Flue Gas Desulfurization (FGD) Wastewater Treatment, Reuse, & Recovery

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Objectives

- Recover wastewater from the flue gas desulfurization (FGD) process for subsequent reuse.
- Recover marketable commodities (gypsum ($CaSO_4.2H_2O$) and magnesium hydroxide ($Mg(OH)_2$), from FGD wastewater for commercial sale.
- Reduce the volume and mass of waste requiring disposal from FGD wastewater.
- Provide the energy for the treatment process from waste low-grade heat at the power plant.

Background

- Flue gas desulfurization (FGD) scrubbers are designed to reduce the concentration of sulfur dioxide (SO_2) that is emitted during coal combustion.
- Wastewater from the FGD process contains high concentrations of dissolved salts that limit options for recycling and reuse.
- This project focuses on treating FGD wastewater with a combination of ion exchange (IX), precipitation, and membrane distillation to improve the recovery of marketable materials and the recycling of water to minimize the disposal of wastewater.
- Laboratory experiments to support model development will focus on the ion exchange and precipitation processes.
- The benefit of the study will be development of a process with improved opportunities for recovering materials and reusing wastewater.

Model Development

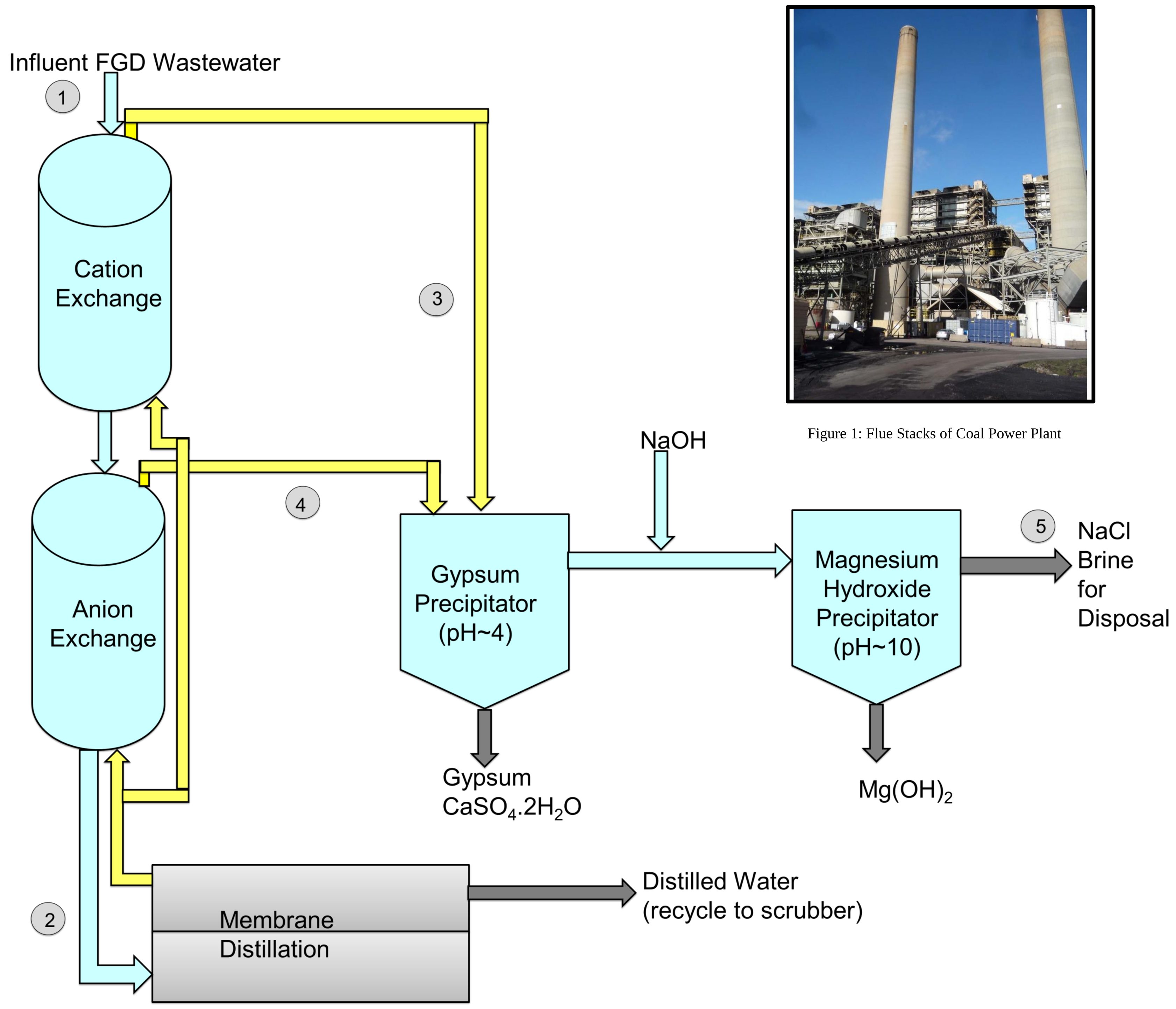


Figure 1: Flue Stacks of Coal Power Plant

Preliminary Experiments

- Resin activity time for Anion Resin and Cation Resin
- Selectivity Determination for Cations


Figure 1: Anion Resin


Figure 2: Cation Resin

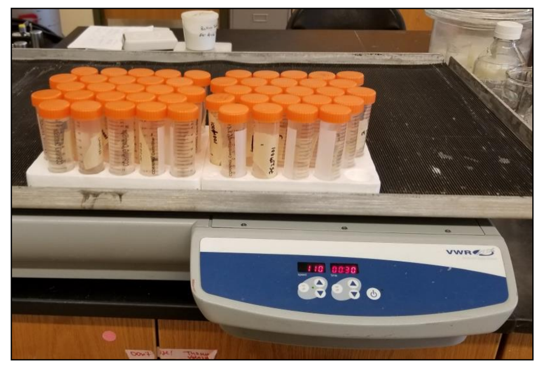


Figure 3: Analyzing Salt solutions of various concentration at different times in the Shake Table

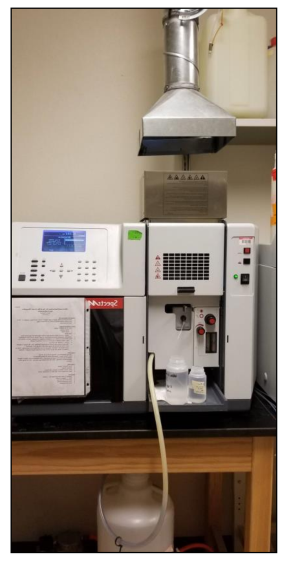
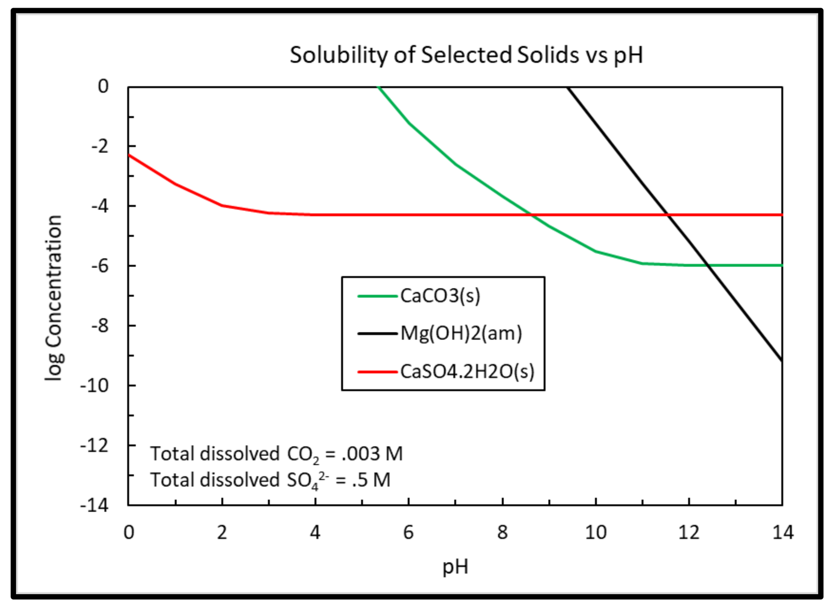


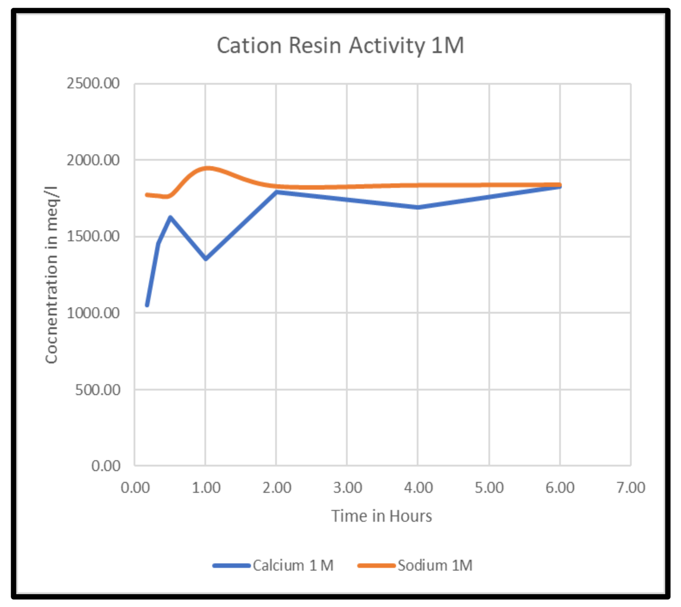
Figure 4: Use of Atomic absorption spectrometry to determine the concentration of Cations

Preliminary Results

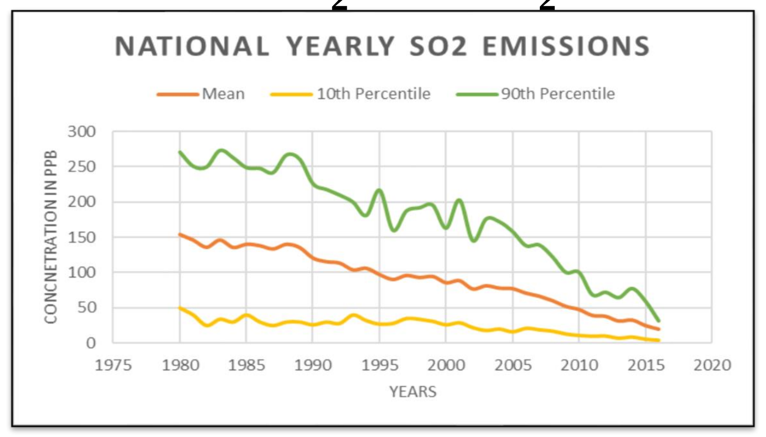
LogC vs pH of Selected Solids



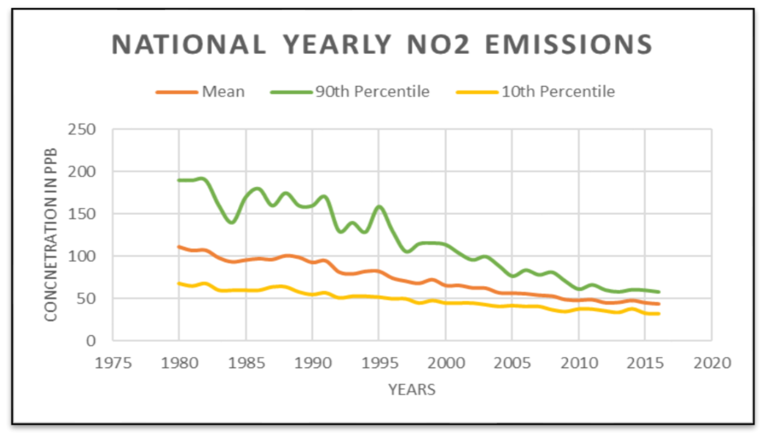
Optimal Time of Resin Activity



Trends of SO_2 and NO_2 emissions



Source EPA, 2016



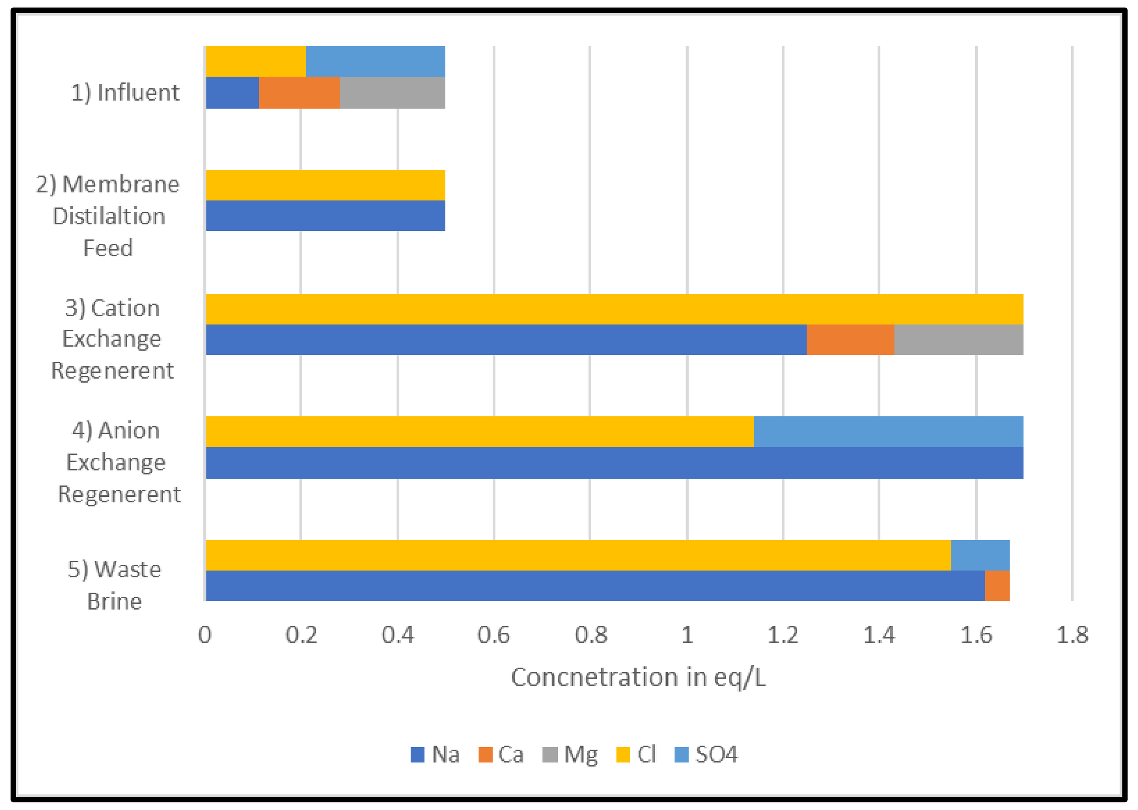
Source EPA, 2016

Constituents of FGD Wastewater

		Concentration		
Constituent	Unit	Industry Avg.[1]	Wateree Station[2]	ELG Long term Avg.[3]
As	ug/L	507.		5.98
Ca	mg/L	3,290.	1,320.	
Cl	mg/L	7,180.	3,840.	
Hg	ug/L	289.	83.	0.159
Mg	mg/L	3,250.	1,670.	
Na	mg/L	2,520.	140.	
NO_3^-	mg/L	91.4	57.0	1.3
Se	ug/L	3,130.	1,570.	7.5
SO_4^{2-}	mg/L	13,300.	2,970.	
TDS	mg/L	33,300.	11,800.	

Notes:
[1]EPA (2015a)
[2]Thomson et al., (2014a)
[3]EPA (2015b) – Long term average concentration standards for existing sources

Ion Concentration of Flow Stream



Future Work

- Precipitation Experiment for Gypsum and Magnesium Hydroxide at different pH and temperature
- Determination of Selectivity of anions required for precipitation
- Using FGD wastewater recipe for resin activity

Acknowledgments

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