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Development and Use of Eco Plaster

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Abstract - *Eco Plaster is made up from the Gypsum, Cow Dung Ash and Gaur Gum powder and river bed clay in a specific proportion in order to maintain the temperature of the building and protect it from the harmful radiations. In this plaster gypsum and cow dung ash are the key elements whereas the Gaur gum powder is the binding agent. Today the cement and sand are getting extinguished which is the main element in the conventional plaster. Gypsum is easily available and is comparatively economical. The Cow dung ash is scientifically proven to be very effective and has medical benefits. It is also considered to be holy and is easily available. These ingredients are used in preparing the Eco plaster. Due to global warming the temperature on the earth's crust is increasing day by day. It is to days need to maintain the temperature of the building and it is not economically as well as environ mentally good to use the air conditioners everywhere all the time. Hence application or use of this e co plaster will be more effective in maintaining the temperature of the building. This plaster can be applied on the walls as well as on the ground and can be painted or deco rated as the other conventional plasters in order to have the elegance of the building.*

***Key Words*:** Plaster, Cement, Gypsum, Clay

1. INTRODUCTION

Plaster is a building material used for the protective or decorative coating of walls and ceilings and for molding and casting decorative elements. It usually refers to a material used for the interior of a building, but it is also commonly used for exterior applications. We also know that humans can live comfortably in temperatures of 20-25°C, but in India, especially in the north, we have 8+ months of summer and the remaining 4 months of winter. But unfortunately, all our building materials now like steel, cement, stone powder and pucca bricks are good conductors of heat, causing our buildings to absorb heat in summer and release it at night, which is when we sleep, and vice versa in winter The same is true. Our buildings become heated rooms in summer and icy caves in winter. Currently, we do not use any insulation in our buildings. In order to fill this gap and correct this error, we are introducing modern building materials and technology of eco plaster which is a gypsum-based Cow dung plaster with some minor additives. We all know that gypsum and cow dung are cheaper and the best insulating material and humans have been using it in houses at no time. Gypsum has been used in pyramids and ancient churches for thousands of years. We use cow dung as compost and as fuel in the kitchen. The radiation shielding feature makes it even more beneficial to users by protecting them from harmful rays. The basic requirements for applying plaster to a wall are minimal, without overusing water as in the other case. The cost-effectiveness of dung gypsum, which is much cheaper than cement gypsum, is the reason for its success. Looking at global issues such as global warming, food security concerns, unemployment, population, the only option left is to seek sustainable natural resources. Research [1] reports the use of cow dung ash (CDA), alumina and lime as a complete replacement for cement in concrete. Usually Cow Dung Ash (CDA) requires more moisture. So only 10% to 20% were replaced. Alumina should reduce the setting time of concrete. So it contributes 30%. Lime powder contributes 50% to replace cement. [2] Investigated the effect of chemical composition and structure of guar gum derivatives on the water retention capacity (WR) and rheological behavior of fresh state cement-based mortar. The study was also done by adsorption isotherms. For this purpose, virgin guar gum, three hydroxypropyl guar gums (HPGs) and two hydro-phobically modified HPGs were selected. The work [3] presents the result on the study for the use of Cow Dung Ash (CDA) as partial replacement in production of concrete. The purpose of this experiment was to investigate the effect of adding different weight percentages (10%, 20% and 30%) of cement with cow dung ash (CDA) and curing for 7, 14, 21 and 28 days. Test for compressive strength.

1.1 TYPE OF PLASTER

1.1.1 CONVENTIONAL PLASTER

a) Cement:-

Cement is a binder, a substance used in construction that sets, hardens, and adheres to other materials to bind them together. Cement is rarely used alone, but binds sand and aggregate together. Cement is mixed with fine aggregate to make masonry mortar, or with sand and gravel to make concrete. Cement is the most widely used material in existence, second only to water as the earth's most consumed resource.

Figure 1: Cement

b) Sand:-

Sand is a granular material composed of finely divided rock and mineral particles. It is defined by size, being finer than gravel and coarser than silt. Sand from rivers is collected from the river itself or its floodplain and makes up the majority of sand used in the construction industry.

Figure 2: Sand

1.1.2 READY MIX PLASTER

It is a ready-mixed cement plaster containing high-quality polymer additives, well-graded sand, and fillers for manual plastering applications. Can be used for interior and exterior wall plastering. It can be used for interior and exterior wall plastering.

Figure 3: Ready Mix Plaster

1.2 BENEFITS

It is a smooth plaster that does not need frequent watering/ saturation. It is a time saving and least rebound, light colored plaster. It gives walls with even quality. Normally at some places, sand contains silt or mud which obstructs plastering and the plaster quality is also affected. Since Ready plaster doesn't have sand or silt, the quality of plaster is not affected.

2. OBJECTIVES

- **To prepare a plaster with less conventional material.**

In conventional plaster, we use cement and sand as the base ingredients availability of sand is lass. Now a day the other alternatives use is crushed sand which is powder stone. But as there is lack of available sand, here in Eco-plaster, sand is avoided. Hence it is tried to minimize the use of this natural resources. For this cow dung as his replacement of cement which is easily available. The use of cow dung ash is done which is one of the waste material. Along with guar gum powder, chickan clay and gypsum is used. This all content which is used in Eco-plaster is easily available.

- **To find a replacement to conventional plaster with more benefits**

Now a day the temperature is increase globally and the concrete structures are cold in winter and hot in summer and hence it is tried to avoid in Eco-plaster. Eco-plaster acts as a coating material too. Hence here we can avoid coating to the wall. Eco-plaster gives smooth surface to the wall. Many harmful radiations like UV rays are trying to reach up to earth surface and cause dangerous diseases. Hence by using cow dung ash, the plaster is tried to make a coat that act as an anti-radiation material

- **To prepare more environment friendly plaster**

The convention plaster contains cement. The process of manufacturing cement produces large amount. And it produces large amount of carbon dioxide which called thermal pollution. There is scarcity of water in many areas where curing is difficult and the water used for curing is cannot reused. But the Eco-plaster does not need the curing that will save water. Hence the Eco-plaster is Ecofriendly plaster

3. ECO–PLASTER

As we are all aware of current environmental issues and problem raised with them, the entire human race is supposed to put efforts and ideas in order to overcome these life threatening issues. As Civil Engineer field being India's biggest work sector it is our responsibility to lead the process. As construction industry is a major natural resource consuming industry it has its greater impact on environment. This impact depends directly upon materials consumed so if we reduce the use or consumption of natural resources it will help to reduce these environmental problems. Also the global warming is one of the major concern nowadays, it require more energy in order keep the surrounding cool. Due to this problem the numbers of user of air conditioner have considerably increased. These not only increase demand of energy but also they are quite expensive to have and operate. So it is need of today to find materials which will effective in both environmental aspect and in case of cost also. Plastering is one of the major construction activities also it consumes great amount of natural resources. Conventional Plaster is mainly made of sand cement. Sand is now available in artificial form called as crushed sand but still it is made by crushing stones in crushers which are generally obtain by mining

which is another reason of environmental loss. And as we all know the cement production industry is major cause of thermal pollution. And the conventional plaster requires quarrying which means use of amount of water until the plaster is set. This all things make the conventional plaster less environmental friendly. Considering all these problems we have come up with an idea of Eco Plaster which can be best replacement for all types of plaster available nowadays. The plaster mainly highlights the problem of natural material consumption, thermal insulation, and cost. The plaster uses abundantly available natural resources and some byproducts which generally thrown as waste. Also the plaster requires no curing, it uses very little amount of water as compare to conventional plaster. Due to materials used in plaster these plaster do not require any kind of surface dressing before painting. This reduces the consumption money and materials. The plaster is already mixed at proportion so there is no need of any other material while applying. After adding definite amount water it can directly be applied on walls and other surfaces also. It do not requires skilled mason, this save the time required for construction leading to more effective completion of any project.

3.1 GUAR GUM POWDER

Guar gum, also known as guar, is a galactomannan polysaccharide derived from guar beans with thickening and stabilizing properties that can be used in food, feed, and industrial applications. Guar seeds are mechanically de-husked, hydrated, ground and screened according to application. It is usually produced as a free-flowing off-white powder.

Figure 4: Guar Gum Powder

3.2 COW DUNG ASH

Cow dung native to India is used to produce ash. The milk yield of this breed is the highest among all breeds in India. It has been widely used to make hybrids in other countries such as India and Brazil. Ancient scriptures state that the "suryaketu" nerves on the cow's back absorb harmful radiation and purify the atmosphere. The existence of cows is a huge contribution to the environment. India has about 300 million head of cattle. Using their manure to produce biogas, we save 600,000 tons of firewood every year. This will prevent deforestation to some extent. Using cow dung to make African deserts fertile. We can reduce the acid content in water by treating it with cow dung. Hence we can say that cow dung has an important role in preserving the environment.

Figure 5: Cow Dung Ash

3.3 GYPSUM

Gypsum is a rock-like mineral commonly found in the Earth's crust that has been extracted, processed and used d since 9000 BC, humans have built or decorated in the form of plaster and alabaster. Plaster was found in underground wall paintings of Catal-Huyuk in Asia, while in Israel, the discovery of gypsum floors began in 7000 BC. In the time of the pharaohs, gypsum was used as mortar Construction of the Pyramid of Khufu (3000 BC). During the Middle Ages and the Renaissance, Decorations and artistic creations are made of plaster. Since then, the range of construction-related uses has continued to expand.

Figure 6: Gypsum

3.4 CLAY

Clay, the main component of loam, is one of the oldest building materials on earth, along with other ancient natural geological materials such as stone and organic materials such as wood.

Clay is a fine-grained natural rock or soil material that combines one or more clay minerals with possibly trace amounts of quartz (SiO_2), metal oxides (Al_2O_3, MgO, etc.) and organic matter. Clays are migrated from their original location by water erosion and deposited in new sedimentary deposits. One-half to two-thirds of the world's population, whether in traditional societies or developed countries, still live or work in buildings made of clay, often baked into bricks as their The load-bearing important part of the structure. It is also a major component of many building techniques

Figure 7: Clay

4. MODELLING AND CALCULATIONS

4.1 ECO PLASTER CALCULTIONS

Eco-plaster contains:
Gypsum plaster 75%, Cow dung ash 10%, Guar gum powder 4%, Chikan Clay 11%, Volume = 0.5 x 0.5 x 0.012 = 0.003 cu.m. Wet volume = 0.003cu.m. Adding 30% to fill the joints. Volume = 1.3 x 0.003 Volume = 0.0039cu.m. Increase 50% for dry volume = 0.0039 x 1.5 =0.00585 cu.m. (Dry volume).
The total material required is 3.5kg.

4.2 ECO PLASTER PREPARATION

The plaster is a mix of various ingredients mixed at various proportions by weight. Based on the different properties of the raw material the proportion of raw materials varied. The plaster contains following materials

- Gypsum
- Gaur Gum powder
- Cow Dung Ash
- Clay

The plaster is gypsum based plaster so the major percentage in plaster is of gypsum. The gaur gum powder added gives the adhesive properties to plaster and also it partially make the plaster slightly water repellant. The cow dung is proved to be a better heat insulator also it imparts color to the pl aster. Hence the use of cow dung ash in the plaster makes the plaster a heat insulating material. The clay added is as partially filler material and also it tends to offer some strength to the plaster. The cow dung ash tends to make plaster a brittle material as it swells after adding water so in order to re duce the percentage of cow dung ash the clay is introduced in the plaster. The plaster was made firstly for a single proportion then after results obtained from this plaster the proportion of materials were varies. The observations were made on site, by checking workability, reaction to water, and its physical appearance. Based on these observations the effect of proportion of materials was analyzed. And after these analyses the proportion of materials were varied. The proportion was varied until the best desired results were not obtained till that proportion was varied. The slight change in proportion of material has its influence on result so all the prepared samples were applied over a surface and all of them were tested. The results were compared with conventional plaster, Ready plaster & Vedic plaster. The comparison was in terms of strength and other engineering properties. The method used for mixing of materials is weight batching**.**

Mixing of material to prepare Eco Plaster

Figure 8: Mixing of materials

4.3 VARIOUS PROPORTION OF ECO PLASTER

Table -1: Sample Table format

Sr. No.	Gypsum (%)	Gaur Gum Powder (%)	Cow Dung (%)	Ash Clay (%)
1	75	5	10	10
2	65	10	10	15
3	60	2	15	23
4	75	5	15	10
5	70	7.5	12.5	10
6	70	2	5	23
7	80	2	5	13
8	75	4	10	11

4.3 APPLICATION OF THE SAMPLE PLASTERS OVER SURFACE

Figure 9: Eco Plaster Application

5. RESULT AND DISCUSSION

5.1 STRENGTH OF ECO PLASTER

Determine the compression strength using nondestructive method:

When testing, a smooth, clean, dry surface should be selected. If there is loosely adhering scale, it should be removed with an abrasive wheel or stone. Rough surfaces caused by incomplete compaction, grout runoff, flaking or machined surfaces will not produce reliable results and should be avoided. The point of impact should be at least 20mm from any edge or shape discontinuity. When taking measurements, the hammer should be at right angles to the surface of the concrete member. Therefore, the test can be performed horizontally on a vertical surface, or vertically up or down on a horizontal surface. The rebound hammer can also be held at an intermediate angle if the situation requires it, but the number of rebounds for the same concrete will vary in each case. The rebound hammer test is performed around all observation points on all accessible surfaces of the structural element. Before taking any measurements, thoroughly clean the concrete surface. Around each point of observation, six readings of rebound indices are taken and average of these readings after deleting outliers as per IS: 8900-1978 becomes the rebound index for the point of observation.

Figure 10: Tool Used

Table -2: Strength Result

Sr. No.	Strength at 7th day	Strength at 14th day	Strength at 21th day
1	0	0	0
2	0	0	0
3	3	3	6
4	0	2	2
5	2	2	2
6	3	6	7
7	5	6	7
8	7	10	12

5.2 RATE ANALYSIS

Table -3: Rate analysis

S. No.	Content Rate (Per Kg)	Rate (Per Kg)	Proportion	Quantity (For 1kg)	Cost
1	Gypsum Powder	20/-	75%	0.75	15
2	Guar Gum Powder	100/-	4%	0.04	4
3	Cow Dung Ash	20/-	10%	0.10	2
4	Chikan Clay	20/-	11%	0.11	2.2

6. CONCLUSIONS

The comparative study between Eco plaster and other plaster based on different properties, has concluded that the eco plaster is the best replacement for conventional plaster. Due to use of its component elements the eco plaster dominates other plaster currently available in market. The first purpose to prepare this plaster was to reduce the impact of any civil project over environment, and by the results obtained the plaster has served the purpose. As a replacement to sand (riverbed sand) in conventional plaster currently artificial sand is also available in market but it is also obtained by crushing stones, which are gained by mining. And on other hand cement is still used for preparation of this plaster. And we all know that the production process of cement is major factor for the thermal pollution, which leads to problem of global warming. So in no manner it is replacement to conventional plaster. The plaster is gypsum based plaster; hence it requires no caring after application on the surfaces. Whereas the conventional plaster requires curing, though it is less than concrete but still it requires curing. Taking in consideration the area to be cared, the amount of water required is very great and method used for caring in India produce great amount of waste water which is completely zero in the case of eco plaster. Also due use of gypsum the plaster do not require any surface dressing like wall putting before paint, the paint can be directly applied over the plaster, which can be a great factor in case of low cost housing project. The gaur gum powder used, is act as cementing material in plaster. It bonds all components together. Also it offers partially water repellent property to plaster. Also it stops the washing-out of gypsum by water when exposed to any water. The gaur gum enhances the overall bonding strength plaster. The C.D.A. has the property of heat insulation. Hence, it is used in plaster to make it heat insulator. Because this property, the plaster stop the heat exchange between atmosphere and building from being heat chamber in summer and from being an ice box in winter. It maintains its inside temperature and heat exchange is paused by the plaster. Also the C.D.A. partially offers a color to plaster. The clay used is, for balancing the definite proportion of materials, it helps not to exceed the definite amount of constituent materials. Also it partially offers some strength to plaster. The overuse of any material hampers the properties of plaster. All materials have criteria for their use in plaster so to

overcome this criterion clay is used. Due to less use of natural resources and use of certain material that are abundantly present either naturally or as waste material makes the plaster more environmental friendly. The plaster requires no caring and also surface dressing is not required before paint job, it helps to reduce cost of the project. Also due to very less use of water it helps to reduce environmental discharge of water. Due to the heat insulating properties there is no need of insulation of any air conditioning apparatus in building, which lower the use of electricity helping in reducing the carbon footprint of building. Keeping environmental aspect and future need and scope in mind the eco plaster may prove best overall other plaster.

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