International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 06 | June-2016 www.irjet.net p-ISSN: 2395-0072

# Comparison of Water analysis between AAC blocks-Gypsum plaster & Burnt red clay bricks-Sand cement plaster

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**Abstract-** *Due to growing interest in sustainable development engineers and architects are motivated more than ever before to choose materials that are more sustainable. Brick masonry and sand-cement plaster consume tremendous volume of water both in production and curing. Carbon dioxide emissions in brick manufacturing process had been significant factor to global warming. As Maharashtra facing a severe drought there is shortage of water for construction activities. So there is need to replace this material with AAC blocks and gypsum plaster. This paper gives comparison between water uses in both cases and also gives the quantity of water we can save.*

***Key Words-*** bricks, construction, curing, plaster, sustainable, water.

## 1. INTRODUCTION

Bricks are one of the most important building materials in the India. In recent years, with expanding urbanization and increasing demand for construction materials, brick kilns have grown to meet the demand. It has directly or indirectly caused a series of environmental and health problems. At a global level, environmental pollution from brick-making operations contributes to the phenomena of global warming and climate change. Also, extreme weather may cause degradation of the brick surface due to frost damage. Global warming and Environmental pollution is now a global concern. Various types of blocks can be used as an alternative to the red bricks, to reduce Environmental pollution and Global warming. AAC blocks may be one of the solutions for brick replacement. Similar to foam concrete, Autoclaved Aerated Concrete (AAC) is one of the certified green building materials, which can be used for commercial, industrial and residential construction. It is porous, non-toxic, reusable, renewable and recyclable.

AAC was developed in 1924 by a Swedish architect, who was looking for an alternate building material with properties similar to that of wood having good thermal insulation, solid structure and easy to work with, but without the disadvantage of combustibility, decay and termite damage. As AAC Block uses fly ash, sand as main raw material, cement, lime as accessory materials, aluminum powder as forming agent, it refers to foaming through chemical reaction. It is one kind of new type green warm preservation wall material formed through raw materials grinding, batching and mixing, pouring and foaming, quiet stop and cutting, autoclave curing processes. It has lightweight, high strength, good durability, heat preservation, sound insulation, fire proofing, impervious, good anchoring properties.

Significant research studies have been conducted on the development of new construction materials using different kinds of material. However, the application of these construction materials in real construction is limited. Therefore more research is needed to study the actual behavior or performance of new construction materials under field conditions to encourage their practical applications. Many research studies had been conducted utilizing various new construction materials. Most of these research works focused on the physical and mechanical properties of construction products. Some of those studies attempted to investigate the durability performance of several construction materials including AAC block like material.

In recent years, the construction sector has witnessed a number of new trends, technology advancements and innovations across applications, all aimed at making construction faster and delivering higher performance. However, very few would have imagined that the substitute for the generations old method of sand cement surface plastering will be an even older method of plastering i.e. gypsum plastering. Gypsum has proved to be a miraculous material aiding interior construction. Gypsum surface plaster is one form that has caught the attention on the sector and is growing in popularity. The oldest example of usage of gypsum as an internal plaster is found in the Pyramids of Giza in Egypt which were lined with gypsum stucco plaster centuries ago and are still intact, which is proof of the durability & performance of this product.

Gypsum is a light weight material which is formed as the result of evaporating sea water in massive prehistoric basins. In terms of its chemical composition, it is Calcium Sulphate Di-hydrate (CaSO4.2H2O) and inherently contains 21% water by molecular weight. Gypsum products have been used for centuries in the construction space and are the material of choice because of gypsum's unique properties. It has excellent insulation properties both thermal and acoustic

and can offer very good passive fire protection, moisture resistance, impact resistance and vapour control when used in combination with the right systems.

When a wall is constructed with brick or block, they are finished with a coat of plaster which is called internal plastering. Internal plastering has traditionally been done through a process of sand-cement plastering finished with POP pruning. This is a two stage process and involves multiple elements like sand, cement and water which is mixed onsite. This form of plastering is being slowly replaced by a direct single coat application of gypsum plaster. So gypsum plaster is actually a replacement of two processes i.e. sand cement plastering & POP punning. Gypsum plaster is produced as a result of calcinations of the raw gypsum in an automatic kettle under controlled temperature.

## 2. ANALYSIS & FIELD WORK

### 2.1 Autoclaved Aerated Concrete (AAC) blocks

First advantage is the blocks are very uniform in shape and are normally equal to six to ten numbers of normal modular brick of 4x4x8 inches. This translated into uniformity in brickwork, in both inside and outside faces of wall. Plus the added advantage of fast masonry. One can achieve up to five times fast progress with these blocks in comparison to normal bricks. The even surfaced wall also requires very thin plaster on both sides which is also a very cement intensive material and thus lot of cost saving is done. Many builders are nowadays preferring Gypsum Plaster directly over blocks wall, thus plaster, putty is done in a single activity one needs to just get on with painting and finish the unit.

The long term benefit of using AAC blocks one obtains is by virtue of its being very good thermal insulator. If the outside temperature is say 36 degrees then the normal brick wall will maintain around 32 degrees in room, whereas the AAC made room will have temperature around 27 degrees, the cooling - heating cost is one of the major cost component in monthly maintenance expenses of any building. Saving on cooling/ heating in entire lifetime of building will be tremendously beneficial. In buildings adjoining to traffic areas like shops/ offices in city center where noise pollution is huge, or in office blocks of industries where sound is unavoidable AAC blocks can cut the noise off very efficiently.

Any construction engineer knows what happens to normal brick walls when groves are cut in masonry for electric and plumbing conduits. The wall almost rips off leaving lot of cracks behind. The hand chiseling or machine cutting destroys the bond between the already weak clay bricks, as a result after the plaster is done many a times cracks appear above conduit lines. The scene with AAC blocks is entirely different. The blocks get cut very easily and the joinery does not get disturbed at all. Normal burnt clay bricks are very disastrous to environment not only the fertile top soil is depleted but lot of carbon mono oxide is released in environment. The brick industry is told to be the third most coal consuming industry after power and steel. The Supreme Court has given directives for phasing out of burnt clay bricks.

Ultimately, the most important and motivating factor which drives the acceptance and use of any material which all of the Developers, Contractors and End Users look forward to is Cost Savings One AAC block of size is equivalent to 8 red bricks hence it reduces 1/3rd of joints resulting in saving of mortar up-to 60%. AAC blocks are automatic machine cut having accurate dimensions resulting in thinner coat of plaster as compared to clay bricks. It saves mortar in plaster to 35% to 40% and having advantage in gaining more carpet area, also AAC blocks enable drastic reduction in dead weight. Even this dead weight reduction leads reduction in consumption of steel and cement and lesser excavation for foundations, which indirectly reduces embodied water consumption. However it is difficult to replace 7 millennium old materials with new one. Also availability is still a challenge in India. AAC blocks are easily available in southern and western regions of country.

| Parameters | Burnt red clay brick | AAC block |
|---|---|---|
| Compressive strength | 2.5-3 N/mm2 | 3-4 N/mm2 |
| Energy saving | Low | Approx. 25% reduction in AC load |
| Embodied energy | High | Low (consume 70% less energy) |
| Environmental impact | One sq ft of carpet area will emit 17.6 kg of carbon dioxide | One sq ft of carpet area will emit 2.2 kg of carbon dioxide |
| Cost benefit for other material | None | Dead weight reduction leads reduction in consumption of steel and cement |
| Saving in plaster | --- | AAC block have uniform shape and texture, which gives even surface (much less compared to |

| | | |
|---|---|---|
| | | conventional bricks) |
| Water saving | --- | high |

AAC has already successfully been used in Europe since early last century and is now among the most commonly used wall building materials in Europe with rapidly growing market shares in many countries, especially in Asia. According to some estimates, AAC accounts for more than 40% of all construction in UK and 60% of all construction in Germany. In India, the demand for these blocks has risen by 10 fold in the last 5 years. AAC blocks are gaining popularity in northern region and demand in tier –II cities. Comparative Analysis indicates that in almost all the parameters, the AAC blocks have a superior edge over burnt clay bricks. The use of AAC blocks leads to savings in overall project cost; enables to speed up the construction process reduced environmental and social impact.

## 2.2 Gypsum plaster

In recent years, the construction sector has witnessed a number of new trends, technology advancements and innovations across applications, all aimed at making construction faster and delivering higher performance. However, very few would have imagined that the substitute for the generations old method of sand cement surface plastering will be an even older method of plastering i.e. gypsum plastering. Gypsum has proved to be a miraculous material aiding interior construction. Gypsum surface plaster is one form that has caught the attention on the sector and is growing in popularity. The oldest example of usage of gypsum as an internal plaster is found in the Pyramids of Giza in Egypt which were lined with gypsum stucco plaster centuries ago and are still intact, which is proof of the durability & performance of this product.

When a wall is constructed with brick or block, they are finished with a coat of plaster which is called internal plastering. Internal plastering has traditionally been done through a process of sand-cement plastering finished with POP pruning. This is a two stage process and involves multiple elements like sand, cement and water which is mixed onsite. This form of plastering is being slowly replaced by a direct single coat application of gypsum plaster. So gypsum plaster is actually a replacement of two processes i.e. sand cement plastering & POP punning. Gypsum plaster is produced as a result of calcinations of the raw gypsum in an automatic kettle under controlled temperature.

Gypsum plaster is directly applied on brick, block or RCC, no separate finishing product required. It requires no curing, therefore ready to paint. Gypsum plaster saves time during construction and ensures timely possession of homes/ building. Gypsum plaster expands slightly on setting and is not, therefore likely to cause cracking of surface. On drying out it forms a sufficient dense surface to resist normal knocks. Gypsum plaster is comparatively easy to spread and level. Gypsum plasters have no appreciable chemical action on paint. Gypsum plaster spread and finished to a minimum thickness increasing carpet area. Gypsum plaster is perfectly lined, leveled, sharp corner and smooth surface. Saving on electricity used for air conditioning as gypsum has very low thermal conductivity. It is more durable and green material. Gypsum plaster light in weight, therefore reduces the load on structure. More cleanliness on site because it is bag packed product and no curing is required.

Thus, now the builders and contractors wants time saving in construction, therefore they choose gypsum plaster due to its superior finish and time saving aspect. Gypsum surface plaster is one type that has drawn the attention on the construction sector and is getting higher popularity these days.

| Parameters | Gypsum plaster | Sand-Cement plaster |
|---|---|---|
| Availability | Ready to use bags | Sand & Water availability is problem |
| Finish | Crack free & smooth finish | Shrinkage cracks are common |
| Time required for paint ready surface | 3 days in normal weather conditions | At least 7 days curing and then 3 days drying |
| Water saving | Does not require water curing | At least seven days of water curing |
| Green credentials | LEED points available | Not applicable |
| Productivity | High- faster work (Reducing plastering time by 70% when compared to conventional Sand cement plaster + POP method) so time saving | Medium (requires more time when compare to gypsum plaster) |

### 2.3 AAC blocks + Gypsum plaster & Burnt red clay bricks + Sand-cement plaster

From above we can say that to reduce water consumption on site we can use AAC blocks and gypsum plaster. But how many amount of water both the processes use and how much percentage of water we can save should be calculated. For this purpose on site observations were done and various things were noted. The observations were done for many rooms in apartment construction and here value for one room is given i.e. water requirement for 340 sq ft. From site observation the following values we get

| | Burnt red clay bricks + Sand-Cement plaster | AAC blocks + Gypsum plaster |
|---|---|---|
| Water requirement both in Production and Curing(for 340 sq ft) | 3295 litres | 175 litres |

From this what we observe that conventional system of using bricks and cement for partition wall consumes lot water as compare to new materials. And as we know new materials are also environment friendly than conventional, it's now time to use AAC blocks and gypsum plaster. From site observation we can see AAC blocks and gypsum plaster requires around only 6% water of conventional system. This is because there is no requirement of water curing.

## 3. CONCLUSION

AAC blocks are extremely resource efficient and environmental friendly material. As gypsum plaster does not require water curing a tremendous amount of water is saved. AAC block and gypsum plaster both only use 6-10 % water of conventional system. As there is no bigger disadvantage by using AAC block and gypsum plaster we can save lot water and it can be used for other activities. If wherever possible construction site makes this replacement of material it will contribute great saving of water in national interest.

## ACKNOWLEDGEMENT

I express my profound gratitude to our project guide Prof. Pranay Khare and Prof Milind Darade for their inspiring guidance due to which our difficulties and questions were shaped into the development of this paper. I would like to thank Principal Dr. Ashok Kasnale and H.O.D Dr. Sanjay Kulkarni, who were the source of inspiration throughout the making of this project and helped us to accomplish our goals in a much easier and healthy way. I would also like to thank my friends who gave me complete support for site work.

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