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Analysis of the Flow Dissolution of Lithium Disilicate Glass

Ben Dillinger, Carlos Suchicital, David Clark

Department of Materials Science and Engineering, Virginia Tech

Abstract

Glass dissolution while under flow conditions is an important area of research for nuclear waste encapsulation and bioglass. Previous work in this area analyzed how complex, multicomponent glasses specific to their related applications would be affected by flow. While these glasses are useful for their applications, it is difficult to analyze the mechanisms and kinetics of flow dissolution using them. The goal of this research was to analyze flow dissolution using a simpler lithium disilicate glass and compare the results to static dissolution (liquid does not move during an experiment). Flow experiments followed the ASTM standard for a single pass through flow test and were conducted at 50°C or 95°C with flow rates of either 0.333 mL/min or 1 mL/min. ICP-MS was used to determine the extent of lithium and silicon leaching and SEM microscopy was used to compare the leached surfaces. Results indicated that lithium dissolution was proportionally related to temperature and inversely related to flow rate. Silicon dissolution was found to be proportionally related to temperature.

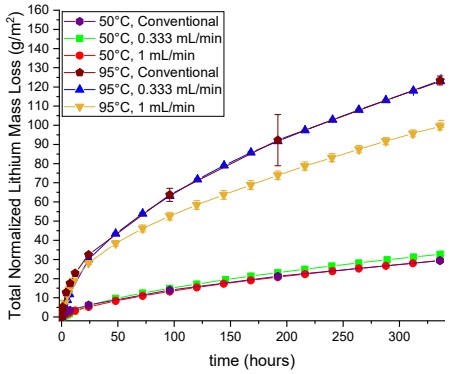

Figure 1: Total Normalized Lithium Mass Loss for Static and Flow Experiments

Biography

Ben Dillinger is a PhD. candidate working with Dr. David Clark. He started in 2016 and plans to finish in spring 2021. He has earned both his Masters (2016) and Bachelors (2013) from Virginia Tech. His research involves examining differences in the dissolution of lithium disilicate glass under various conditions such as microwave heating, flow, and ultrasonication. The goal of this research is to identify changes in the kinetics and mechanism that may occur. He previously worked on determining the effects of microwave heating on the dissolution of aluminum hydroxide in sodium hydroxide. For his masters he worked on understanding the crush strength of porous wall hollow glass microspheres. Ben has multiple journal and conference publications and has presented at the MS&T and ICACC conferences.