Terraforming Venus- Cooling and Transforming the Planet

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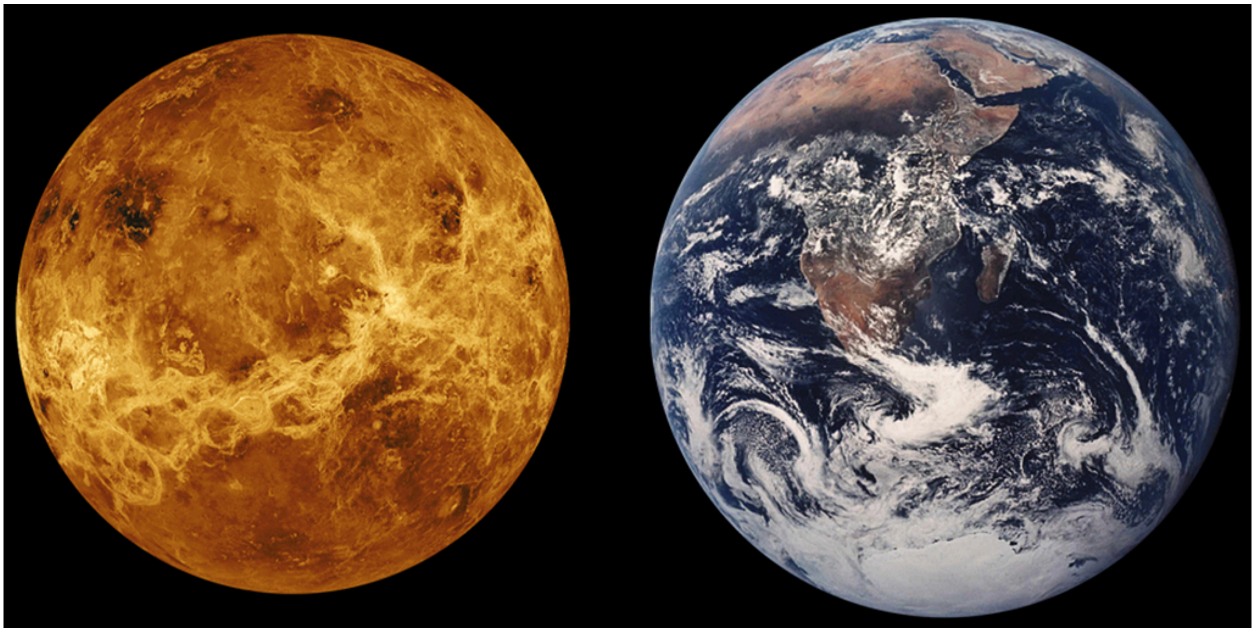

In terms of colonizing other planets, it is much more logical, and efficient, to colonize Mars and Venus before making efforts to colonize planets in other star systems. Reaching other star systems is difficult, at best. Terraforming Venus and Mars supports the expansion of humanity to other planets, providing new resources and lowers the chances of human extinction, should Terra be hit by a large asteroid.

Terra vs Venus

Venus and Terra are roughly the same size, with nearly the same gravitational attraction. Terra's atmosphere[1], however, is composed primarily of 78% nitrogen, 21% oxygen and small amounts of carbon dioxide, argon, and water vapor, while Venus' atmosphere[2] is made up of about 96.5% carbon dioxide and 3.5 % nitrogen.

Due to a runaway greenhouse effect[3] on Venus, caused by its carbon dioxide rich atmosphere, Venus has developed an extremely hot surface, with an average temperature of 460°C (about 867°F). Compare this to the temperature of Mercury, which orbits much closer to the sun, and "only" reaches temperatures of 430°C (800°F) on the side facing the sun. (Mercury has a "very" slow rotation[4], and lacking an atmosphere, the dark side can reach temperatures as cold as -290 F.)

Terraforming Venus will require massive amounts of energy, and spaceships that are much more technically advanced than we are currently using.

Step 1- Cooling Venus

Cooling Venus is the first step in altering the planet's atmospheric chemistry. Currently, the planet is simply too hot for astronauts to even consider stepping foot on. Their spacesuits would melt. Spacesuits can protect astronauts[5] from temperatures up to about 121°C (250°F). Additionally, the process of cooling Venus will convert a number of poisonous gases into solids and liquids, removing them from the atmosphere. Cooling Venus will also make the process of breaking carbon dioxide down to oxygen and carbon much easier.

The process of cooling Venus will require delivering a cloud of particles in orbit around Venus, or in the upper atmosphere, blocking Sol's sunlight. (A similar technique could be used to cool Terra[6]… if it weren't for the short-sighted stupidity of governments being controlled by the out-of-touch-with-reality extremely rich.) Because Venus' atmosphere is made up of 97% carbon dioxide — and a smaller percentage of extremely poisonous gases — the planet will not cool quickly, but retain its heat. It could easily take a decade or two to cool Venus to a temperature 27° centigrade (80° fahrenheit) at its equator. When this temperature is achieved, the poisonous gases in the atmosphere will have cooled to a liquid or solid state, and will now be on the surface of the planet. At this temperature, humans can build atmospheric domes to live in, and wear something similar to spacesuits to work outdoors.

The cloud of particles orbiting Venus will eventually spread out, or drop from the atmosphere, becoming less and less effective as time passes. This cloud may need to be "maintained" by adding additional particles. (In terms of cooling Terra, which needs much less cooling, the cloud of particles might be made up of a material that breaks down over time as it reacts with ultraviolet light. Otherwise, getting rid of the cloud, after Terra has cooled 4 or 5 degrees, might be difficult.)

Step 3- Breaking Down the Carbon Dioxide

There are two potential methods for breaking carbon dioxide into carbon and oxygen- the use of electron guns[7] and a process using liquid gallium and electric current[8]. The gallium and electric current carbon punching tactic used in the Tribo Process will effectively decompose carbon dioxide into one carbon atom and two oxygen atoms.

I have been unable to find a research paper describing the effects of electron guns on carbon dioxide or its foundation molecule carbon monoxide. However, considering the sheer volume of carbon dioxide in Venus' atmosphere (96%) both methods could be used. The electron gun technique is clumsier and less effective, and might not even work. (It might knock out a bonding electron, only to have it replaced, instantly, by another electron.)

It is important that the carbon monoxide foundation molecule be broken down, as well. If it is not, the carbon monoxide molecule will eventually combine with a second oxygen atom[9] and become carbon dioxide, once again. (The carbon punching process supported by using gallium and a mild electrical current, has been proven to be highly effective. It successfully neutralizes the remarkably strong bonding electron that supports the carbon monoxide molecule.)

Step 4- Supplying Gallium

Gallium is an element that is needed for the process of breaking carbon dioxide down into oxygen and carbon. Large amounts of gallium will be needed to terraform Venus within a reasonable amount of time. The more carbon punchers operating simultaneously, the faster the carbon dioxide is broken down.

I have a strong prejudice against removing Terra's resources from Terra. Fortunately, many asteroids seem to contain gallium. This "observation" is supported by the analysis of several iron meteorites which are believed to be the fragments of metallic asteroids.

The presence of gallium concentrations have been researched extensively within iron meteorites[10], and a classification system separating asteroids into "gallium-germanium groups" (IAB, IIAB, IIIAB, IVA, IVB) has been developed. Gallium is typically present as a trace element in M-type, or metallic asteroids, which are made up primarily of iron.

Moving the appropriate asteroids into an orbit around Venus could be done while the planet is cooling. Parachutes could be used to lower the asteroids containing gallium to Venus' surface, rather than relying on gravity alone, which would result in asteroids melting and vaporizing as they fly through the atmosphere.

Step 5- Delivering Water To Venus

Venus is described as the driest planet[11] in the solar system, with the atmosphere containing only 0.002% water (and no liquid water on the surface).

Breaking down the carbon dioxide in Venus' atmosphere will release massive amounts of oxygen. Far more than is needed for purposes of breathing. Bringing in hydrogen gas to combine with the oxygen (and providing a fuel to power the domes and equipment) will result in water production. These efforts, however, aren't going to create any oceans, and a lack of water will severely limit the growth of plant life. (It just occurred to me — we could ship the excess oxygen to Mars for terraforming purposes.)

Dropping several large comets into the atmosphere, after the planet has been cooled, might be helpful — comets are mostly water[12]. Venus is 95% the mass of Terra. Adding an ocean or two would also have the effect of increasing Venus' mass, and, in turn, its gravitational attraction.

"Terran-like weather" on Venus will only take place when oceans have been introduced into the planet's environment.

Bringing water to Venus should take place after the planet has been cooled, and while the carbon dioxide is being converted to oxygen and carbon. Hydrogen should be used as a fuel source, combining it with oxygen to produce water.

Step 4- Obtaining and Introducing Nitrogen

Earth's atmosphere is composed of 78% nitrogen, 21% oxygen, and small amounts of carbon dioxide, and argon. Venus, unfortunately, has no significant amounts of nitrogen. Stealing nitrogen from Terra would be… stupid. However, Saturn's moon, Titan[13], does have a stratosphere that is 98.4 nitrogen, and might act as a source.

A massive sack-like container could be used to collect and transport the nitrogen.

It's vaguely possible Titan has developed some form of life (though probably not carbon-based). This concern should be investigated before stealing Titan's nitrogen.

Step 5- Dealing With the Poisons on Venus' Surface

There isn't actually that much poison in Venus' atmosphere. As it cools these poisons should rain down somewhat evenly around the planet. Considering the small amount of poisons, there's a good chance they will be spread so thinly they will pose no threat to human terraformers. However, there is also the probability some of the poisons will pool, creating puddles — maybe even very small lakes.

If the poisons do pool, collecting them should be accomplished using a combination of human and robotic services. If some of the poisons come down as pellets (sleet), cleaning them could be fairly simple, but the pellets would be scattered everywhere and the process should be assigned to single purpose robots.

In Conclusion

The primary reason for terraforming Venus is the expansion of the human race. Altering a planet (or 3 or 4) within our own solar system, in the long haul, is far more cost effective than travelling to other star systems, and having to terraform planets "there." Additionally (and I hope I'm wrong), we may never develop the technology needed to achieve faster-than-light speeds, and the ability to survive the incredible "cold" that exists between solar systems (which is kind of a necessity for interstellar exploration). Don't get me wrong — I want to explore other solar systems, and hope we develop the needed technology, but, with almost no understanding of gravity, we're definitely not there yet.

It will be at least 50 years before we're technologically advanced enough to make terraforming Venus feasible. A major breakthrough in space ship fuels (or in our understanding of gravity) will be needed before we can terraform Venus or Mars efficiently. (Mars doesn't have a poisonous atmosphere, but needs a lot more mass/gravity to sustain Terran life, and to stop bleeding its atmosphere into space. A strong, organized magnetic field may also be necessary.)

Altering Venus' environment as dramatically as described will require a huge amount of energy, and could easily take 200-500 years before the project, from start to finish, is complete. Maybe longer.

References

[1] ‘Astronomy’ by Andrew Franknoi, David Morrison, and Sidney C. Wolff, Chapter 54, Earth’s Atmosphere @ https://open.maricopa.edu/asttemp/chapter/earths-atmosphere/, incorporated into Pressbooks on August 7, 2019.

[2] ‘Venus Atmosphere, Mainly Composed of Carbon Dioxide and Nitrogen’ by the Royal Belgian Institute for Space Aeronomy @ https://www.aeronomie.be/en/encyclopedia/venus-atmosphere-mainly-composed-carbon-dioxide-and-nitrogen

[3] ‘Greenhouse effects... also on other planets’ by the European Space Agency on 14/02/2003 @ https://www.esa.int/Science_Exploration/Space_Science/Venus Express/Greenhouse_effects_also_on_other_planets

[4] ‘How Hot is Mercury?’ Nola Taylor Tillman published by Space.com, published November 29, 2016 @ https://www.space.com/18645-mercury-temperature.html

[5] 'How Cold Is Outer Space?' Alfredo Carpineti, published by IFL Science, October 5, 2022 @ https://www.iflscience.com/how-cold-is-outer-space-65599

[6] ‘Injecting light-reflecting particles into the stratosphere could also make marine clouds brighter’ published by NOAA Research on March 24, 2025 @ https://research.noaa.gov/injecting-light-reflecting-particles-into-the-stratosphere-could-also-make-marine-clouds-brighter/

[7] ‘Investigation of industrial-scale carbon dioxide reduction using pulsed electron beams’ by G. M. Petrov; J. P. Apruzese; Tz. B. Petrova; M. F. Wolford, published in the Journal of Applied Physics of AIP Publishing, March 10, 2016 @ https://pubs.aip.org/aip/jap/article-abstract/119/10/103303/141035/Investigation-of-industrial-scale-carbon- dioxide

[8] ‘Brief History of Gallium & Its Use in Carbon Punching’, Keith D. Foote, published by Medium October 17, 2025 @ https://medium.com/@zentrekker/brief-history-of-gallium-its-use-in-carbon-punching-86d2b180aaca

[9] ‘Carbon Monoxide' published by UCAR (University Corporation for Atmospheric Research) Center for Science Education, © 2017 UCAR @ https://scied.ucar.edu/ learning-zone/air-quality/carbon-monoxide

[10] ‘The distribution of gallium, germanium, cobalt, chromium, and copper in iron and stony-iron meteorites in relation to nickel content and structure', John F. Lovering, Walter Nichiporuk, Arthur Chodos, Harrison Brown, published by Science Direct Volume 11, Issue 4, 1957, Pages 263-278 @ https://www.sciencedirect.com /science/article/abs /pii/0016703757900996

[11] 'Venus has almost no water. A new study may reveal why', Daniel Strain published by CU Boulder Today on 5/6/2024 https://www.colorado.edu/today/2024/05/06/venus-has-almost-no-water-new-study-may-reveal-why

[12] ‘Nasa Science SpacePlace’, article last updated October 24, 2019 @ spaceplace.nasa.gov/comet-ocean/en/

[13] ‘Saturn's Moons; Titan Facts,’ published by NASA Science @ https://science.nasa.gov/saturn/moons/titan/facts/