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CO_2 Conversion Challenge

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Challenge

Objective

Future habitats on Mars will need to be largely self-sufficient. This includes recycling supplies brought from Earth and using local resources such as carbon dioxide (CO_2) and regolith to manufacture mission products. Many of these products such as food, nutrients, medicines, plastics, fuels and adhesives are organic – comprised mostly of carbon, hydrogen, oxygen and nitrogen. These molecules are readily available within the Martian atmosphere and can potentially be converted to "food" for microbes that can be used in advanced biomanufacturing systems to generate a wide array of mission products.

NASA's CO_2 Conversion Challenge, a Centennial Challenges competition, seeks to incentivize the public to develop non-biological systems that can convert CO_2 into useful sugar molecules, like glucose. Sugars are the preferred feedstock for the types of microorganisms commonly used in commercial biomanufacturing systems. While sugars are usually derived from certain plants on Earth (ex., sugarcane), this approach is not easily adapted to space missions because of the size of these systems and resources needed to grow these plants.

Developing new CO_2 conversion technologies to rapidly and efficiently make sugars will enable in-situ manufacturing of products that allow humans to live and thrive while exploring other planets. These technologies will also help revolutionize sustainable manufacturing on Earth, as they allow an extensive range of products to be made from the CO_2 in the atmosphere and industrial emissions.

Prize Purse

The total available prize purse for all phases of this challenge is expected to be $1,000,000 provided by NASA.

Description

The CO_2 Conversion Challenge takes place in two phases:

Phase 1: Concept — Completed May 2019

Teams described in detail their approach to achieve the conversion of CO_2 to D-glucose, or other simple sugars. Teams submitted a system design concept and preliminary supporting data to prove the ability to carry out a conversion process. NASA awarded five teams $50,000 each for a total prize amount of $250,000. Phase 1 was completed in May 2019.

Phase 2: Demonstration
Phase 2 of the competition opened in September 2019. In this phase, teams build a physiochemical system and demonstrate physical conversion using CO_2 as the sole carbon source into one of the molecules identified below (listed in order of preference).

- D-Glucose
- Other 6-carbon sugars (hexoses)
- 5-carbon sugars (pentoses)
- 4-carbon sugars (tetroses)
- 3-carbon sugars (trioses)
- Glycerol

Points will be given based on the preference of the molecule created, the overall concentration of the molecule in the product, and overall system attributes. A total prize purse of $750,000 is available for Phase 2, to be divided among the top three teams to successfully create any of the pre-defined molecules.

Centennial Challenges, part of the Prizes and Challenges Program within NASA's Space Technology Mission Directorate, offers incentive prizes to generate revolutionary research and technology solutions to problems of interest to NASA and the nation. Centennial Challenges is managed at NASA's Marshall Space Flight Center in Huntsville, Alabama.

For more information on the CO_2 Conversion Challenge, visit:

www.co2conversionchallenge.org

For information on the Centennial Challenges program, visit:

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