NASA SBIR 2010 Phase I Solicitation

X3.01 Process Technologies for Life Support System Loop Closure

Lead Center: MSFC

Participating Center(s): ARC, GRC, JSC, KSC

Atmosphere Revitalization Process Technologies

**Regenerative CO\(_2\) Reduction Reactors:** Carbon dioxide reduction processes based on the Bosch series of reactions suffer from catalyst coking and subsequent deactivation. A novel process where the catalyst is either resistant to coking and/or may be regenerated in-situ is sought.

**Alternatives to Pyrolysis for CH\(_4\) Management:** Process technologies are sought that convert CH\(_4\) into either elemental products (carbon and H\(_2\)) or other useful commodities (fuel, organic synthesis precursor, or other) by reaction with available cabin resources such as O\(_2\), N\(_2\), or other readily available reactant.

**Gas Separations:** CO\(_2\) reduction processes involve complex feed, recycle, and effluent gas mixtures. Process technologies and techniques for separating H\(_2\), CH\(_4\), and CO from complex effluent gas streams to facilitate their recycle and further reaction are sought.

**Regenerable Particulate Matter Filters and Separators:** Efficient methods of regenerating particulate filters and separators are sought to reduce crew maintenance time and eliminate the need for consumable filter elements. These units should be self-cleaning in-place (preferable) or off-line. Targeted technologies should be compact and lightweight, easily integrated with the spacecraft life support system, and provide viable methods for disposing of collected particulate matter while minimizing or eliminating direct contact by the crew.

Water Recovery Process Technologies

Efficient technologies are desired for recovering and purifying wastewater to potable quality. Emphasis is on the development of technology that is capable of operation in microgravity. In addition, the use of power and consumable components or chemicals should be minimized. Wastewater requiring treatment on spacecraft may consist of one or more waste streams including urine, brines, humidity condensate, hygiene water, and/or laundry water. Areas of emphasis are the following:
Removal of Dissolved and Suspended Solids from Wastewater: Process technologies suitable for serving as primary or secondary treatment stages to provide alternative treatment options to the vacuum compression distillation process equipment used on the International Space Station are sought. The dissolved and suspended solids may be composed of organic or inorganic compounds. The wastewater may have a total organic carbon concentration as high as 2000 mg-C/l and conductivity up to 12 mS/cm. Performance of proposed process technologies should be insensitive to solids precipitation.

Water Recovery from Brines: Many systems used for wastewater recovery produce clean water while concentrating contaminants into a highly concentrated brine waste. Microgravity-compatible process technologies capable of recovering a product water containing

Oxidation Technologies for Disinfection of Recovered Potable Water: Techniques for reducing the concentration of bacteria in potable water to less than 50 CFU/ml are sought that require minimal consumables resupply and are demonstrated to be compatible with the spacecraft cabin environment and life support systems.