Principles of Engineering

Space Technology

MISSION TO MARS - RENEWABLE RESOURCES

Mission 1 – Introduction to Aquaculture

Objective:

At the completion of this mission, you will demonstrate how Aquaponics systems work. You'll then assemble a working model of an Aquaponics system.

Briefing:

Fig 1. Even a small classroom aquaponics systems can produce a lot of food.

One of the problems that engineers, scientists, and astronauts will have as they plan bases on our Moon or Mars is coming up with renewable resources for food, water, and air. Launching spacecraft to re-supply these bases will be costly and dangerous. This, coupled with the long space flights and a degree of uncertainty make local renewable resources (like Aquaponics) desirable if not essential. Aquaponics systems produce vegetables and fish, as well as, cleanse wastewater and convert CO_2 to Oxygen. They also produce organic material that can enrich otherwise barren soil. Ultimately, fresh vegetables and fish are a healthier choice and Aquaponics may be the only way for those working in space to enjoy them.

As the name implies, aquaponics is the combination of Hydroponics and Aquaculture (Fish Farming). Essentially, it's a delicate balance between meeting the needs of the fish, maintaining the quality of their water, and providing for the growth of the fish and plants. Aquaponics systems are, in fact, closed systems where fish excrete waste into their water, which feeds the plants causing them to grow, bear fruit, and multiply. The plants remove some harmful waste from the water and produce food not only for people but for fish as well. Plants also convert CO_2 into Oxygen… very important on a Moon or Mars base. Unlike soil, the plant cup gravel does not provide nutrition for the plants. All nutrients come from the fish waste in the water. The gravel holds the plant's roots, but its primary function is as a bio-filter. It holds bacteria that metabolize the remaining waste converting it to inert organic material. This maintains the water quality so the fish stay healthy, grow, and reproduce. That's good because fish are not only a great resource for protein, but quite tasty… especially if the only other choice is NASA "food in a tube."

How Does an Aquaponics System Work?

Now that you know what and aquaponics system is… Here's how it works. There are four parts to an aquaponics system. All parts need to be carefully considered and monitored closely to insure not only the health and balance of the system, but to maximize food production and the waste water processing.

- ***Water*** – All living things need water. Plants and animals need it to help metabolize food and flush away waste, but for fish… Water is their environment. Water carries the air they breath and transport waste away. Water can support plant and animal life only if it's relatively free from pollutants and pathogens. That's why it's important to wash everything that comes into contact with the aquaponics system. The smallest amount of soap under a fingernail can kill an entire stock tank. Everything that goes into the system is washed with water, and water, only.
  Temperature, water hardness, PH, and dissolved gasses are also important qualities that effect fish health. Different species of fish and plants do better at a different temperature, water hardness and PH levels. Some dissolved gasses like ammonia, CO_2 and chlorine are dangerous to fish and need to be monitored and controlled. City utilities often add chlorine to the water supply to kill micro-organisms that can make people sick. However, chlorine also kills fish so let the water stand at least 24 hours before adding it to the system. This allows the chlorine to evaporate away. Water hardness and PH must also be monitored and controlled. Generally speaking, the softer the water and the more neutral the PH, the easier it is to control ammonia and pathogens. These conditions are normally optimal conditions for aquaponics systems.

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