water from a urine container into the concentrated fortified drink as part of a recycling stage. An activated carbon pretreatment removes most organic molecules. Salinity of the initial liquid mix (urine plus other) is synergistically used to enhance the precipitation of organic molecules so that activated carbon can remove most of the organics. A functional osmotic bag is then used to remove inorganic contaminants. If a contaminant is processed for which the saline content is different than optimal for precipitating organic molecules, the saline content of the liquid should be adjusted toward the optimal value for that contaminant.

A first urine treatment method converts urine into a fortified sports drink, resembling Gatorade, using a first urine cell. A membrane filter that is hydrophilic allows water to diffuse through the filter but blocks most contaminants using a micropore construction. Water is drawn through the membrane by a forward osmotic pressure differential, generated by the liquid feed, sugars, and electrolytes contained in a concentrated sports drink, which is positioned on the product (output) side of the membrane. Water, initially contained in urine, diffuses through the membrane to approximately balance the concentration gradient. As a result, the sports drink will become diluted and the urine will become concentrated. The maximum number of urine recycling sessions is about ten. The process is a modification of a process used in a water treatment cell from Hydration Technologies X-Pack.

A second urine treatment method uses osmotic distillation and a hydrophobic, microporous membrane filter, with a product (output) side exposed to a second liquid phase that is capable of absorbing wastewater that is presented on the input side of the filter. The method is sometimes referred to as isothermal membrane distillation and is driven by a vapor pressure gradient rather than by a temperature gradient.

This work was done by Michael T. Flynn of Ames Research Center and Sherwin J. Gormly of the National Space Grant Foundation. Further information is contained in a TSP (see page 1). ARC-15890-1

Microchip Non-Aqueous Capillary Electrophoresis (μNACE) Method to Analyze Long-Chain Primary Amines

NASA's Jet Propulsion Laboratory, Pasadena, California

A protocol was developed as a first step in analyzing the complex organic aerosols present on Saturn's moon Titan, as well as the analogues of these aerosols (tholins) made on Earth. Labeling of primary amines using Pacific Blue™ succinimidyl ester is effected in ethanol with 25 mM triethylamine to maintain basic conditions. This reaction is allowed to equilibrate for at least one hour. Separation of the labeled primary amines is performed in ethanol with 1.05 M acetic acid, and 50 mM ammonium acetate in a commercial two-layer glass device with a standard cross-microchannel measuring 50 microns wide by 20 microns deep. Injection potentials are optimized at 2 kV from the sample (negative) to the waste well (positive), with slight bias applied to the other two wells (–0.4 and –0.8 V) to pinch the injection plug for the 30-s injection. Separation is performed at a potential of 5 kV along the channel, which has an effective separation distance of 7 cm.

The use of ethanol in this method means that long-chain primary amines can be dissolved. Due to the low pH of the separation buffer, electro-osmotic flow (EOF) is minimized to allow for separation of both short-chain and long-chain amines. As the freezing point of ethanol is much lower than water, this protocol can perform separations at temperatures lower than 0 °C, which would not be possible in aqueous phase. This is of particular importance when considering *in situ* sampling of Titan aerosols, where unnecessary heating of the sample (even to room temperature) would lead to decomposition or unpredictable side reactions, which would make it difficult to characterize the sample appropriately.

This work was done by Peter A. Willis and Maria Mora of Caltech, and Morgan L. Cable and Amanda M. Stockton of ORAU for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-48615

Low-Cost Phased Array Antenna for Sounding Rockets, Missiles, and Expendable Launch Vehicles

Commercial applications include conformal satellite antennas for recreational vehicles, cars, and residences.

Goddard Space Flight Center, Greenbelt, Maryland

A low-cost beamformer phased array antenna has been developed for expendable launch vehicles, rockets, and missiles. It utilizes a conformal array antenna of ring or individual radiators (design varies depending on application) that is designed to be fed by the recently developed hybrid electrical/mechanical (vendor-supplied) phased array beamformer. The combination of these new array antennas and the hybrid beamformer results in a conformal phased array antenna that has significantly higher gain than traditional "omni" antennas, and costs an order of magnitude or more less than traditional phased array designs.

Existing omnidirectional antennas for sounding rockets, missiles, and expendable launch vehicles (ELVs) do not have sufficient gain to support the required