Scientific Journal of Impact Factor (SJIF): 5.71

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 6, Issue 03, March -2019

ANTI- THERMAL STRUCTURE

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Abstract — *this report summaries the introduction, literature, method, result and conclusion of Anti-Thermal Structure is shown on this project. This report includes an overview of effect of heat on concrete and steel structure in the building. It is very important as the damage caused by heat is very huge. It is necessary to construct the heat resistive structure is known as Anti-Thermal Structure. The control method is economical and it is eco-friendly method.*

The main purpose of this topic is to compensate with the failure of wall because of the heating oven and the heat which is emitted from the heating devices. The various ways which can be used to overcome the problem and various steps need to be taken for the particular that various industry such as food and steel where the heating units are used for the various kind of processes that takes place. Heat resistant materials can be used in this place to mitigate with the issues.

Keywords- *Anti-Thermal Structure, literature, methods, overview, concrete, steel, resistive structure, damage, economical, eco-friendly methods, curb, heating units and spent solvents.*

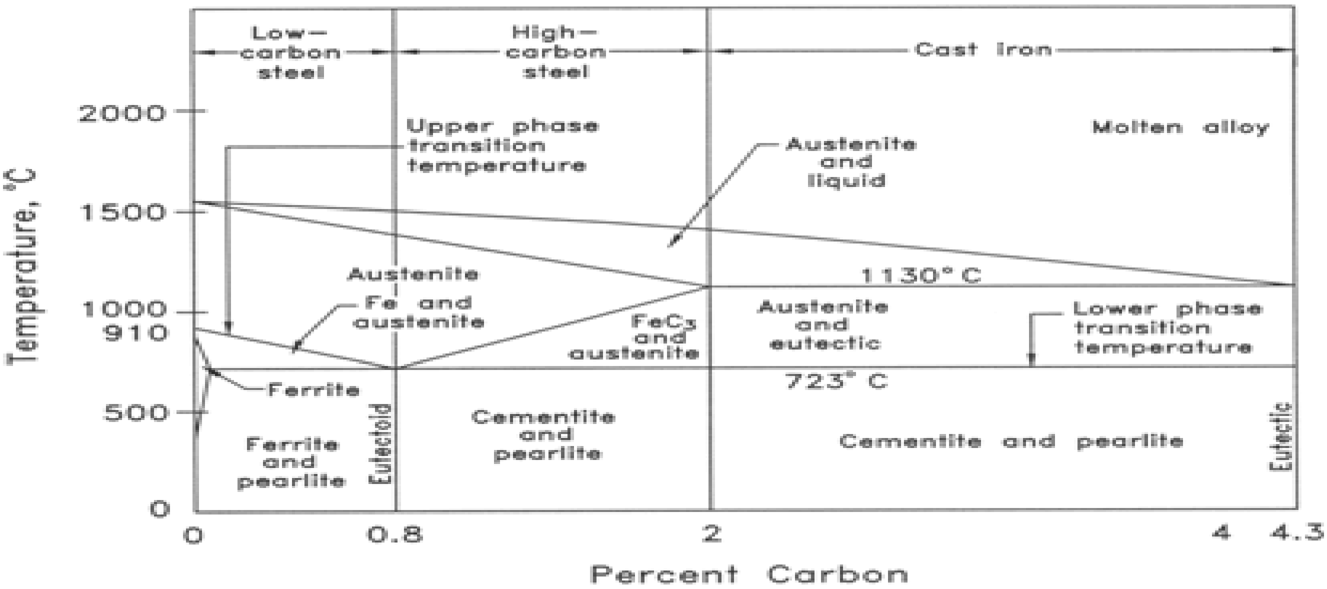
INTRODUCTION

The Excel Crop Care is a Private Sector Organization that offers services in Agricultural Fertilizer. It is the Post-Quake Construction. The building was constructed in 2002 at Gajod-kera. We have found the problem in this industry was failure of wall due to heat. At Excel Crop care Ltd we saw that the plaster was falling off bricks due to heat. Finally we decided to overcome the Solution related to it.

Anti-Thermal Structure: - A type of structure which is heat resistive to compressive strength on concrete and tensile strength on steel. Normally Structural failure refers to loss of the load-carrying capacity of a component or member within a structure or of the structure itself. Structural failure is initiated when the material is stressed to its strength limit, thus causing fracture or excessive deformations. In a well-designed system, a localized failure should not cause immediate or even progressive collapse of the entire structure. Ultimate failure strength is one of the limit states that must be accounted for in structural engineering and structural design. But in this case heat effects the compressive strength and tensile strength of steel due to heat first of all formation of cracks takes place then plaster falling off bricks and at last the wall cripples.

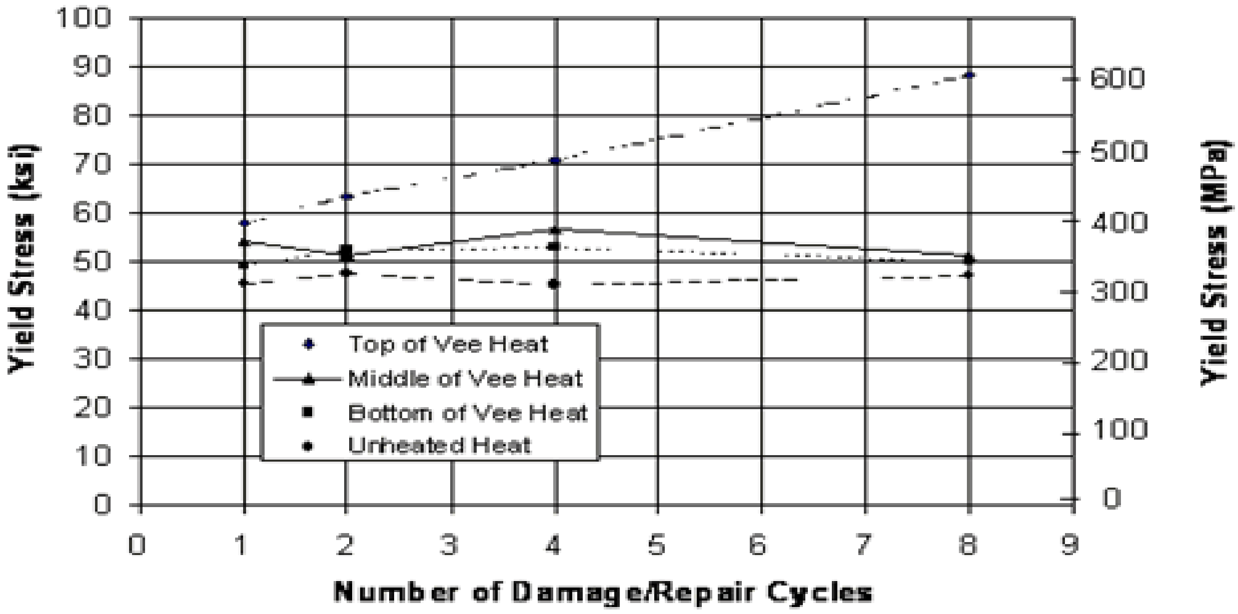
THE EFFECT OF STEEL

The potential for detrimental effects from heating damaged steel has limited the implementation of heat straightening. However, with an understanding of the properties of steel, heat straightening can be safely conducted. Heating steel reduces the yield stress as well as the elastic modulus but the coefficient of thermal expansion increases with temperature.
The behavior of these parameters complicates attempts to understand the response of steel to heat straightening. In addition to these short–term effects, heat can result in long–term consequences which may be detrimental. Since there are various alloys under the banner of 'steel', we were hoping for simply a general idea of the effect, if possible.
Here is a quick quote to steel us in a good direction: Most steel has other metals added to tune its properties, like strength, corrosion resistance, or ease of fabrication. Steel is just the element iron that has been processed to control the amount of carbon. Iron, out of the ground, melts at around 1510 degrees C (2750°F). Steel often melts at around 1370 degrees C (2500°F).
Alloy used (of course this is important since impurities and composition determines strength), width and height of the beam, manufacturing process (tempering), temperature of and nature of the heat source, and finally the weight atop of the beam.
If someone here is expert enough to fill in these variables and design an illustrative scenario, that would be great. My goal is to understand how heat effects the beam's ability to hold the weight and at what temperatures the beam will fail at.



FATIGUE AND FRACTURE PERFORMANCE

Connor, Kaufmann and Urban (2008) conducted the first major study on fatigue and fracture performance of heat–straightened steel. Their full–size tests led to the conclusion that damage and repair cycles did not have a significant effect on fatigue life of girders at stiffeners and cover plates. However, live load stresses may be magnified by residual local damage (even within normal tolerances) after heat straightening. They recommend stress adjustment factors be applied to ensure that the residual damage will not cause an unacceptable increase in live load stress that would result in a fatigue failure.



HOW HEAT EFFECTS ON CONCRETE?

In this research work, the effect of low and high temperature on various properties of concrete was investigated. The properties investigated were modulus of rupture of concrete beams, compressive strength and tensile strength of concrete. Three different temperatures were used for this purpose. It has seen that the temperature variation results in both positive and negative impacts on different properties of concrete. It also yields good results but keeping in view the demand of concrete's strength the temperature of the environment under which it is mixed, cast, cured and finally tested must be controlled. Increase in temperature increases initial strength while at the same time it reduces the long term strength. These were low, room and high temperatures. The low temperature was 5°C, room temperature was 28°C and high temperature was taken as 55°C. But in industries more than 55°C+ may decrease the compressive strength of concrete.

EFFECT OF HIGH TEMPERATURE ON CONCRETE:

The reaction of concrete to elevated temperatures will vary with the factors listed previously; but to get some idea of a typical succession of effects as temperature rises, let us trace the laboratory history of an ordinary concrete when it is subjected to increasing heat. The first effects of a slow temperature rise in concrete will occur between 200 and 400 degrees Fahrenheit when evaporation of the free moisture contained in the concrete mass occurs; instant exposure can result in spelling through generation of high internal steam press u re s. As the temperature approaches 500 degrees Fahrenheit, dehydration or loss of the non-evaporable water or water of hydration, begins to take place. The first sizable degradation in compressive strength is usually experienced between 400 and 750 degrees Fahrenheit. At 600 degrees Fahrenheit strength reduction would be in the range of 15 to 40 percent. At 1,000 degrees Fahrenheit reduction in compressive strength would typically range from 55 to 80 percent of its original value.

Temperatures in the 1000 degrees Fahrenheit range are critical because calcium hydroxide dehydrates at that temperature. Calcium hydroxide is a hydration product of most Portland cements, the amount being dependent upon the particular cement being used. Aggregates also begin to deteriorate at about 1000 degrees Fahrenheit; for example, quartz expands greatly and suddenly at 1063 degrees Fahrenheit. Concrete will undergo normal expansion up to 300 to 500 degrees Fahrenheit but above this it begins to shrink at an even faster rate. At 700 to 800 degrees Fahrenheit, in addition to great re- ductions in strength, cracking of restrained concrete will have rendered the concrete virtually valueless. At around 1,000 degrees Fahrenheit it will usually be possible to break the concrete into pieces with the bare hands. Naturally, the rate at which the concrete is brought to these temperatures and the length of time the temperatures are maintained will have an important bearing on how the physical properties of the concrete are affected.

At approximately 600 degrees Fahrenheit surface hairline cracks begin to form. At 1,000 degrees Fahrenheit deep cracks have begun to be formed and these increase in size upon cooling of the concrete; they eventually result in the disintegration of the concrete. After the concrete cools there is a further reduction in strength amounting to a loss of about 20 percent of the strength of the concrete observed at the l, 000-degree temperature.

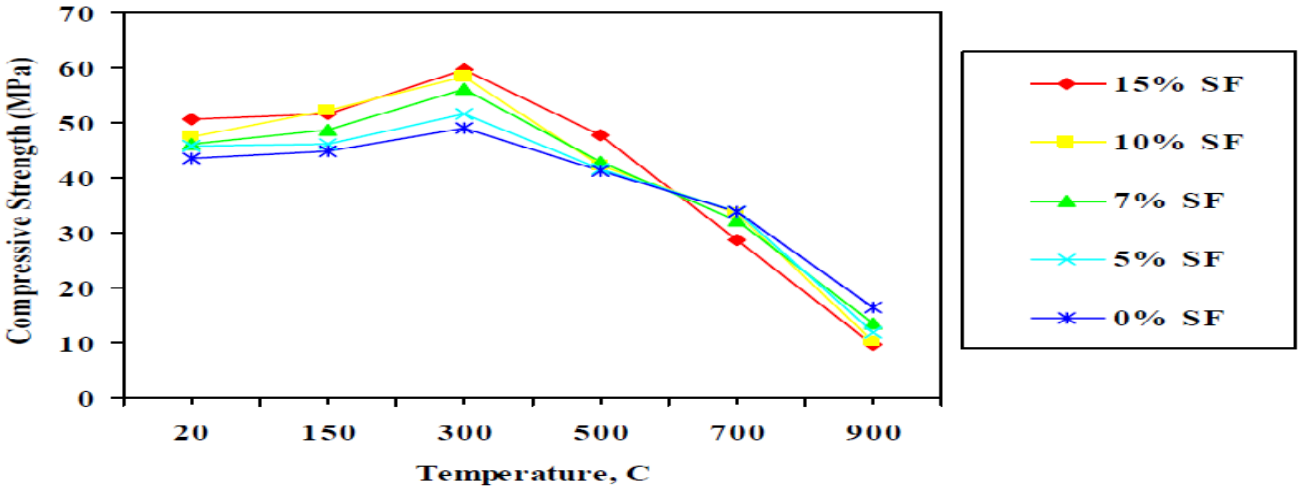
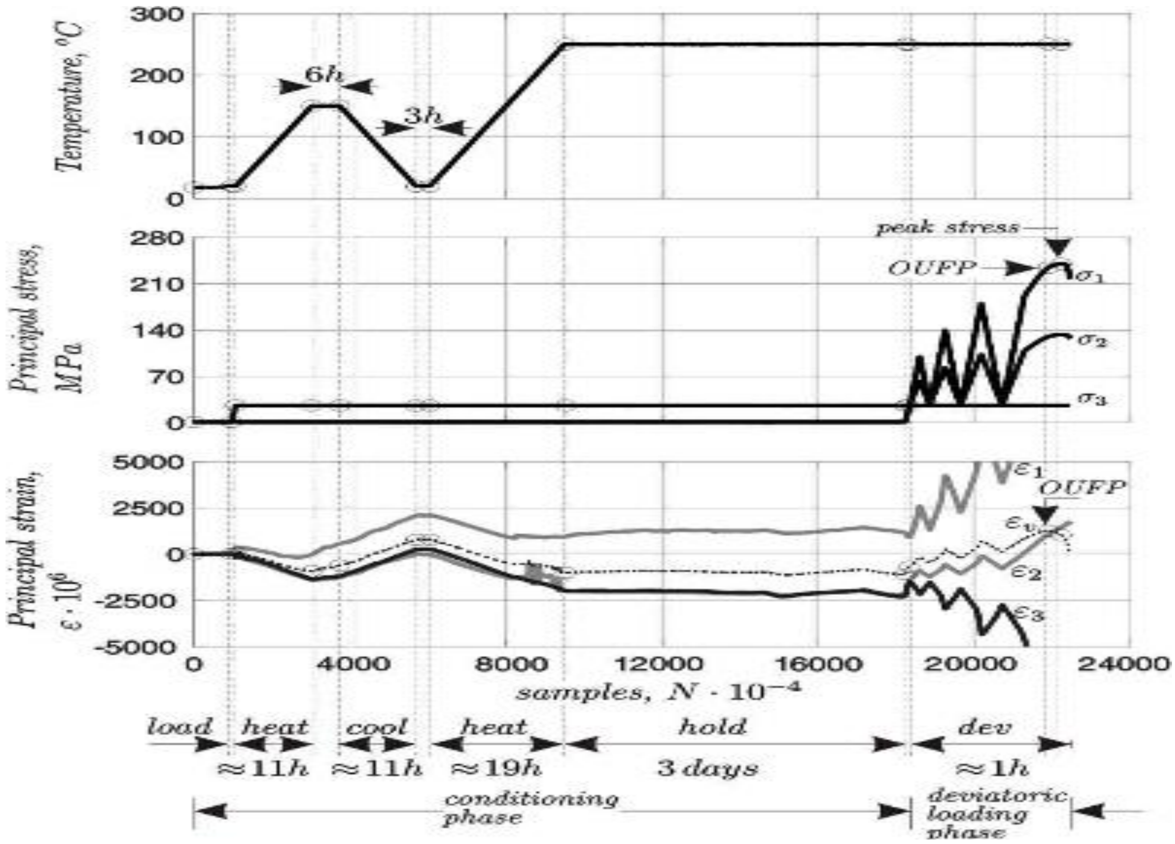


Figure 1. Effect of temperature on the concrete strength

Reference: www.cement.org

LITS+ Damage: Load Induced Thermal Strain and Damage in Concrete under Multi-axial Compression at Elevated Temperature



Reference: www.shef.ac.uk

GENERALLY FALLING OF WALL OR PLASTER ARE DUE TO FOLLOWING REASONS:

1. Cracks in the wall.
2. Heat of Furnace / Boiler / Oven.
3. Water Damage.
4. Stained Interior Wall.
5. Loose Plaster
6. Nail Pops.
7. Roof Truss Uplift.
8. Dry Wall.
9. Bad Quality of Brick

HEAT OF FURNACE/ BOILER/ OVEN:

Recently we had visited Excel Crop care Ltd. The building was constructed in 2000. At Gajod - Kera. We founded the problem in the industry was Failure of wall due to heat of furnace. We saw that the Plaster of wall was falling due to heat of Furnace.

This Picture was taken at Excel Crop Care Ltd. on MARCH 10 at 3:00 pm. The Structure was Post-Earthquake (Approx. 10 years). There we saw that cracks was developed in the wall and plaster was falling from the wall due to heat of Furnace.

CRACKS IN THE WALL:

In this picture that cracks are developed in the wall. The more cracks takes place at corners, but here in this case cracks are developed at not only corners but in the center of the wall. Normally the cracks in the wall takes place by naturally or natural calamities like Earthquake. It is also the cause of external heat from the atmosphere which has impacted the wall very badly and as a cause it leads to cracks.

HEAT OF FURNACE ON THE WALL:

The pictures shows that how the wall is affected by the heat of furnace. The wall badly affected by the heat. Even in case of oven the same effect takes place, here furnace is connected to the wall and the wall gets reacted by the effect of heat.

This is just because of heat on the wall surface as it has damaged the wall very severely and as a result it also affects the internal electrification and the wiring which has been done just after the construction of the wall. Here, instead of using conventional materials special insulating materials should be used to prevent the deterioration of the wall and left such thing in adverse condition.

Heat Insulating materials such as thermal resistant bricks and cement should be used to prevent such type of damage and also it saves wall from other failure factors.

WATER DAMAGE:


Another problem is water damage, the walls are damaged by the water seepage in the wall and the walls. Short-term exposure to the wall won't harm most building materials, but water quickly damages plaster and dry wall. Common sources of water damage includes leaks in the walls, chimneys, windows, skylight, plumbing, water heaters, and condensation.

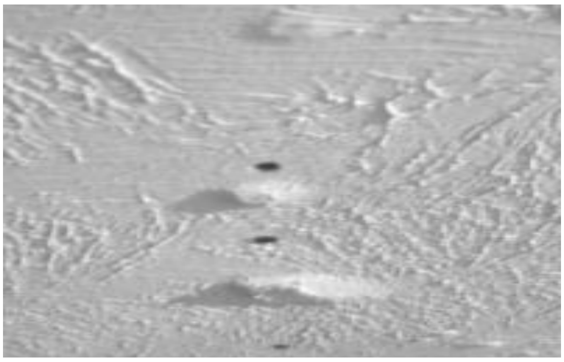
STAINED INTERIOR WALL:


As we can see in this picture that the wall are stained. This biggest problem is with is sun fades. The picture shows that how the bricks are stained by the Heat and the Water. There might be some other problem but this problem is very severe as the elevation also looks bad.

LOOSE PLASTER:


Generally falling of plaster takes place due to improper plaster work, due to improper mixing of mortar and improper curing and by the water leakage, this type of walls mainly seen at houses, as we can see in the picture, whole plaster is coming out from the wall.

NAIL POPS:



Nail pops are bumps on a wall that can occur when the head of a nail protrudes and begins to poke through the outside of the drywall. The nail pops are generally seen on the ceiling of the wall and the roofs. Generally it occurs at different place of the ceiling. The picture showing how the nail pop occurs and the nail pop is coming out.

SOLUTIONS FOR THE PROBLEM

Solution of our IDP consist the use of following materials:

1. Perlite Cement
2. Cavity wall
3. Anti-Thermal Paint
4. Thermal Insulating Bricks
5. Fire Brick
6. Fireproof Ceramic Fiber Cloth
7. Insulate ceiling Sheets.
8. Castable cement.

PERILITE CEMENT:

Perlite is not a trade name but a generic term for naturally occurring siliceous volcanic rock. When Perlite heated to a suitable point in its softening range, it expands 4 to 20 times its original. This expansion is due to the presence of 2-6 % of combined water in the core Perlite rock. When quickly heated to above 8700 C the crude rock pops in manner similar to popcorn as the combined water vapor and creates countless tiny bubbles in the glass – sealed bubbles which account for the excellent insulating properties and light weight concrete It is classified as chemically inert and has a pH of approximately 7.

Perlite is a siliceous volcanic rock. It has been in the form of cement. it is the best insulating material, fire resistant, light weight concrete. it can be used in place of ordinary Portland cement.

Thermal paint can resist a temperature up to -80*C - 100*C. it can serve as adhesive for ceramic Glass metal and etc. it has been used in oven, kilns, steam pipes, chimneys, etc.

We have used different types of bricks and insulating materials such as Fire Bricks, Insulating Bricks, Cotton Mesh, Insulate ceiling sheets, Castable cement, etc. These Fire bricks are used in place of ordinary bricks as these bricks can resist the temperature 2000*C to 3000*C. The insulate sheets has been used as a roofing material to resist the heat. The solution suggested by us has been applied in the industrial Oven.

At last in the industry the fire brick wall is constructed of 5x5x3 which can resist the temperature up to 2000-3000*C and the Thermal paint is applied in the manufacturing department which can resist -80*C to 1800*C. The Cost of construction of wall is 82,795 Rs. and the cost of Applying Paint is 3, 47,023 Rs.

THERMAL INSULATION BRICKS

Nowadays they are called heavy and dense Firebricks but old masters still call them fire clay bricks just because they are made of simple fireclay (which actually is the most ordinary mud.) Fire Clay can be easily located out in the nature but it must containing the right refractory properties, suitable content ratio of silica and alumina. Some shops call these bricks fireplace bricks. They are used for instance for building cooking chamber in wood fired ovens, for creating fireplaces, all sorts of fire boxes and wood heaters' lining, linings in a small or the hugest industrial furnaces, you name it. Fire clay bricks are very heavy/dense having low porosity and even on various re-heating, they will last for very/very long time.

INSULITE CEILING SHEETS:

These sheets are made up of different minerals such as Bauxite Crystals, Broken crystals of glass, polystyrene...etc.

CASTABLE CEMENT:

Cement ball before heating & after heating in oven

This Balls are made from the Castable cement. This Balls are self-tested by our group members. In this Process first of all we have made these balls and then kept these Balls in the Oven At 1200 degree Celsius for 24 Hours to check whether the Castable cement can resist the heat or not. Then we have taken out the sample after almost a Day and the results which you can see in this Picture. The balls had changed its color to red but it had resisted the 1200 degrees Celsius. So this Castable cement can be used in Industries, Bakery where the temperature is more in oven and kilns.

Ceramic fiber wool placed on door of Oven

This is a picture of Oven in which bricks are to be tested for the client's satisfaction. The blanket or cotton sheet is placed on the interior of the oven door. The purpose of this Blanket is to keep and maintain the temperature in the oven. The balls are also tested in this oven for 24 hours at 1200 degree Celsius.

International Journal of Advance Engineering and Research Development (IJAERD)
Volume 6, Issue 03, March-2019, e-ISSN: 2348 - 4470, print-ISSN: 2348-6406

Specifications:

Ceramic Fiber Cloth Manufactory
1 Density: 500+/-30 kg/m3
2 Working Temp:400 and 1000
3 Wire and fiberglass reinforced.

Characteristics:

Good compression strength.
Non-toxicity, environmental protection.
Low thermal conductivity and low thermal capacity.
Good antacid oil resistance and water vapor resistance

Application:

Common applications :door seals or caulking for ovens, furnaces and boilers, expansion joints, cable or pipe wrapping, high temperature seals or gaskets. These products have been widely used in welding, foundry works, aluminum and steel mills, boiler insulation and seal, exhaust systems, shipyards, refineries, power plants and chemical plants.

ANTI - THERMAL PAINTS:

Thermal Paint is a paint based product that is temperature sensitive. When applied correctly, it creates an irreversible visual picture of the temperature contour patterns. This is an essential tool for the accurate analysis of high temperature materials working close to their maximum temperature capabilities.

Characteristics: -

The heat resistant paint (high temperature protective coating) can resist temperature from -80℃ to 1800℃, or even higher temperature.

With thermal conductivity of 0.03W/m.K, the heat resistant paint can effectively suppress and even shield as much as 90% radiant heat of infrared.

The heat resistant paint (high temperature protective coating) can serve as adhesive for ceramics, glass, metal, and others.

Heat resistant coating for chimney stacks, pipes, petro-chemical & water tanks, boiler fronts, duct work, piping and furnace structure.

TYPES OF ANTI - THERMAL PAINTS:

Heat Resistant Aluminium Paint

Heat Resistant silicon Paint - up to 1200 degrees F, 650 degrees C.

High Heat Enamel Paint up to 1200 degrees F for

General Measures

- Excellent insulation – they stop up to 90% of heat from ceiling or roof;
- Lifetime up to 25 years;
- Water & mould resistant – suited for bathrooms & kitchens;
- Simply cleaned with a soft brush and warm water;
- Paintable with any water based paint (but not required to);
- Not-toxic, environmental friendly & fire retardant;
- Reduce sound impact from external sources;
- Acoustic qualities of tiles add to your enjoinment of sound system;
- Creating comfortable environment in your home both winter & summer;
- Economical method of renovating and decorating ceilings;
- Easy alternative & cost effective to painting;
- Easy to install, cut & fit

CONCLUSION

As I have overcome to the problem and the following solution are as under:

Perlite is a siliceous volcanic rock. It has been in the form of cement. It is the best insulating material, fire resistant, light weight concrete. It can be used in place of ordinary Portland cement.

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ACKNOWLEDGEMENT

I have taken efforts in this project. However, it would not have been possible without the kind and help of many individuals and organization. I would like to extend my sincere thanks to all of them.

I am highly indebted to Mr. BIPIN TANK for their guidance and constant supervision as well as for providing necessary information regarding the project and also for their support in completing the project.

I would like to express my gratitude towards my parents, friends and members of EXCEL CROP CARE LTD. for their kind co-operation and encouragement which help us in completion of this project.

I would like to express my special gratitude and thanks to industry persons for giving us such attention and time.

My thanks and appreciation also goes to my colleagues in developing the project and people who have willingly helped me out with their abilities

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