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Partial Replacement of Cement by Baryte

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Abstract: The use of high volume baryte concrete fits in very well with sustainable development. High performance concrete is being widely used all over the world. High volume baryte concrete mixtures contain lower quantities of cement and higher volume of baryte (up to 40%). The use of baryte concrete at proportions ranging from 0 to 40% of total cementations binder has been studied extensively over the last twenty years and the properties of blended concrete are well documented.
The replacement of baryte as a cement component in concrete depends upon the design strength, water demand and relative cost of ash compared to cement. The specific gravity and chemical properties of baryte cement, coarse and fine aggregate were determined. Cubes and the cylinder cubes werecured for 7 and 28 days respectively. The cubes and cylinder cubes were subjected to compressive strength tests after densitydetermination at 7 and 28 days respectively. The slump of different baryte percentage are compared
Keywords: Baryte, Cement, High performance concrete, Course aggregate, Fine aggregate.

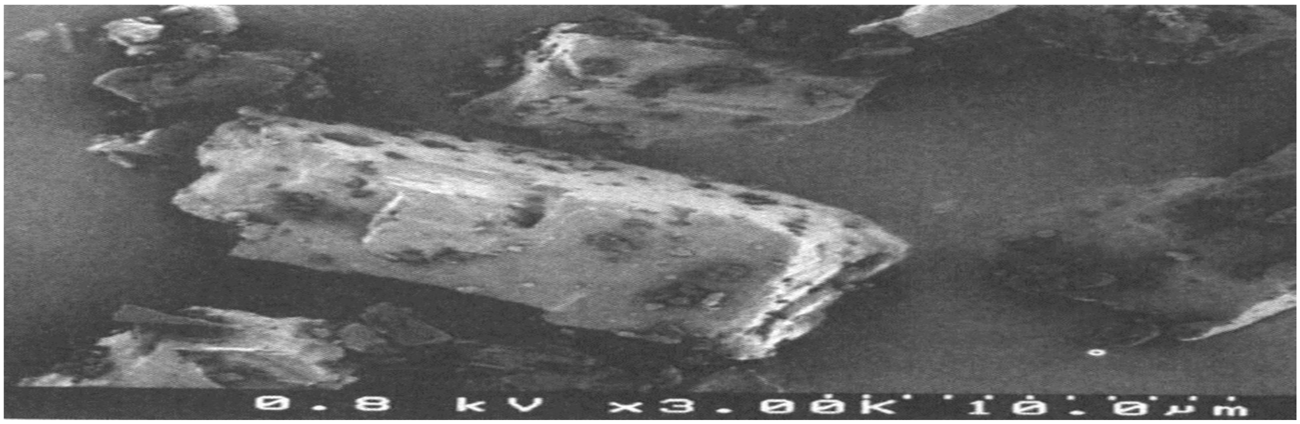
I. INTRODUCTION

Barite is the mineralogical name for barium sulfate ($BaSO_4$), a high density mineral used primarily as weighting agent for drilling fluids. While it is used for other purposes, drilling fluids account for over 80% of the total worldwide barite ore production and consumption. It is particularly well suited as a weighting agent for drilling fluids due to its low solubility, low hardness (Mohs hardness of 3-3.5) which prevents abrasion and erosion of drilling equipment and relatively high density which is sufficient to formulate drilling fluids to the weights required to control the range of subsurface pressures normally encountered in oil and gas drilling.
Barite occurs in numerous locations around the world with commercial mines in various locations. The purity of the raw material and the contaminating minerals vary with the source and the quality tends to degrade with time as the main deposit ismined. Pure barium sulfate has a specific gravity of 4.50, drilling-grade barites have historically been >4.2.
Contaminants in barite ore and drilling-grade barite include quartz, carbonate minerals (calcite and siderite), sulfide and sulfate minerals (pyrrhotite, gypsum, anhydrite, and Celestine), hematite and other trace minerals. Heavy metals such as mercury, cadmium, and lead are present in some barite ores and may make a particular ore undesirable due to regulatory discharge limits on these elements in some countries. Quartz and calcium carbonate are the primary contaminants that cause barite ore to have a low specific gravity. The specifications for ground baryte used in drilling fluids began with the first use of paint pigment grade barite to kill a well were near Opelousas, Louisiana in 1924.
The pigment grade barite was manufactured by the Dutch Boy Paint and Pigment Division of the National Lead Company. Pigment grade barite sold as a lower cost material as an alternative to white lead in paints. The specifications for pigment grade barite at the time were 94 % minimum content ofbarite with a specific gravity of 4.2 – 4.3. This specification and test procedures were adopted as an ASTM specification in 1941.1By 1926, the Baroid Division of the National Lead Company was formed and began selling barite specially ground for the drilling fluid market, trade named Baroid®, out of Los Angeles with a specific gravity 4.25. The name Baroid® was widely used instead of the name barite for many years regardless of which drilling fluid company brand name was on the sack and is still used as a common name for barite in some places today.1American Petroleum Institute (API) specifications
For barite was first published in 1950. Appendix A of the API Recommended Practice RP29 Manual of Procedure for Laboratory Evaluation of Drilling Mud Materials had three specifications. It is suspected that these three specifications were due to regional practices and suppliers. Spec 1 required a purity of 94% minimum barium sulfate, a specific gravity between 4.0 and 4.25, however, for every 0.1 SG less than4.25, the cost of goods was reduced 5% over that of the 4.25 material. Spec 2 required a SG of 4.25 SG and that the product is free of abrasive material, particularly sand. Spec 3 required only that the product be a minimum of 95 % barium sulfate, with a SG above 4.25 and calcium carbonate below 0.1 %.Spec 3 was theonly specification that did not also have a drilling fluid performance test.2The required durability characteristics are governed by the application of concrete and by conditions expected to be encountered at the time of placement. These characteristics should be listed in the job specifications

Portland cement → Gypsum+Portland cement Clinker(pulverizing)
Portland cement Clinker → Calcareous & Clayey Materials (burning) Paste → Portland Cement + WaterMortar → Portland Cement. + Water + Sand
Concrete → Portland cement. + Water + Sand + Gravel

A. Barium Sulfate

Natural barium sulfate, known as barite, is a high brightness, high specific gravity, low oil absorption inert filler. It finds use in powder coatings because of its high specific gravity, good brightness and low oil absorption. Synthetic barium sulfate, known as blanc fixe, is used for photographic paper coatings and in industrial and automotive primers.



Natural Barite

B. Objective

Main objective is to make baryte as a familiar construction material. Replacement of cement by using barite will increase the strength of concrete. Different ratios are adopted & design methods are implemented and compared to standard values. Control concrete mix will be designed having a compressive strength of 40 to 50 Mpa, Slump between 100 – 120 mm and thecement content is 350 kg/m^3

C. Mix Design Criteria

To perform a concrete mix design several criteria (i.e inputs) areneeded together with the properties of the used material the criteria needed include:

- Required strength
- Required slump
- Minimum cement content

Properties of available or used materials are studied

D. Design Stipulations for Proportioning

- Grade designation : M20
- Type of cement : PPC cement, IS 8112
- Max. Nominal size of aggregate. : 20 mm
- Minimum cement content : 320 kg/m3
- Maximum water cement ratio : 0.47
- Workability : 75 mm (slump)
- Exposure condition : Mild
- Degree of supervision: Good
- Type of aggregate. : Crushed angular aggregate
- Maximum cement content : 450 kg/m3
- Chemical admixture: Not used

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II. TEST DATA FOR MATERIALS

A. Specific Gravity

1) Cement used: PPC cement

- Specific gravity of cement: 3.15

2) Specific Gravity of Aggregate

- Coarse aggregate: 2.68
- Fine aggregate: 2.65

3) Water Absorption

- Coarse aggregate: 0.6 percent
- Fine aggregate: 1.0 %

III. EXPERIMENT AND TESTING

A. Slump Test Value

- For 20% of baryte - 10mm
- For 25% of baryte - 25 mm
- For 30% of baryte - 40 mm
- For 35% of baryte - 48 mm
- For 40% of baryte - 55 mm

IV. RESULT AND CONCLUSION

Lab Strategy

S.NO	CUBE.SIZE(CM)	Replacement of cement (%)	Compression Stress (N/mm^2)	
			7 Days(Curing)	28 Days(Curing)
1	15X15X15	100% Cement	13.3	20.1
2	15X15X15	80% Cement, 20%Baryte	28.4	31.3
3	15X15X15	75% Cement, 25%Baryte	31.4	31.8
4	15X15X15	70% Cement, 30%Baryte	36.4	36.9
5	15X15X15	65% Cement, 35%Baryte	23.4	28.6
6	15X15X15	60% Cement, 40%Baryte	19.4	25.1

V. CONCLUSIONS

It was observed that the compressive strength of the mixedconcrete cubes has more strength than the concrete cubes up to certain ratio then it get reduced.

Compressive strength of concrete of 0% of baryte mixed concrete is 13.3N/mm^2 (7 days curing) Were as for 20% 25%, 30 % it was 28.6N/mm^2, 31.4N/mm^2 and 36.4 respectively. But in case of 35% and 40 % compressive strength values were 23.4N/mm^2 and 19.4N/mm^2 respectively (comparatively less).

Compressive strength of concrete of 0% is 20.1N/mm^2 (28days curing) Were as for 20% 25% 30 % it was 31.3/mm^2, 31.8N/mm^2 and 35.4 respectively. And in case of 35% and 40% compressive strength values were 28.6N/mm^2 and 25.1N/mm^2 respectively (comparatively less).

From the above observations it is clear that values are increasing up to some ratio limit then it get decreased. And also itis noted that the compressive strength of 28 days curing value can be achieved by adopting just 20% baryte of 7 days curing.

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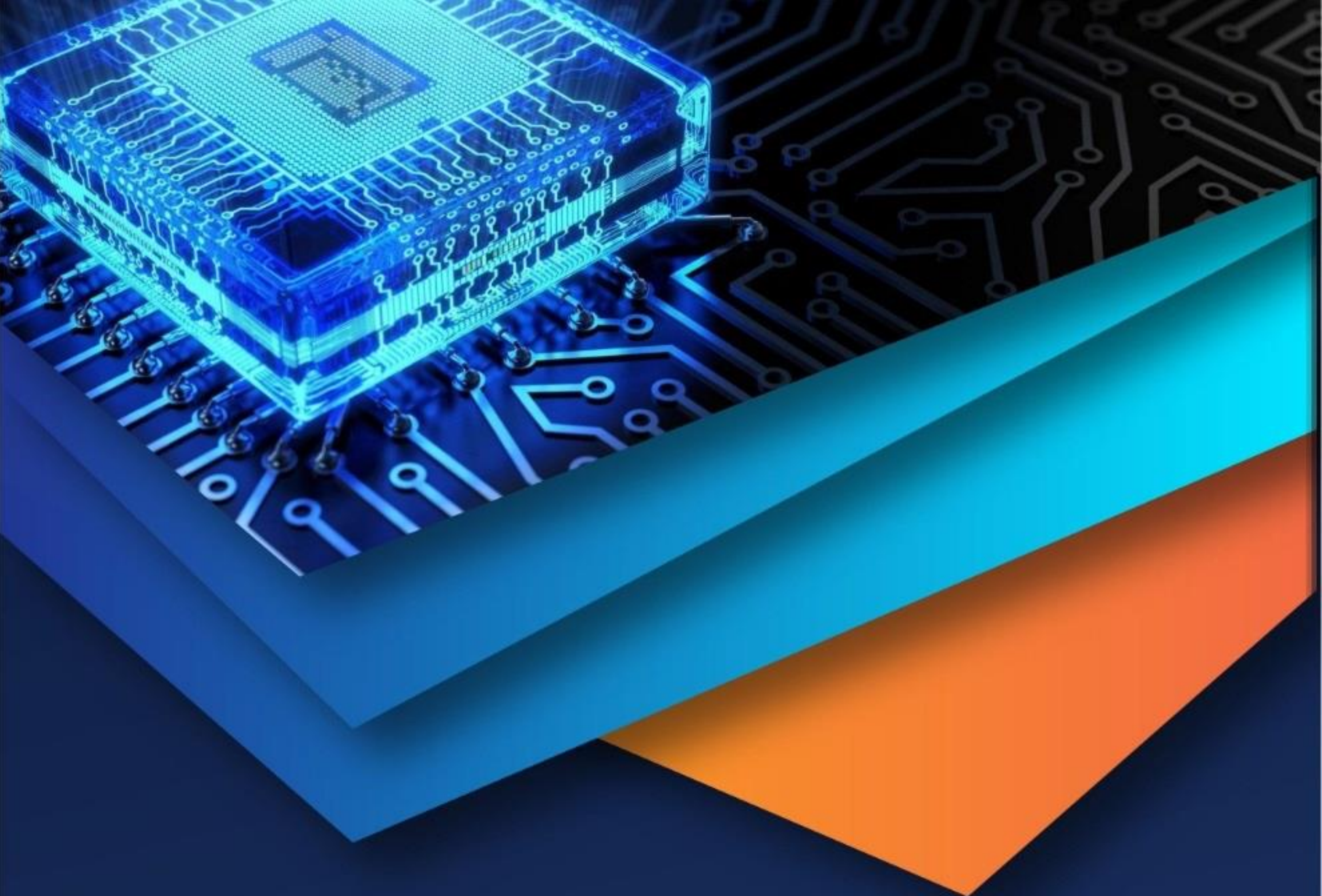

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