POSSIBILITIES OF MAKING COOL ROOF TILES REINFORCED WITH NON-RECYCLABLE PLASTIC WASTES - A REVIEW

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INTRODUCTION:
Now a days, the real estate business growth was unavoidable to meet the demand for the shelter to people of nations having a growing population and faster development of nations. The rising income of people leads to get higher standards of living. In the world, over 50% population lives in urban areas, and it will reach 70% by 2040. Energy consumption in buildings is growing worldwide at the average growth of about 40% in recent years. The buildings in tropical and semitropical regions have high energy consumption, especially for meeting the demand for cooling. Special attention to be taken in reducing the cooling loads to decrease the construction and operational cost of buildings by their energy-conscious designs and cool roof techniques. [1]

With increasing the solar reflectance of building roofs in urban areas, the outflow of short-wave solar radiation increases, only less amount of solar heat energy is absorbed leading to lower surface temperatures and reduced outflow of thermal radiation into the atmosphere. This process of “negative radiative forcing” effectively counters global warming. Cool roofs will reduce cooling-energy use of air conditioner in buildings and increase comfort in unconditioned buildings; and cool roofs and other cooling applications controls heat in summer in urban heat islands, improving indoor air quality and comfort. [2]

Environmental conditions at which occupants feel thermally comfortable are not fixed, it depends on the outdoor weather conditions. Therefore, Adaptive thermal comfort temperatures also vary due to change in mean monthly outdoor dry bulb temperature. Weather data analysis of the city shows that high dry bulb temperature and high wet bulb temperature is observed during May to July months. Even though speed of wind is higher during these three months (3-5 m/s). An 72% uncomfortable condition inside buildings is observed during summer months. Building envelope is also designed to reduce external heat gain. The solar heat gain is controlled by judicious design of glazing, building envelope and orientation. The buildings are always thermally massive in nature. The construction framed structure with reinforced concrete have cavity brick infill walls plastered inside and out, coffers also plastered inside, with and hollow concrete blocks filling the roof vermiculite used as an insulating material on both roof and walls. [3]

Solar radiation falls on a roof may reach to more than 1000 W/m² in clear sky conditions and from 20 to 95% of this radiation may be absorbed. Concrete roof with Phase change material (PCM) gives a maximum reduction in indoor temperature of about 4-6°C. As the indoor temperature goes higher than 2.9°C the melting temperature of PCM is happened, the PCM melts by absorbs heat from surrounding and hence indoor temperature reduces. [4]

Double-layered or double-skin roof is a very effective way to heat dissipation from roof to the ceiling of building. Radiant Barrier System is very effective in stopping the radiation heat transfer between roof and ceiling. Double-Skin design of building exterior wall is a passive cooling technology and is a rather available and acceptable method for architect to make energy-saving designs. [5]

The most optimized mix ratio of the roof tile constituents to achieve the desirable engineering properties of tiles like light weight, durability, strength, and water tightness. Plastics are nonbiodegradable materials, therefore won’t absorb them like alternative waste. Styrene could be a not perishable plastic and smart immune to photolysis. It is a major downside within the ocean and its bed. Even though reusable, styrene isn’t recycled in several components of the globe. The biggest downside in enlarged styrene is its density, it takes up a comparatively massive amount of area in each geographical region. The foremost distinctive property of polystyrene is that it is often in rigid kind or foamed, and might be formed and moulded very simply by melting it once more because it could be a thermoplastic. Postscript could be a excellent electrical insulator, has wonderful optical clarity thanks to the lack of crystallinity, and has smart chemical resistance to diluted acids and bases. It is often accustomed fabricate into an oversized number of finished product since it’s a viscous liquid once heated on top of its glass transition temperature that may be simply moulded. Plastics absorb less water than other polymer materials. The degree of wet absorption depends on the sort of plastic and also the close conditions like temperature, humidity and contact time. Not solely will dimensions change thanks to wet absorption, but also material properties, like mechanical strength electrical conduction and also the dielectric loss issue, are often additionally affected. This property of EPS is a necessary characteristic for the manufacturing of EPS roof 0000tile as a result of this may build the roof tile tough, long lasting and can greatly facilitate cut expenses on uncalled – for repairs. Plastic waste, like EPS, is non-biodegradable however a thermoplastic, it’s a 100% recyclable. [6]
Plaster of Paris (POP) is a white powder mixture of mineral and a basic salt of calcium sulphate with a molecule of crystallization (CaSO₄ ½ H₂O). It can be hardened by adding wet thereto. The surface of statues created by POP can have a smooth surface. [7]

Due to the increasing population the daily usage of plastic merchandise like plastics luggage, water bottles, varied plastic utensils etc. increases steady. There’s regarding 15 tonnes of plastic waste is made a day, scientists say that it takes 300 years for complete combustion. This is often terribly dangerous for surroundings & human life. Here a sincere effort is created to utilize the plastic in recycle stage in producing of tiles. Plastic waste within the style of granules can be mixed with sand and epoxy. This can replace the standard tiles and many be used wherever immense loading is found on the floor. The plastic tiles are unit additional sturdy than the standard tiles with relevance various engineering views. Flexural strength of plastic tile is way beyond the ordinary tile. Abrasion of plastic tile is negligible as compared to normal tile. As far because the porousness and aesthetics of plastic tiles area unit concern, it’s a decent alternative to normal tile. Bond strength of plastic tile is beyond the standard tile. The less wear and tear are going to be seen commonly in these plastic tiles than ordinary tiles [8]

The air-conditioner is that the largest client to energy among all of the common household appliances that embody, ceiling fans, refrigerators. The accrued dependence on air-conditioners may be a concern as air-conditioners heavily consume energy, that ends up in increasing the level of carbon emission. The use of light colour roof tiles ends up in energy savings of up to 13.14% is achieved when the roof tile colour is modified from red to white. [9]

The darker roof surfaces that are additional common in urban areas truly can increase temperature by 1 to 3 °C to the building rather than decreasing. In addition, improved temperature management and funky roof applications plays a serious role to scale back the energy needs for the inside areas of the buildings that have white roofing surfaces. The white or lighter coloured roofs tend to replicate a region of the star radiation that creates the roof’s surface cooled. [10]

The impact of an easy and effective passive cooling system in reducing thermal loads in roofs. The experimental results demonstrate that the aluminium–polyurethane insulation system with associate degree optimal orientation reduces the centre temperature of a cement-based roof significantly. The roof insulation system can cut back the standard thermal load by over 70% whereas effectively dominant thermal fluctuations primarily colour of roof. [11]

The ceiling temperature mustn’t rise more than 4.45 K higher than the air temperature this would correspond to 0.723 K elevation of the mean bright temperature that in turn permits 0.556 K increase in CET (Corrected Effective Temperature) within the assumed area. They used a gradual state method to calculate ceiling temperatures. [12]

In order to optimize the cost of construction, engineers have always been looking for thermal efficient, durable and light weight roofing which requires less maintenance and labour to install. Coir is a natural building material and have potential to be an raw material for the production of roofing materials like corrugated sheets and tiles. Properties like breaking load, flexibility and ductility were improved with the addition of this coir fibres. The in-cracking pattern of tiles which used coir fibre and those without coir fibre it was observed that the cracks are more sharp in the tile without coir fibre. This can be justified that the crack in the tiles with coir fibre is with less sharpness. [13]

The thermal expansion of concretes is a most important problem for roof, as it may cause serious cracking on walls and roofs. The presence of 40 mm thick reinforced concrete screed will reduce the thermal expansion of concretes primarily to the screed while minimizing the expansion of the roof slab or concretes. [14]

Floor covering is more essential for ensuring the quality, properties and good appearance of flooring regarding its intended use. Some of the main requirements are flexural strength, resistance to abrasion, volume stability, good flexibility, comfort for walking, skid resistance, cleanability and fire resistance, etc; Slip resistance of ceramic tile is an existing and important problem. The risk of slipping depends not only by performance of tiles, but also human and environmental made issues. The coefficient of friction should be greater than 0.60 [15]

The various technical properties of ceramic floor tile, abrasion resistance is most vital owing to its importance in process doable defining tile applications. The good issues concerned within the ways presently getting used for classifying the abrasion resistance of floor tile, is that the abrasion check is administrated by the seeing of damage, which can raise serious issues like manual error for the quantification of abrasion resistance of tile, since such systems rely on the visual capacity of the observer and also the observation conditions (lighting, distance, angle of vision). [16]

Water absorption one among the foremost vital think about tiles the water absorption of sophistication a sort of roof tiles is 14-19% however shouldn’t exceed 20%. Water absorption for every tile calculate the water absorption as a share of the dry mass victimisation the expression: [17]

\[ Wc1 = (m2 – m1) \times 100/m1 \]

Where,

\[ Wc1 : \text{Water content by mass (percent)} \]
\[ m1 : \text{mass of the dry tile} \]
m2 : mass of the wet tile

CONCLUSION

Cool roof tiles are the most effective complement to each system if you’re trying to conserve on energy costs. Through tiles has characteristics that closely reflect daylight instead of reworking it to heat. By projected the sun’s heat instead of accumulating it, they hold buildings cooler and decrease the intensity of temperature. Coolness is evaluated by two characteristics, solar reflectivity and warmth emission. It’s potential to manufacture roof tile from recycled high-density plastics that the density of tile decreases with the raise of the high-density polyethylene which keeps the tile in light weight. The plastic tiles are better than the normal tiles with reference to numerous engineering views. Flexural strength of plastic tile is far higher than the standard tile. Abrasion of plastic tile is negligible as compared to normal tile. The darker roof surfaces in several urban areas can increase temperature by 1 to 3 degrees rather than decreasing. Replacing of dark colour to light colour of roof tiles ends up in energy savings of up to 13.14% can be achieved by replacing the colour of roof from red to white.

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