THE IMPACT OF SURFACE FINISH AND ORGANIC ADDITIVES ON THE SHEAR BEHAVIOR OF EXTRUDED CERAMIC PASTES

BY

PAUL E. SWARTS JR

ADVISOR: Dr. William Carty

ABSTRACT

The contribution of die-wall friction in ceramic extrusion systems is a variable that has been studied to only a limited degree. The introduction of abrasion-resistant surface coatings, now a common practice in industry, and their associated roughness, is an important area that requires study. To determine the contribution of surface roughness, and the potential to understand that factor in extrusion processes, simple alumina extrusion batches with two levels of a surfactant (a fatty acid), were evaluated.

The goal was to use wall pressure as a function of temperature (°C) and linear extrusion velocity (mm/second) to derive the constants for wall shear behavior constant (β) as well as rate dependent constant (n). Constraints included: four capillary die surface finishes, temperature testing capability ranging from 10°C to 60°C, extrusion noodle velocity up to 50.8 mm per second, and two alumina based extrusion batches designed to elicit a low and high wall pressure response, with which substrate surface finish and capillary wall pressure relationships were developed.

Through minor changes in batch composition, two stable wall pressure regions were achievable without concern of temperature sensitivity. On a high wall pressure batch, varying roughness of the capillary wall surface yields mean pressure differences with little difference in slip behavior. Addition of 0.8% total fatty acid reduced wall pressure to a level where varying roughness of the capillary wall surface yields differences in wall slip behavior. The above modifications were able to produce a range of shear rate behavior constants allowing for the understanding of the interaction of surface finishes when combined with high and low wall pressure extrusion batch.