POWERING HUMANITY ON MARS

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Abstract

Mars's surface is filled with rocky canyons, volcanoes, dry lake beds, craters, and vast plain arid deserts. It is the 4th planet away from the sun, located 142 million miles away from it, thus reducing the amount of solar energy reaching it to a great extent. So we have to utilize the incoming solar energy to mars to its fullest extent and look into other alternative sources by which we could produce energy to lead a sustainable society. This research paper gives a comprehensive approach in effectively dealing with the above two mentioned scenarios:

1. Effectively utilizing the incoming solar energy.
   a) Usage of retractable solar panels
   b) Linking solar power with the latest carbon capture technology to maximize energy production
2. Alternative forms of energy:
   a) Asteroid Mining
   b) Usage of suborbital accelerator
   c) Using clusters of microorganisms for converting CO2 into fuel

Introduction

Since the dawn of the space race, Mars was always seen as a prospective candidate for sustaining human life outside earth. In order to develop a martian community the primary necessity to find is energy. At present, we are mostly relying on RTGs(Radioisotope thermoelectric generators) and solar energy to produce energy for space missions. RTGs use Plutonium-238. It is easy to use but no doubt, expensive. Also, a mild mistake can create catastrophic effects. Looking at the modern-day world, the most viable option might seem like the use of solar energy as an energy substitute. But it also has a few significant drawbacks. The main reason is that the solar irradiance of mars is 590W/m^2 on average, which is only half the value we receive on earth; thereby, the amount of energy we can produce per square meter in mars will be only half that of earth. Secondly, dust storms on Mars are very frequent. These storms may deposit huge amounts of dust, thereby blocking sunlight from solar panels. Usage of wind energy is also not a viable option as Mars has a thin atmosphere. Explored here are a few ideas to improve the efficiency of solar energy and also alternative ways to generate fuel for meeting energy demands.

1. **Effectively Using Incoming Solar Energy**

- **Usage of sensor-based retractable solar panels**

  As discussed above, dust accumulation on solar panels is a major issue with solar power generation. But this could be tackled if we could develop a retraction mechanism for solar panels that closes the solar panels in case of a sandstorm and reopens them after the storm passes. For this system to work effectively, we can proceed in either of two ways. One way is by setting up a real-time weather monitoring system using satellites. Another way is by surrounding the base perimeter with an array of sensors that monitor the air's wind speed and particle concentration. If the wind speed gets very high or is laden with dust particles, the sensor array may pass the alert to the base. The base would, in turn, direct the retraction of the solar panels, thereby preventing much dust accumulation on them.

  But the above methods come with their drawbacks too. The primary reason is that dust storms on Mars are widespread, and if we apply this system, we would not be able to generate much energy.

- **Using Carbon Capture technology with solar panels**

  Recently, NASA developed a technology in which solar panels can convert carbon dioxide into usable fuel by using solar thin-film panels. Here photochemical cells composed of metal oxide films use UV, visible, and Infrared portions of sunlight along with titanium dioxide composites to perform a reaction in which CO2 is converted into methane. This would be very effective on mars as the martian atmosphere is 95% by volume CO2. Adding to this, this process is extremely cheap and highly effective in producing fuels on Mars.

2. Alternative forms of energy

- **Asteroid Mining for Interstellar travel**

  The asteroid belt between Mars and Jupiter is filled with millions of asteroids laden with abundant resources waiting to be explored. Among all the minerals found in asteroids, the most useful substance in the case of energy production is water. Water can be split into liquid hydrogen and liquid oxygen, the primary propellant and oxidizer required for a cryogenic rocket engine. So if we develop an array of asteroid mining satellites that hunts down the most resourceful asteroids and mines them,

the mined resources can be shipped to either the martian base or the martian space station, where it could be converted to usable fuel.

But this method also possesses some drawbacks. First of all, tracking down the required asteroids suitable for mining can be a tedious task. Construction of mining satellites on earth and transferring them to mars can be time-consuming and risk-laden. So to address this drawback, mining satellites can be indigenously built on mars, but humanity needs to progress a lot in the technological field to achieve this feat.

- **Suborbital accelerator**

This is the latest cutting-edge technology currently being developed by a company called Spin Launch. In this technology, payloads attain hypersonic speeds by accelerating them in a ground-based centrifuge. To carry this out effectively, the large centrifuge chamber is made into a vacuum, and the payload or satellite to be launched is attached to the arms of the centrifuge. The vacuum inside the centrifuge chamber helps the centrifuge attain very high velocities. When the maximum velocity is achieved, the payload is released from the centrifuge in a highly precise manner channeling the payload to the exit. This maneuver is highly

fuel-efficient and reduces the total fuel consumption to one-fourth the fuel required on an actual launch. A significant drawback to such a system is the complex infrastructure required and high initial investments.

- **Using clusters of microorganisms**

  Researchers at the Georgia Institute of technology found that various microbes like cyanobacteria have the ability to take in CO2 and convert it into sugars. These sugars produced can then be converted into propellant by a modified E. coli bacterium by fermentation. If we implement this system, we can save the cost of transporting fuel from earth. In addition to that, the excess oxygen produced in the process can be used for various other purposes in the martian settlements.

Conclusion

Based on all the above points we can see that the methods that are feasible with our current technology is solar power. Hence if we integrate solar power with retractable panels and carbon capture technology then there would be an enormous increase in energy production. This would act as a sustainable and long-lasting energy source that can power martian settlements and martian rovers.

In the case of rocket propulsion, the most viable option would be the use of a suborbital accelerator. Even though the initial cost of construction of such a project would be high in the long run it would be of great use.

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