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Could Helium-3 really solve Earth's energy problems?

Categories:

fusion, Months, Nuclear, Research

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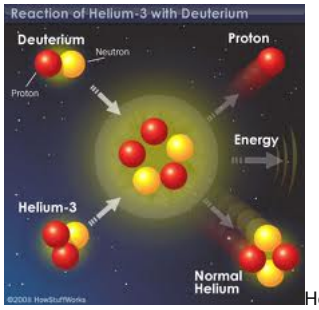
China is looking at mining Helium-3 from the moon. I have combined information for several articles to try and make sense of what all the excitement is about and why it has spawned a new space race.



Helium-3 is slightly different than the gas that fills birthday balloons. Rather, Helium-3 is a stable isotope of helium that is missing a neutron, with this missing neutron allowing for the production of clean energy. The moon holds a tremendous supply of Helium-3 on its surface, but will Helium-3 really be the answer to our energy problems on Earth?

Countries like China are taking this very seriously. Prof Ouyang was speaking ahead of the first Chinese attempt to land an unmanned spacecraft on the lunar surface.The Chang'e 3 lander is due to be launched in the near future. It will be the first to make a soft touchdown on the Moon since an unmanned Russian mission in 1976.No humans have set foot on the lunar surface since America's Apollo missions ended in 1972. One of the reasons quoted for going to the moon "the moon is "so rich" in helium-3, which is a possible fuel for nuclear fusion, that this could "solve human beings' energy demand for around 10,000 years at least".

Helium-3 Fusion Reaction

Two types of fusion reactions make use of Helium-3 to produce clean energy. The first uses deuterium (deuterium is hydrogen with a neutron) reacting with Helium-3, to produce helium and a proton. The second type of reactions uses two atoms of helium-3 to create helium and two protons. The protons created during the reaction are the crown jewel of Helium-3 fusion.

One of the best parts of the proposed Helium-3 reaction is the complete lack of radioactive byproducts. No neutrons are emitted, and no isotopes are left as products that could radioactively decay. The proton is a particularly nice side product, since clean energy can be harnessed from this stray proton by manipulating it in an electrostatic field.Traditional nuclear fission reactions create heat, which is then used to heat water. The boiling water forces turbines to spin and generate energy. In the Helium-3 fusion process, energy is created via the

reaction itself, with no nasty radioactive material for future generations to monitor.

The Helium-3 fusion process is not simply theoretical — the University of Wisconsin-Madison Fusion Technology Institute successfully performed fusion experiments combining two molecules of Helium-3. Estimates place the efficiency of Helium-3 fusion reactions at seventy percent, out-pacing coal and natural gas electricity generation by twenty percent.

The amounts of helium-3 needed as a replacement for conventional fuels are substantial by comparison to amounts currently available. The total amount of energy produced in the $^{2}_{1}H + ^{3}_{2}He$ reaction is 18.4 MeV, which corresponds to some 493 megawatt-hours (4.93×10^{8} W·h) per three grams (one mole) of ³He. Even if that total amount of energy could be converted to electrical power with 100% efficiency (a physical impossibility), it would correspond to about 30 minutes of output of a gigawatt electrical plant; a year's production by the same plant would require some 52.5 kilograms of helium-3. The amount of fuel needed for large-scale applications can also be put in terms of total consumption: According to the US Energy Information Administration, "Electricity consumption by 107 million U.S. households in 2001 totaled 1,140 billion kW·h" (1.14×10^{15} W·h). Again assuming 100% conversion efficiency, 6.7 tonnes per year of helium-3 would be required for that segment of the energy demand of the United States, 15 to 20 tonnes per year given a more realistic end-to-end conversion efficiency.

Chang'e 3 model: Not since the Soviets' Luna 24 mission has there been a soft landing

Mining the Moon

According to British space scientist, Prof Richard Holdaway,China could have astronauts on the lunar surface by 2025. "They started from a long way back but now they're catching up fast – they want to monitor what's happening on the ground, they want to be part of the analysis of climate change and a much bigger programme looking at the Moon for mining or as a staging post to other parts of the Solar System."

Liu Yang, China's first female astronaut

On the subject of mining the Moon he told BBC reporter David Shukman "It's perfectly plausible from the technical point of view, absolutely plausible from the finance point of view because they have great buying power, so I think, yes, there's nothing at all to stop them doing that probably within something like 10 years."If all goes according to plan, the spacecraft will take six days to reach the Moon and then face the challenge of a soft landing. Will the next boots to walk on the lunar surface to be worn by Chinese astronauts.

The Russian company Energia claimed in 2006 that it would have a permanent moon base in 2015 and harvest Helium-3 by 2020. But the company appears to be woefully behind in making these claims become reality.

Conclusion:

I have this big problem with all this which is best illustrated in the following picture I found on Google images. Perhaps I am a dumb-as or am I just missing something?

Sources:

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