**Analysis Results of Mineral Recovery SOPOS/DMPs for Data to be Included in a Mineral Recovery GDR Content Model**

**Assessed by:** Neil Popovich

**Date:** November/December 2014

**Background:**

Information collected by Neil Popovich during November/December detailed review of Mineral Recovery Statement of Project Objectives and Data Management Plans. The following information is relevant to seven of the nine FOA awards. The other two FOA awards (Simbol and UC Davis) are not applicable to this information because they are aimed at collecting analytical chemistry on existing geothermal sites (not R&D of mineral recovery processes).

**Background information for each submittal (Refer to Metadata tab in other Content Models):**

* Dataset title
* Dataset description
* Author information
  + Name
  + Author role
  + Company/organization name
  + Address
  + Phone number
  + Email address
* Important notes and assumptions helpful for data interpretation. This can be an excerpt of text provided to DOE in the quarterly reports to DOE.

**Variables to describe/evaluate REE removal:**

* Removal technique/method description (adsorption, ligand, magnetic nanofluid, etc.)
* Removal media chemical structure description (silica structure with xxx removal agent, metal organic framework with XXX removal agent).
* Rare Earth Element evaluated (Li, Mn, Ca, Wu, Y, etc.)
* Removal media capacity: weight REE absorbed/weight media (miligrams per gram or %wt of REE/wt of media)
* Removal efficiency of individual REE: % total of an individual REE removed)
* Removal efficiency of all REEs (% total of all combined REEs removed)
* Removal media selectivity (wt of REE evaluated on removal media/ total weight of all REE on removal media)
* Selectivity factor (Ratio of number of times more likely to remove a certain REE specie)

**Variables influencing removal and describing removal media**

* Brine temperature (°C)
* ionic strength/concentration of removal media (g/L)
* pH
* salinity/total dissolved solids in mg/L
* Reaction time (seconds)
* Mass loading of removal media (wt of removal media/ weight of removal media + weight of support structure)
* Removal media concentration (ligand per gram of nanoparticle)
* Magnetic properties of the removal media?
* Removal media structure:
  + Atomic composition of removal media
  + Molecular weight of removal media
  + Media surface properties (concentration of surface sites)
  + Polymer surface area
  + Particle size
  + Ligand density
  + Polymer porosity
  + Polymer cross linking ratio

**Variables describing the removal (“reactor”) technique**

* Reactor type (plug, batch, membrane, mat)
* Reactor inlet analyte concentration (mg/L)
* Reactor exit analyte concentration (mg/L)
* Reaction time (seconds)
* Reactor volume (Liters)
* Flow rate (L/sec)
* Column length (cm)
* Column diameter (cm)
* Reactor pressure (kPa)
* Pressure drop across reactor (kPa)
* Reactor lifetime (Liters of total brine flow)
* Fowling time (Liters of total brine flow)
* Chemical stability of removal media (only good for a certain pH/chemistry range?)
* Thermal stability of removal media (only good for a certain temp range?)
* Contact efficiency (% contact efficiency)
* Scalability of reactor
* Pre-conditioning of brine carried out before the reactor (pH adjustment, competing REE removal, etc)

**Variables describing the ability of the media to be re-used**

* Removal media lifetime (days, hours, number of media regeneration cycle)
* pH (effect on media re-use) –
* Reactor/removal media reversibility- (can media be re-used- Yes/No)
* Chemical stripping agent use to remove REE from media (Nitric acid, Hydrochloric acid, etc.)
* Chemical stripping agent concentration (mol/L)
* Percent of REE removed from media (% removed through during media ‘rinse’)

**Techno economic and process economics**

* Brine flow rate (L/minute)
* REE concentration in brine (g/L)
* REE recovery amount per brine flow rate (grams/L)
* Process size (brine volume in Liters processed per day)
* Total annual REE recovered per year (tons)
* Base year for analysis assumptions
* REE market price
* Removal media cost/production cost
* Capital costs
* Energy cost
* Labor cost
* Taxes
* Depreciation per year
* Extraction efficiency
* Operating expense: media, chemicals, labor, utilities
* Rate of return of removal process (%)
* Net present value