

Demonstrations of Holistic, Lower Cost/Energy Effluent Water Management Approaches for Coal-Fired Energy Plants

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Jeffery Preece
Principal Investigator

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Project Team

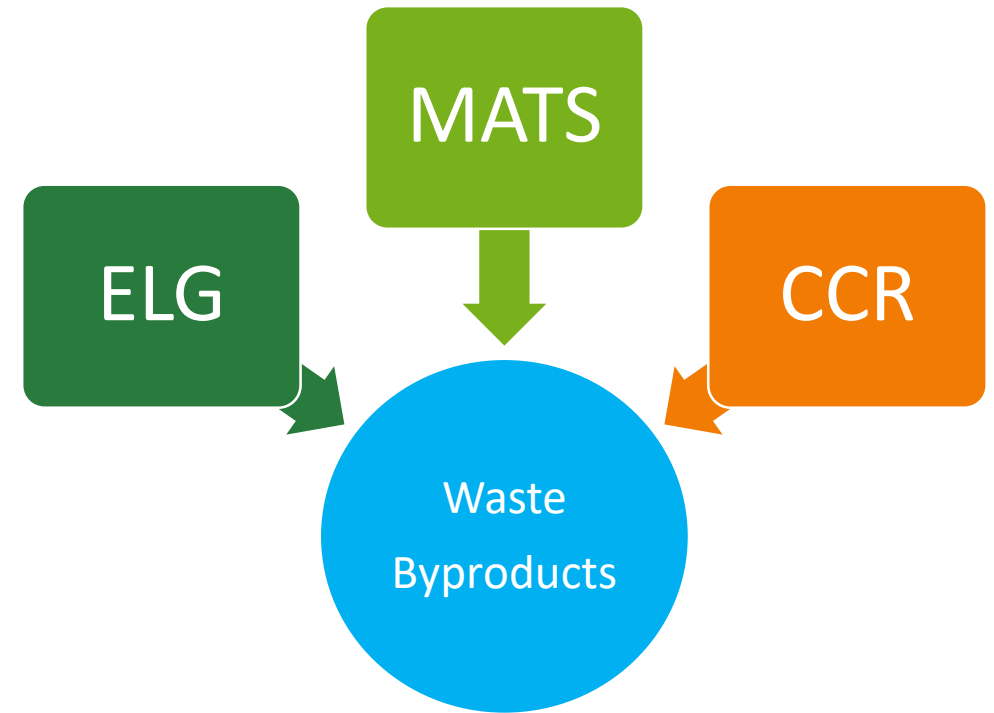


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Air-Water-Solids Research Need

- Increasing impacts on air, water, and solids management from recent environmental regulations
- Power plants must focus on “holistic” long-term approaches
- New research needed for waste byproduct management targeting halogens, heavy metals, etc.



Project Objectives

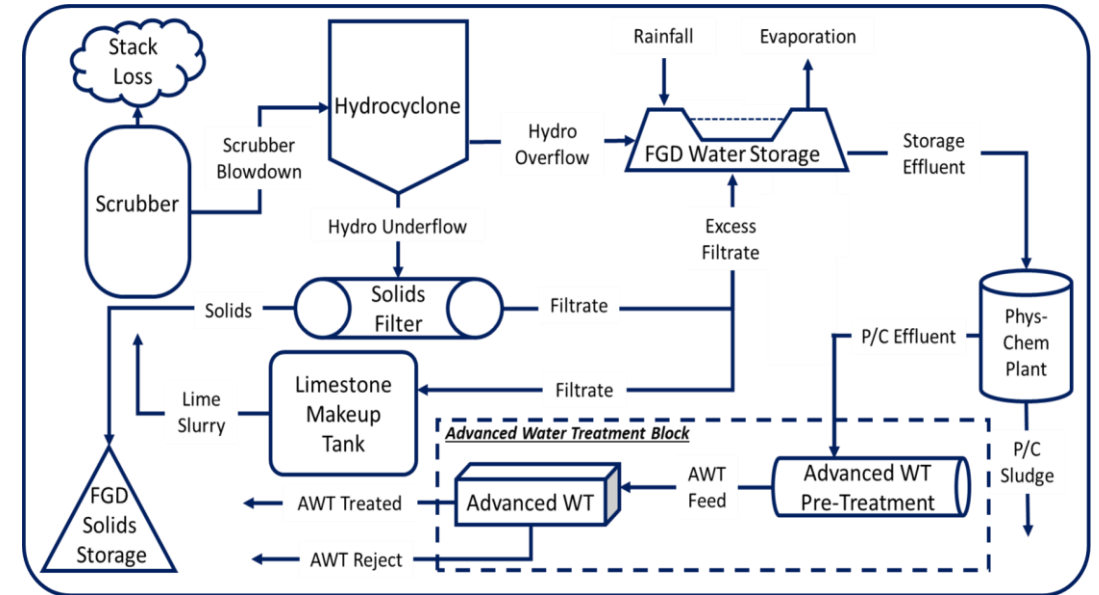
- Evaluate holistic water and waste management strategies from operating coal-fired power plants
 - Integrated water treatment
 - Byproduct evaluations for encapsulation
 - Template for water and waste mass balance evaluations
- Demonstrate pilot-scale treatment process for FGD wastewater
- Test encapsulation of wastewater treatment byproducts using fly ash and other additives

Key Project Activities

- 2018
 - Generic water and material balance data from power plants
 - Saltworks pilot test plan for demonstration
- 2019
 - Saltworks 60-day pilot at the Water Research Center (Georgia Power Plant Bowen)
 - Encapsulation testing with Saltworks byproducts, Plant Bowen fly ash, and additives
- 2020
 - Geochemical modeling and field testing of encapsulation mixes
 - Dynamic water balance tool incorporating results

Dynamic Water Balance Design and Usability

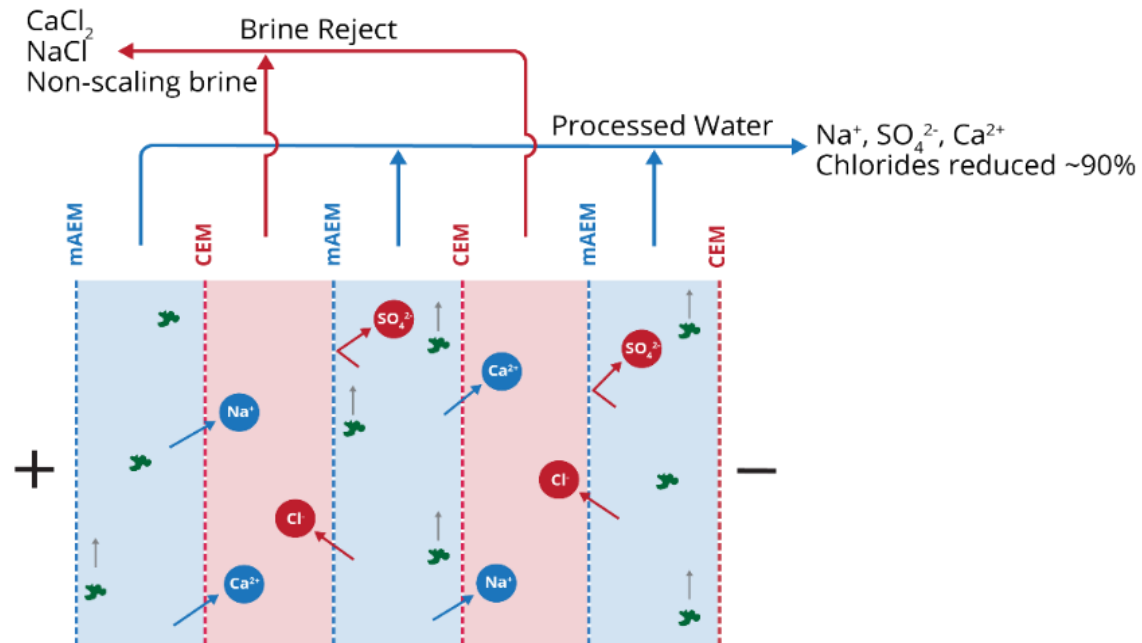
- Interactive process flow diagram for stream/unit operation analysis
- Tool-tips and help prompts to assist in user's navigation of the model
- Built-in analytical tools
 - Dynamic water balances
 - Predictive FGD byproduct production
 - Stream comparison graphs
- Analysis with three different water balances



Unit operation analysis

Flex EDR Selective Pilot Demonstration

- Pre-treatment chemical softening & filtration
- Monovalent electrodialysis reversal technology



Monovalent Electrodialysis (mEDR) with FlexEDR Selective

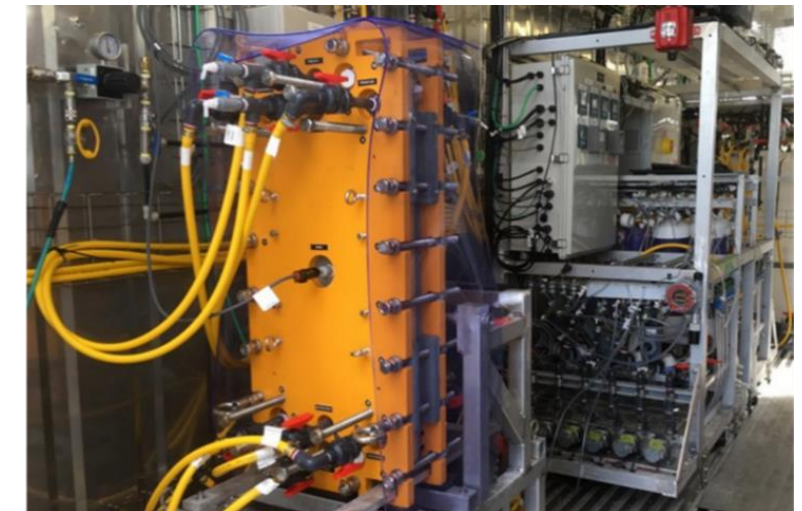
Remove chlorides at high recovery with minimal pre-treatment

mAEM Monovalent anion exchange membrane (blocks sulphate, passes chloride)

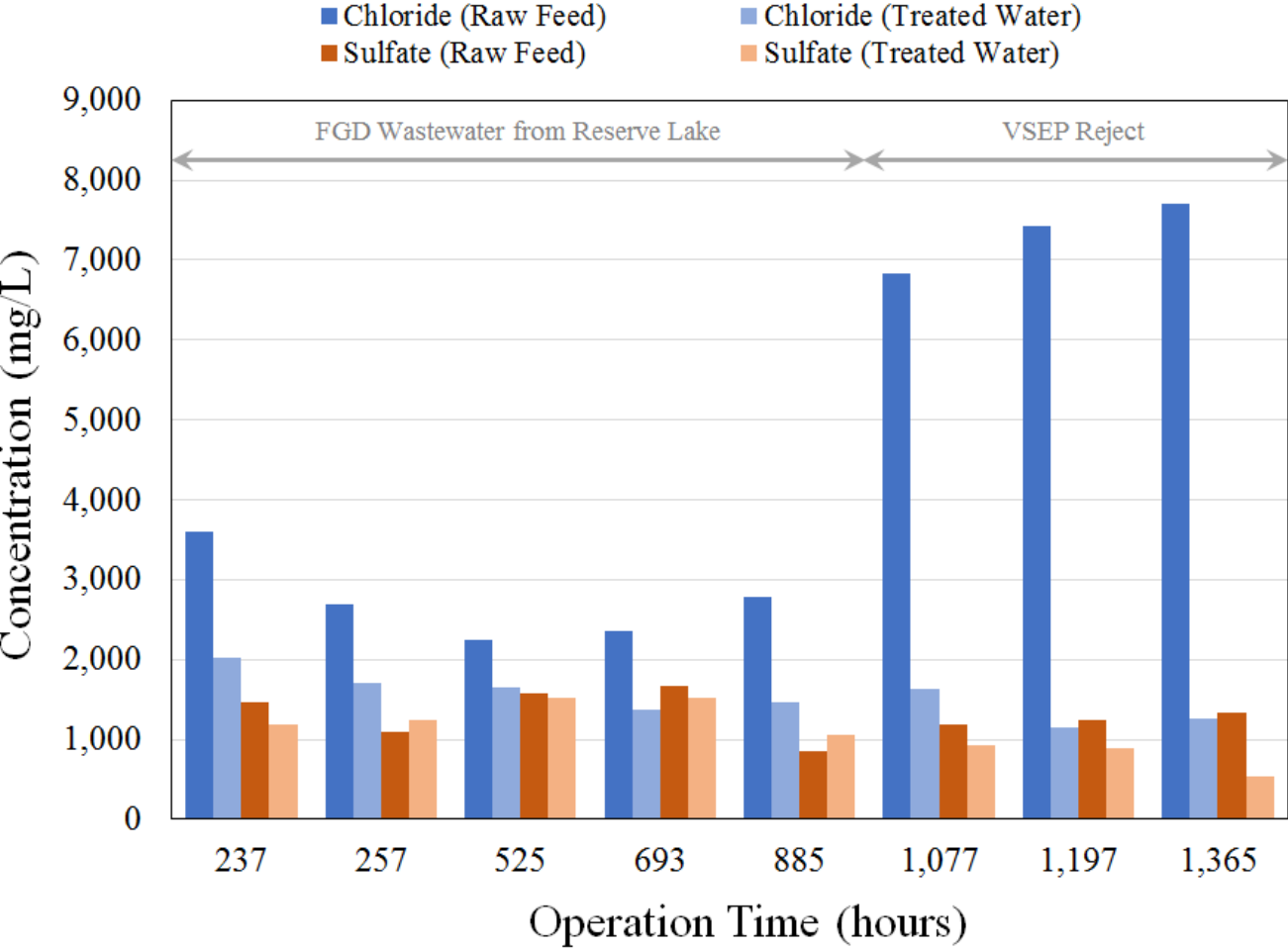
CEM Cation exchange membrane

Organics do not transit or foul membranes

POWER's 2020 Water Award



Selective Chloride Removal



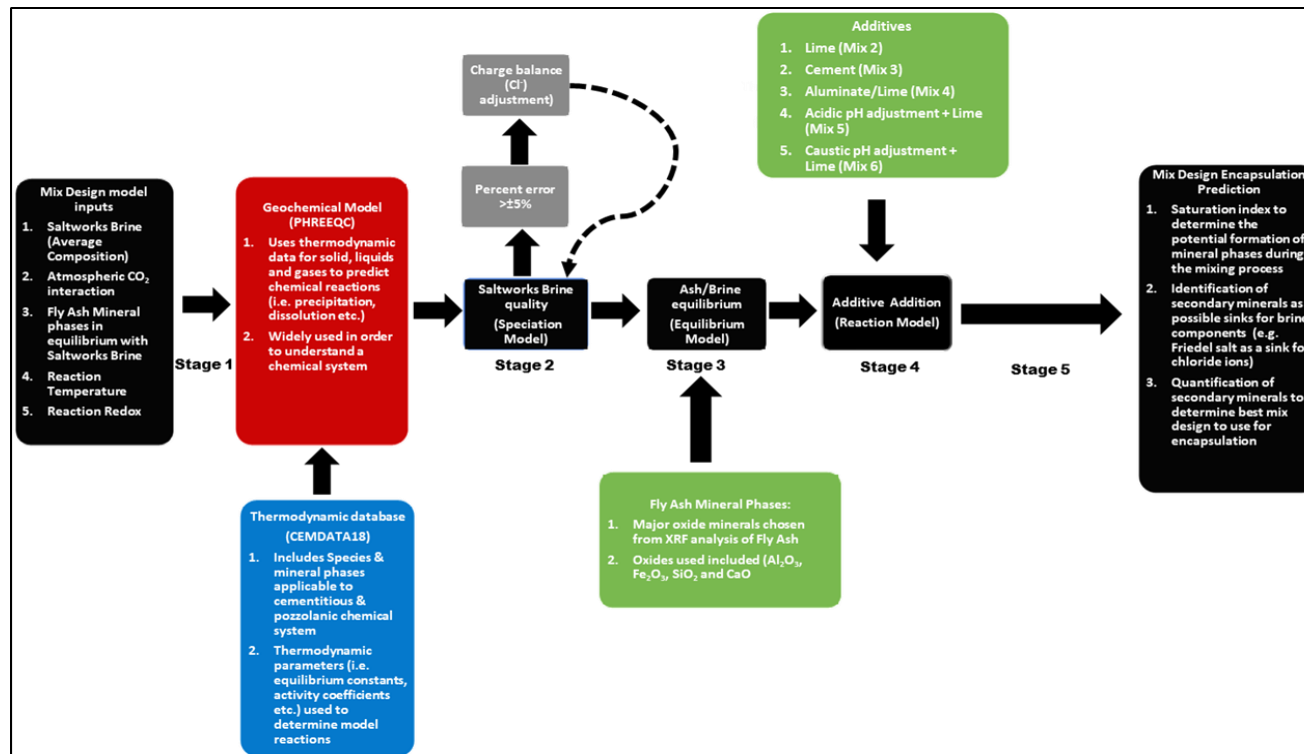
Brine Composition as a Percentage of Total Dissolved Solids

Chloride	61.5%
Calcium	32.4%
Sodium	3.4%
Nitrate	1.0%
Sulfate	1.0%

Brine Encapsulation Studies

- Geochemical modeling
- Bench-top testing and mineralogical testing
- Field lysimeter deployment

Modeling process used to predict mix design experiments



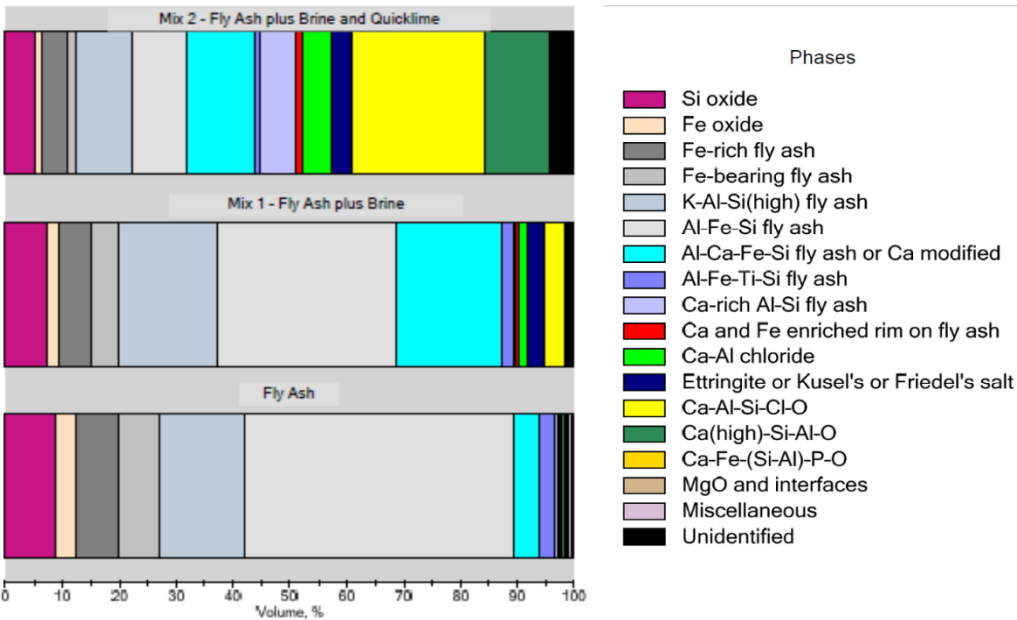
Field lysimeters connected to runoff and leachate tanks

Brine Encapsulation Studies

- Comparisons of geochemical modeling and field-derived results
- Insight to support enhanced modeling capabilities
- Data on long-term material properties

Secondary Mineral Phases	Mix 1		Mix 2		Mix 3		Mix 4		Mix 5		Mix 6	
	XRD	Model	XRD	Model	XRD	Model	XRD	Model	XRD	Model	XRD	Model
Calcite	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dolomite	x	x	x	X	x	x	x	x	x	x	✓	x
Ettringite	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	x
Gypsum	✓	x	x	X	x	x	x	x	x	x	x	x
Friedel's Salt	x	x	✓	✓	x	x	✓	✓	✓	✓	✓	✓
Portlandite	x	x	x	X	x	x	x	x	x	x	✓	✓
Thaumasite	x	x	x	X	x	x	x	x	x	x	✓	✓

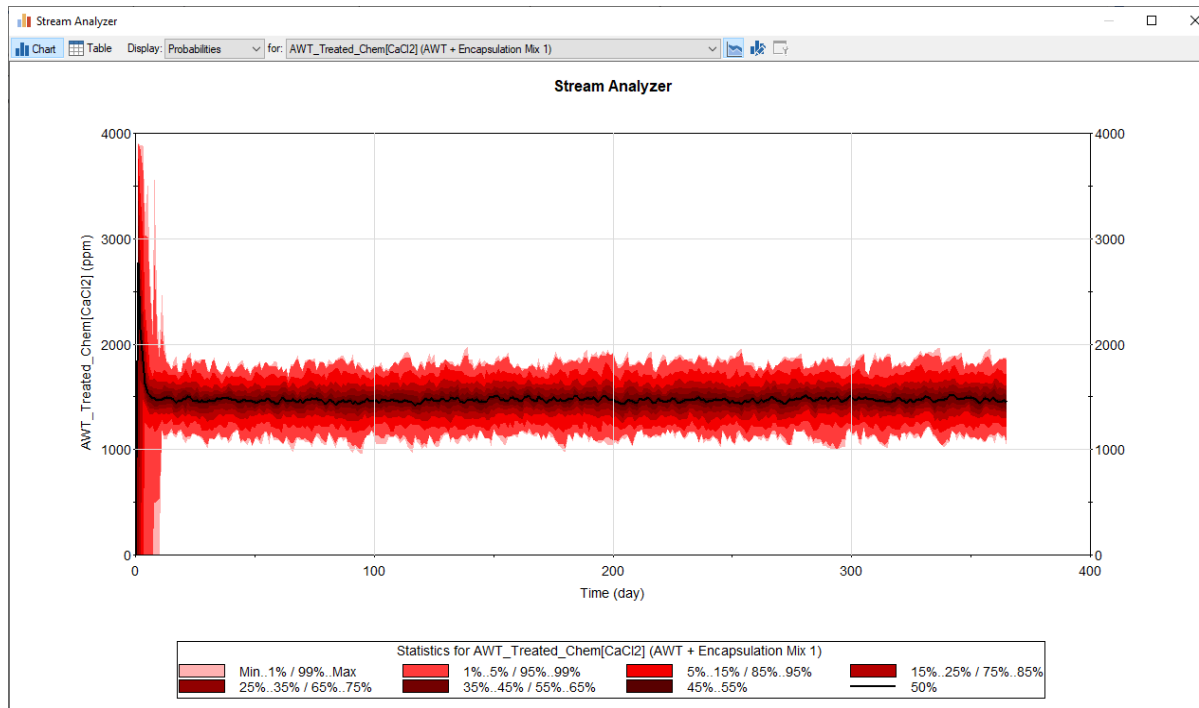
Secondary mineral phases detected by XRD and predicted by PHREEQC to be present in mix design samples



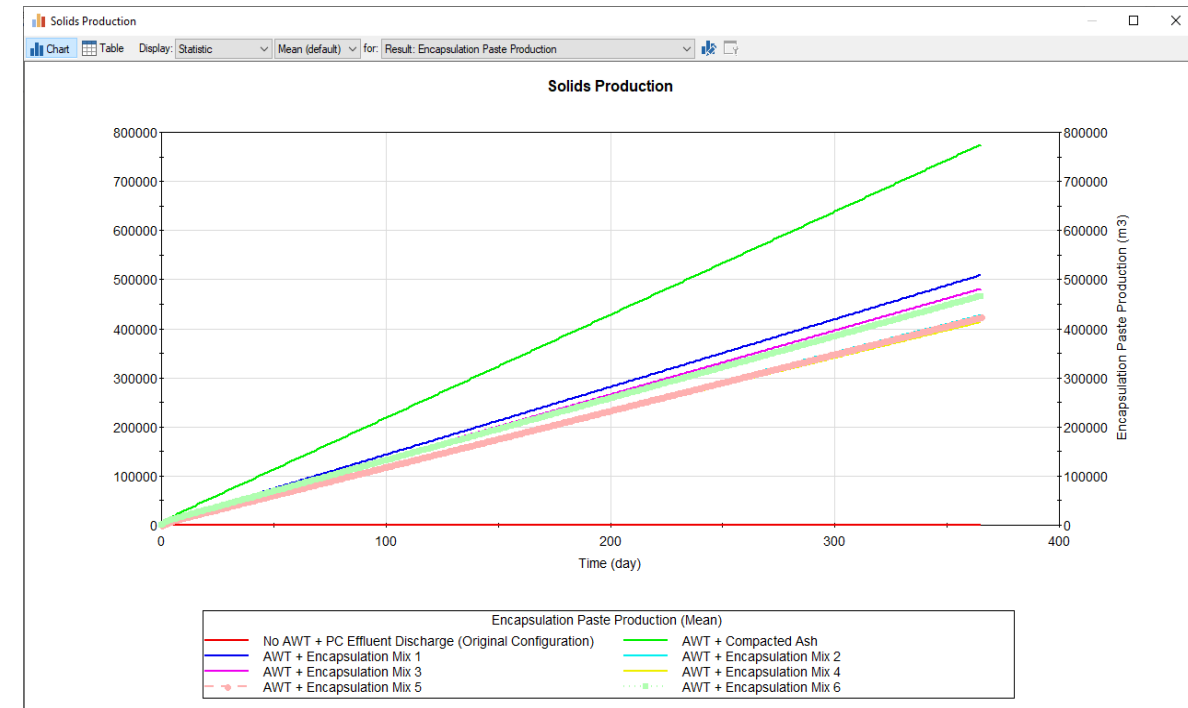
QEMSCAN mineral abundance graph comparing fly ash to two different mixes

Dynamic Water Balance with Integrated Systems

- Integrated water volume and chemical composition model
- Flexible input/output module to support with site-specific scenarios



Projects water quality and volume resulting from the use of the advanced water treatment system



Projected produced solids volumes for simulated encapsulation mix design

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