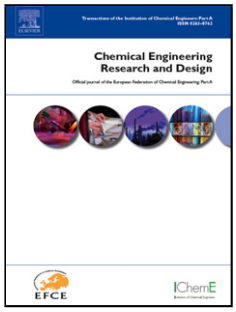

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Effect of Mixing Conditions on the Wet Preparation of Ceramic Foams

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Highlights

- Systematic investigation of the impact of mixing parameters on foam properties
- DoE employed to rigorously identify process parameters affecting foam properties
- Mixing in sparged stirred tank correlated using dimensionless groups
- Foam properties evaluated as a function of global mixing parameters
- Correlation between mixing regimes and foam bubble size distribution

Abstract

Ceramic foams are a promising alternative to conventional catalyst supports due to their macro-porosity, which should enhance mass transport properties during reactions. Whilst direct foaming is a straightforward production method, the use of kitchen mixers commonly reported in the literature to initially froth the ceramic slurry limits understanding of scale-up. This study reports a systematic experimental investigation of the impact of mixing parameters on the properties of the foams produced in an agitated baffled vessel of diameter, T = 175 mm, equipped with an up-pumping pitch blade turbine with diameter of either D = 0.23 T or 0.51 T and a bottom round sparger with a diameter of 45 mm. The flow conditions in the present study were in the low to mid transitional regime ($50 < Re < 1000$). Design of Experiments (DoE) was employed to generate a series of screening experiments by variation of sparging time, air flow rate, impeller speed and impeller diameter. The mixing behaviour was described as a function of relevant dimensionless groups (Re, Fr, Flg, etc.) whilst the gas-liquid flow regime was estimated by examination of a ceramic particles free system. The properties of the foams obtained were correlated with key dimensionless numbers, though the exponents obtained deviated from values in the published literature. In addition, the rheology of the foam was correlated to the bubble size distribution showing that rheology measurements have potential for at-line measurement to control the structure of the produced material.

1. Introduction

The direct foaming of a ceramic slurry is a simple and versatile method to generate macroporous ceramic materials. These can be used as refractory insulators, filters for molten