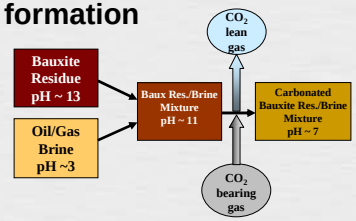
Sequestration of CO_2 in Mixtures of Bauxite Residue and Saline Waste Water

Treatment Concept

Direct sequestration of CO_2 from anthropogenic point sources using bauxite residue slurry (red mud) as a caustic source and produced brine as a source of alkaline earth metals to promote mineral carbonate formation



Reactant Materials

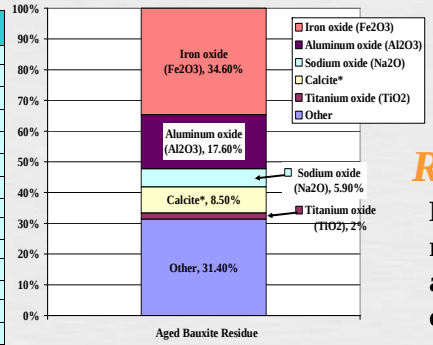
Oil/Gas Produced Brine

- 20-30 bb generated annually in the USA
- 65% of this water is re-injected; remaining water is treated/discharged
- Oriskany Brine - 20 wt.% NaCl eqt. fluid

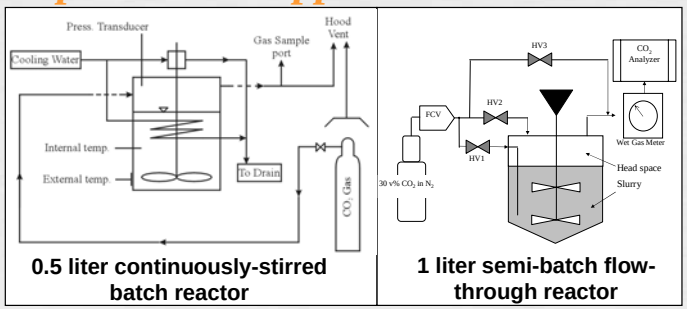
Bauxite Residue Slurry

- Over 70 million tons generated annually as result of Bayer extraction of alumina
- pH of the liquid reaches values of 13 or higher

	Units	mean brine composition	mean bauxite residue composition
	pH	2.72	13
Al	mg/L	< QL	2000
Ba	mg/L	847	< QL
Ca	mg/L	25133	2
Fe	mg/L	165	4
K	mg/L	1930	77
Mg	mg/L	1540	< QL
Mn	mg/L	5	< QL
Na	mg/L	48733	4865
P	mg/L	< QL	< QL
S	mg/L	23	399
Si	mg/L	7	155
Sr	mg/L	9503	< QL
Cl^-	mg/L	122929	2576
Br^-	mg/L	797	< QL
$SO_4^=$	mg/L	< QL	400



Experimental Apparatus

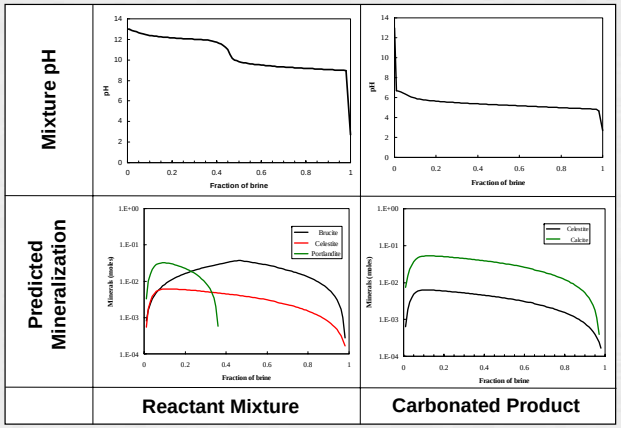


0.5 liter continuously-stirred batch reactor

1 liter semi-batch flow-through reactor

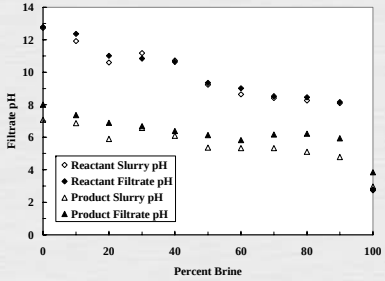
Geochemical Equilibrium Modeling

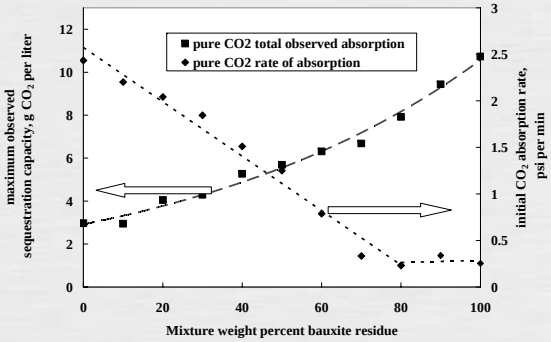
A simplified geochemical model was used to predict treatment concept effectiveness. The model was constructed using Phreeqc Interactive v 2.12 The Pitzer activity coefficient model was used with interaction parameters from Plummer et al. (1988) (20°C, 1atm of CO_2).



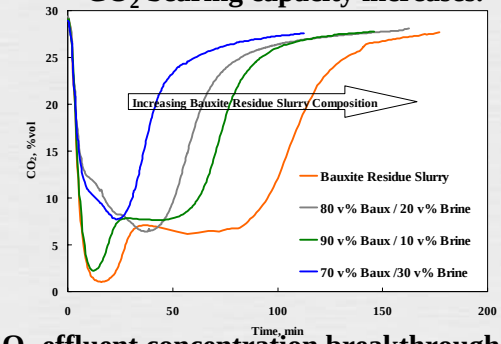
Results

Neutralization of reactive slurry as a result of carbonation





Batch evaluation demonstrates that the rate of CO_2 dissolution in the reactive slurry decreases with increasing composition of bauxite residue, while the CO_2 bearing capacity increases.



CO_2 effluent concentration breakthrough curve for flow-through carbonation of bauxite residue/Oriskany brine mixtures.

Summary

Batch and semi-batch experiments were conducted to assess feasibility of utilizing mixtures of caustic bauxite residue slurry and produced brine from the Oriskany sandstone formation to sequester CO_2

- **Bauxite residue/brine mixture of 90/10 by volume sequestered 9.5 g of CO_2 per liter of mixture (100 psig of CO_2 at 20 °C)**
- **Carbon trapping is accomplished primarily through solubilization**
- **Solution of the product mixture was neutralized following carbonation**
- **Flow-through carbonation at 25 °C and 1 atm. demonstrates that carbonation rates are acceptable for proposed process applications**

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This research was partially funded by the Alcoa Front End Innovation Program.