FLUE-GAS DESULFURIZATION EFFLUENT MANAGEMENT USING AN INNOVATIVE LOW-ENERGY BIOSORPTION TREATMENT SYSTEM TO REMOVE KEY CONTAMINANTS

Jinjian Wu[1], Joon Min[1,a], Young Chul Choi[2 b], Nishil Mohammed[2]

[1] ES Engineering Services, LLC, a subsidiary of Montrose Enironmental Group, Inc. [2] Southern Research

[a] Principal Investigator, TEL: 949-400-3458, Email: jmin@montrose-env.com [b] co-Principal Investigator, Email: ychoi@southernresearch.org

INTRODUCTION

Under the 2015 Effluent Limit Guidelines (ELGs) Rule enacted by the U.S. Environmental Protection Agency (EPA), existing producers of FGD wastewater need to limit the concentrations of mercury, arsenic, selenium and nitrite/nitrate in their discharged FGD streams (Table 1). Although EPA has postponed the original compliance date of November 1, 2018, they will propose a new revised Rule with a projected compliance date of November 1, 2020[1]. As such, many facilities will still need to address this compliance issue by implementing an economic and efficient treatment process to prepare for the release of the new ELGs

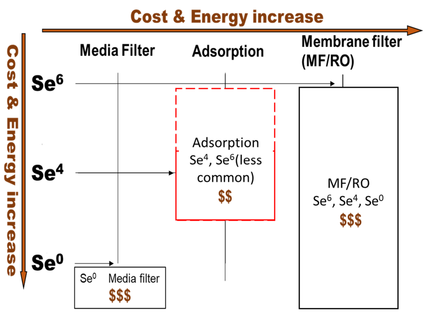
Table 1. Proposed ELG limits for FGD wastewater discharge [2]

Contaminants	Unit	Daily Maximum	Monthly Average
Arsenic	µg/L	11	8
Mercury	ng/L	788	365
Selenium	µg/L	23	12
Total Nitrogen (NO_3/NO_2-N)	mg/L	17	4.4

NEED

Current treatment methods for selenium in FGD wastewater include biological reduction, adsorption, and membrane processes. Biological reduction converts Se^6 and Se^4 to Se^0. [2] Although effective, it has limitations including:

- Long retention time, which requires larger footprint and higher capital costs
- Requires frequent handling of biological sludge/backwash waste
- High food source (electron donor) consumption to achieve complete reduction to Se^0



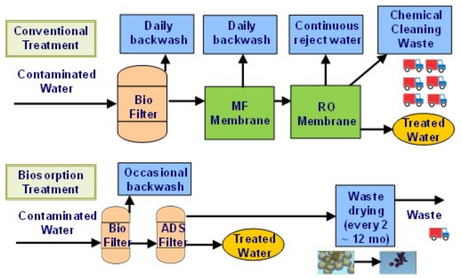
Membrane processes such as RO is able to reject Se^6 and Se^4. However limitations exists for membrane treatment of FGD wastewater including:

- High fouling/scaling potential
- Requires concentrate management and disposal
- High capital and O&M cost

APPROACH

In this project, a novel hybrid process is proposed to remove selenium and other key contaminants in FGD wastewater. The hybrid process combines chemical and biological processes to achieve selenium removal. The process has advantages including:

- Reduction on overall reaction time for selenium removal; smaller footprint
- Capturing selenium, arsenic in solid media phase, rather than in backwash stream, achieving better waste management [3]
- Spent media volume reduction by dewatering naturally to achieve volume reduction for disposal cost reduction [3]
- Meeting TCLP leaching test of the spent media

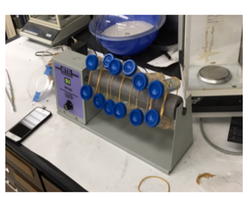


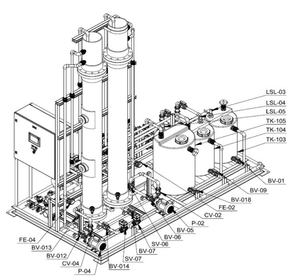
PROJECT PROGRESS

Schedule and Progress:

	Tasks	Period 1				Period 2				Period 3	
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
1	**Project Management & Planning**										
2	**Perliminary Testing**										
	2.1 Bench Scale Protocol										
	2.2 Procurement and Testing										
	2.3 Develop Operation Plan										
3	**Equipment Fabrication & Shipping**										
4	**System Installation/Comissioning**										
5	**Operation and Monitoring**										
6	**Treatment Efficiency Evaluation**										

Next Steps:





BENFITS AND FUTURE WORK

Technology	Energy Requirements	Water Requirements	
	Treatment Process	Backwash / reject rate	Startup wash water
Biological Treatment	- Influent pumping - Chemical feed	- 5 ~10% - ~Daily backwash to remove selenium solids	- Start up rinse water to wash out fine media due to attrition for carbon based media
Conventional Media Adsorption	- Influent pumping	- 0%	- Start up rinse water
Conventional Ion Exchange (regenerable)	- Influent pumping	- ~ 5 % - Daily regeneration with brine and rinse cycle	- Start up rinse water
Membrane (RO)	- High pressure influent pumping - Inter-stage pumping - Chemical feed	- 15~20 % - Continuous reject stream due to RO recovery limit	- Membrane conditioning water - Regular membrane cleaning water
Hybrid Process	**- Influent pumping - Chemical feed**	**~2~3%**	**- Start up rinse water**

Potential Benefits:

- Lower capital and O&M costs compared with existing treatment processes
- Lower energy consumption
- Low wastewater generation and easier management

Future Work

- Scale-up production in treatment system
- Integration of treatment system in existing FGD management

REFERENCES

1. https://www.epa.gov/eg/steam-electric-power-generating-effluent-guidelines-2015-final-rule
2. https://www.federalregister.gov/documents/2015/11/03/2015-25663/effluent-limitations-guidelines-and-standards-for-the-steam-electric-power-generating-point-source
3. Min, J.H., Zhang, J.Z., Tasser, C., Crozes, G.F., Hering, J.G., "Development and application of low-cost biopolymer-based adsorptive media for arsenic, chromium, and selenium removal." Paper at the KSEA Western Regional Technology Conference "Green Earth and Beyond", Caltech, Pasadena, CA, Feb 9, 2008.

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