

Construction Material on Mars

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Abstract— As we tend to all apprehend that our planet earth is in solar system that is at intervals a galaxy referred to as “Milky Way”. Our solar system includes sun and its eight planets that are believed to own been developed as result of condensation of gases and Mars seems ruby red from earth as result of presence of iron oxides. Its skinny atmosphere comprise of nitrogen and argon. Mars movement among and seasonal cycles among are likewise almost like those of the planet. Of all the planets in our solar system, mars are possibly apart from earth to harbour liquid water. Radius of mars is 0.53 times of earth .its rotation time is 24.6 hours and revolution period is 687 days. A significant step in space exploration throughout the twenty first century is human settlement on mars. While thinking about human settlement on mars question arises in mind which construction material will be good and economical, Rather than transporting all the construction material from earth to the mars with improbably high price exploitation. So in this paper we have explained various construction materials and have compare their effect on earth and mars and also have tried also tried to explain which of them will show good effect with Martian soil and surface. Thus reviewing all the construction materials we have tried to conclude and explain which material will be good on mars and why it will be so.

Key words: Mars, Sulphur Concrete, Martian Soil, Polysulphides, Solar System, Martian Concrete, Cement Concrete, Cement Sulphur Concrete

I. INTRODUCTION

Mars is fourth planet in our solar system nearest to the earth and is at distance of 141,633,260 miles from sun and is bright rust coloured which is due to iron rich mineral present in its crust. It has rust colour due to iron mineral oxides, or rust, causing soil to look red. It also has thick carbon dioxide atmosphere layer which can be responsible for generation of living organism. Mars has cold atmosphere, the average temperature is about minus 80 degree Fahrenheit (-60 degree Celsius) although they can vary from minus 195 degree Fahrenheit (-125 degree Celsius) near poles during winter to much as 70 degree Fahrenheit (20 degree Celsius) at midday near equator. NASA’s Mar’s Reconnaissance Orbiter found the first definitive detection of carbon-dioxide’s snow cloud making mars the only body in solar system known to host the unusual winter weather. The red planet also causes water ice snow to fall from cloud. Mars comprises of 95.32% carbon dioxides, 2.7% nitrogen, 0.13% oxygen, 1.6 % argon, 0.08% carbon monoxides, minor amount of water, nitrogen oxides, neon, hydrogen, deuterium-oxygen, krypton, Zeon, etc. Mars has core of 1800 to 2400 miles in diameter comprising of iron, nickel, sulphur. It has a mantle of 900 to 1200 miles consisting of peridotile a compound made up of silicon, oxygen iron and magnesium. Mars has crust of 30 miles thick in which we get volcanic basalt rock which are sulphur rich. Thus we can see the different specification of mars and if we have to think about settlement of human on mars they will need shelter which will be made up of some specific material.

In this paper we have tried to review some different construction technologies and their effect on mars and have tried to conclude which of them will be better among all. [1]

II. MOTIVATION

The concept of construction on Mars arises due to the good exploration in space technology. As far as increasing global issues due to natural calamities or pollution, there can be a danger to our planet. As a need to save human species the planet which has somewhat same atmosphere and geological contain is mars on which we can send human species if there is any danger to living species on earth. And if humans settle on mars there will be need of shelter as mars has cold temperature and quite far from sun. So there will be need of construction material. So considering the gaps question arises that, what will thee the construction materials? What will be the different technologies? Which of them will be economical? And can this be practically possible? This paper tells an idea to indirectly answer all this inquires, fill the research gap and conceptualized the better concrete technology used on mars.[2]

III. LITERATURE REVIEW

The soil on mars is called as Martian soil. Martian soil is slightly alkaline and contains nutrients such as magnesium, sodium, potassium and chlorides all of which are necessary for growth of living organism. By many experiments on Martian soil it was found that Martian surface was basic as result 8.3 in ph value. In this review paper we have reviewed many construction material ideas which can be suitable for construction of structure on mars .When there will be need to settle on mars the building material we will have in mind are cement concrete , cement sulphur concrete and sulphur concrete . Now looking toward cement concrete it is the best material used for construction on earth. But if we compare it’s on mars it will be not use for construction because we will not able to take this material from earth to mars due to high financial requirement. And if we tried to manufacture it on mars it will face some problems such as due presence of no limestone bed , silica and alumina on mars, so thinking about manufacturing of cement on mars fails thus this concrete technology does not hold good effect.

The next construction material is MOS Sorel cement which can be used for construction of structures on mars. It is magnesium oxy-sulphate Sorel cement. Only one material $MgSO_4.H_2O$ needs to be beneficiated. But it has some disadvantages such as the hydroxide may drop out of solution before it react with epsomite, heat generated may lead to premature cure and improper stoichiometry causes exfoliation. Thus, this construction material can be good on mars but not excellent. [3]

Now moving toward the cement sulphur concrete same problem will arise as it will not economical to carry concrete material from earth to mars and also it is not possible to manufacture the cement on mars as we have seen problem above. So this concrete material too fails on mars surface. [5]

Now moving towards the sulphur concrete, as we know that the Mars is sulphur rich planet and its regolith and Martian soil contain large amount of sulphur which we can extract from them if we have a space research lab on Mars. This sulphur concrete is a material which will show an excellent result as it is suitable for construction material due to Mars climatic and geological condition. This technology will also be economical as we will not carry material from Earth to Mars.

Sulphur concrete is composite construction material composed mainly of sulphur and aggregate. The important compounds of normal concrete are cement and water, which is not a part of sulphur concrete. Some compounds like acid which attacks normal concrete but sulphur concrete resists them. For fast curing and for acid resistance sulphur concrete has been used in small quantities.

The researcher did experiment for sulphur concrete where sulphur was used as binder and Martian soil as aggregate that concrete is called as Martian concrete. The mineral content of Martian soil consists of titanium dioxides, silicon dioxides, aluminium oxide and ferric oxide with lesser amount of iron, magnesium, calcium, sodium, potassium and manganese oxides. By these experiments, the researcher concluded that a mixture of 50% sulphur and 50% of Martian soil with a particle size of 1 mm resulted in an optimal product that has greater compressive strength. As Mars is a sulphur rich planet, the Martian regolith is surprisingly rich in sulphur. So we can use sulphur concrete which is based on raw material that is abundant on Mars. Thus this sulphur concrete building material can be excellent among all the construction materials as it will be economical as there will be no issues of taking any building construction material from Earth to Mars, as Mars has a great amount of sulphur. [6]

IV. MATERIALS AND METHODS

As we have seen different construction material among all sulphur concrete is found to be excellent for construction on Mars so we have explained its material and method. Method for manufacturing sulphur concrete is based on hot mixing of sulphur and aggregate in which all of the blended components are heated till a 140 degree Celsius to 150 degree Celsius the sulphur used within sulphur concrete can be combined with any form of traditional aggregate, the researcher predicted that the most excellent amount for sulphur binder is about 30% of the bond while for the sulphur concrete is only 15% of the bond. The sulphur matrix with the percentage of mineral extender is 5% for mortar and 10% for concrete.

System of Sulphur concrete production is primarily based on sulphur's properties of changing its viscosity with the change of temperature, by 119 to 122 degree Celsius sulphur completely turns solid into liquid it consists of some following steps.

- 1) Heating sulphur until 150 degree Celsius.
- 2) After melting of modified sulphur mix the components.
- 3) After moulding the sample into the metal moulds.
- 4) Cooling the sample. [7]

V. SUMMARY

In this paper we have reviewed some construction material such as cement concrete, MOS Sorel Concrete, Sulphur

cement concrete and sulphur concrete which we can use on Mars. While comparing them we have got an idea the sulphur concrete is best amongst all for construction of structures on Mars because Mars is a sulphur rich planet thus it will be economical as well as high result getting construction material as sulphur concrete shows good effects on Mars. Sulphur concrete has high resistance to most of the aggressive agents present on Mars. It gains high strength in short time. The sulphur concrete made by using Martian soil had and twice the compressive strength of sulphur concrete made with sand aggregate. Sulphur concrete is a thermoplastic material which allows it to be recycled on reheating. It does not require water which is totally or nearly absent from the Martian surface. Sulphur concrete has a disadvantage that it has limited thermal resistance, but due to the low temperature on Mars it has no damage on construction. It also has high energy consumption during production process. It also needs stable temperature during production process because of its low melting point fire could damage to building.

VI. CONCLUSION

After reviewing and comparing the different construction material on Mars we have found sulphur concrete is best among them. It is because of great sulphur content on Martian surface. Thus this material will be economical as there will be no need of carrying material from Earth to Mars, the only requirement will be of a laboratory on Mars where sulphur from Martian regolith and soil can be extracted. The sulphur concrete will also be an excellent construction material because of its properties of easy coping, fast curing, recyclability and adaptability in dry and cold environment.

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