Notes from ISRU Monthly Meeting

September 2020

Notes from Discussion

Synopsis from ISRU Supply / Demand Workshop ::REFER TO SLIDES::

- Over 200 attendees
- Over half were LSIC attendees
- Also have seen an uptick in LSIC memberships
- An out brief report and presentation is in the works for NASA (will also be shared with the group)

- Gary Barnhard pointed out that determining the most manageable phases for water / hydrogen (on demand vs. production) for different customers should be more than a secondary concern.
    - Michael Nord responded that Firehawk and OrbitLab want water, not liquid hydrogen

- Dallas Bienhoff suggested taking water and breaking it into how much oxygen and how much hydrogen a customer needs
    - Jerry Sanders responded that just stating the product need was important, without necessarily knowing where it specifically comes from at this pointKarl Hibbitts pointed out that another variable is different mixtures used by different customers
    - Ron Jones added that producing hydrogen without knowing the demand could lead to issues with storage

    - Clive Neal pointed out that establishing an evolution plan for demand is a major outstanding issue, and should be listed as its own 'bullet point' as a question to address
    - Karl Hibbitts and Jerry Sanders added that anchor tenants would likely be a factor

- Jerry Sanders added that another bullet point should be aded for understanding the lunar water resources better

ISRU Water Ice Open Discussion ::REFER TO SLIDES::

- John Gruener raised a concern about a lack of knowledge about what surrounds water ice, and how expensive it might be to extricate

- Dennis Wingo pointed out via chat that perfect is the enemy of good, so what is good enough?
    - He followed up that his opinion is that the amount of power needed to operate on the lunar surface is being vastly underestimated

- Karl Hibbitts pointed out that he didn't expect a relationship between surface abundance of frost and subsurface abundance of ice
    - Dennis Wingo argued that the Apollo missions proved the existence of ice and we just have to get there and measure what's actually present

    - Dennis Wingo also pointed out that determining whether there's a high enough concentration of water depends upon the established systems engineering, just like it does terrestrially

- Gary Barnhard pointed out another consideration was what transformation would be necessary to transport for further processing

- Kirby pointed out the discussion between Leslie and Dennis (in chat) about how drilling dry wells was not necessarily bad, that drilling them to 'practice' was still a win
    - Clive Neal agreed and said this wasn't about mining wells, but extracting minerals
    - Michael Poston added that a discussion at LEAG said sampling would necessitate drilling to check controls
    - Dennis Wingo pointed out that the drills that have already been used extraterrestrially have been science implements and not true mining tools

- Kirby Runyon synthesized the point that there's a need to understand subsurface ice abundance at the relevant scale, so what should the relevant scale be?
    - Kirby further extrapolated that the community was on board with a CLPS lander dedicated to handling ISRU and related geotechnical issues (all agreed)

- Kirby Runyon asked what the group's thoughts were on wheeled versus walking robots
    - Clive Neal responded that walking robots were too risky, and that the initial mining would not be done on an incline anyway
    - Gary Barnhard pointed out the value of Occam's Razor and setting up an engineering system to succeed

- Bonnie Dunbar pointed out that if water is in a liquid phase during processing, you may have to worry about whether 1G models and heat mass transfer apply to the environment

Discussion about Year One Goal ::REFER TO SLIDES & CONFLUENCE::

- Gary Barnhard said his initial reaction was a need to mature the end to end process
- Leslie Gertsch suggested replacing technology approach with capabilities approach
- Dallas Bienhoff pointed out that both water and regolith should be listed as sources of oxygen
- Dennis Wingo suggested that an actual numerical scale should be identified

Notes from Chat

- Other Materials for ISRU
    - Aluminum for rocket fuel
    - Silicon / aluminum for solar panels
    - Methane seen in LCROSS data (low concentrations)
    - LCROSS also found carbon bearing compounds
    - Hydrogen is also in demand, along with O2

- OVERALL: Need for ground truth on all volatiles
    - Concentration data important

- Water Storage / Usage
    - ALICE fuel would be water even at launch
    - Main storage as water with days of O2 and H2 storage

- Defense Innovation Unit is about to award activities under Multiple Orbit Logistics opportunity (inc. lunar landers) - should be contacted about propellants being considered

- Location of post Supply / Demand Workshop discussion on Confluence: https://lsic-wiki.jhuapl.edu/x/B4A9

- CSDC provided range of values for water that ISRU must beat to be salable

- Demonstrations of water ice extractability needed, info about abundance and quantities

- Extraction system demonstrations needed, including mining, transport, processing, refining / purifying, and more transport to manufacturing / placement

- How to measure how much H2O / OH vapor is lost in extraction process
    - Measure or estimate from research on Earth and in situ

- Viability of 100 to 1000ppm of OH extraction for reserve of H2o depends on cost and efficiency of extraction system (not well defined)

- Power is a big driver for lower concentrations b/c of need to process more material

- Julie Kleinhenz's work simulates water vapor extraction from simulant regolith

- Need to stop calling resource extraction digging wells

- VIPER Trident has been tested at Glenn Research Center drilling into ice-bearing simulant in thermal vacuum chamber (refer to Kris' presentation)

- Relevant scale for technology requirements depends on extraction technologies to be used (bucketwheel excavator vs. RASSOR-sized excavator) and safety factors in the system