologic cycle in an open system.

Table: Experimental Data of hydrology cycle.

Bauxite Material (mm)	Bulk Density (g/cm^3)	Void ratio	Porosity (%)	Saturation,%	Specific Retention %	Specific yield %
0.075	2.58	0.548	38.73	26.67	15.73	23.25
0.15	2.63	0.675	39.20	27.35	14.47	24.73
0.425	2.68	0.775	39.36	27.89	14.25	25.11
0.6	2.78	0.896	41.04	28.89	13.12	27.92
1.18	3.03	1.03	41.77	29.87	13.03	28.47



Graph: Percent Porosity, Specific Retention and Specific Yield V/S Sample particle Size.



Graph: porosity V/S Bulk Density.

III. Conclusion

This work is briefly discuss to the components of hydrologic budgets are measured, calculated and estimated. The net groundwater flow (groundwater inflow minus leakage) is determine by the water balance approach utilizing measurements of precipitation is determine using the energy budget methods, and setup volume changes were estimated from setup-stage and setup volume. The analysis is utilized to make qualitative assessments of the significance of setup-groundwater exchanges during the study periods. A groundwater model is used to determine the groundwater inflows and seepage from the setup. The analysis made it possible to develop quantitative estimates of minimum groundwater inflow and leakage rates.

The hydrologic budget for setup is expressed as

$$\Delta S = P + Q_{in} - Q_{out}$$

The hydrologic budget by Grubbs showed that the groundwater inflow to the setup and leakage from the setup to the groundwater system is the dominant components, respectively, in total inflow (precipitation plus groundwater inflow) and total outflow (leakage) begets of the setup.

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