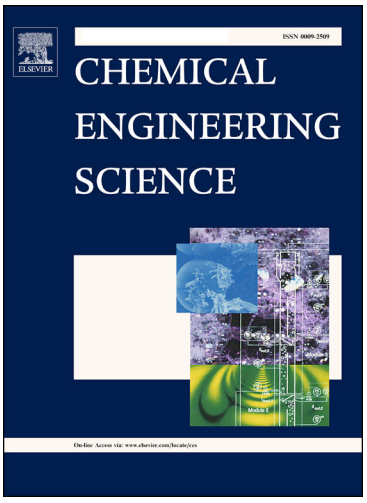

Short Communication

A direct calculation method of the Metzner-Otto constant by using Computational Fluid Dynamics

J. Ramírez-Muñoz, R. Guadarrama-Pérez, V.E. Márquez-Baños

PII: S0009-2509(17)30577-8
DOI: http://dx.doi.org/10.1016/j.ces.2017.09.023
Reference: CES 13800

To appear in: *Chemical Engineering Science*

Received Date: 12 July 2017
Revised Date: 11 September 2017
Accepted Date: 13 September 2017

Please cite this article as: J. Ramírez-Muñoz, R. Guadarrama-Pérez, V.E. Márquez-Baños, A direct calculation method of the Metzner-Otto constant by using Computational Fluid Dynamics, *Chemical Engineering Science* (2017), doi: http://dx.doi.org/10.1016/j.ces.2017.09.023

Short Communication

A direct calculation method of the Metzner-Otto constant by using Computational Fluid Dynamics

J. Ramírez-Muñoz[1*], R. Guadarrama-Pérez[1], V. E. Márquez-Baños[2]

[1]*Departamento de Energía, Universidad Autónoma Metropolitana-Azcapotzalco, Av. San Pablo 180, Col. Reynosa Tamaulipas, CDMX, 02200, México.* [2]*Posgrado en Ciencias Naturales e Ingeniería, División de Ciencias Naturales Ingeniería, Universidad Autónoma Metropolitana -Cuajimalpa, Av. Vasco de Quiroga 4871, Cuajimalpa de Morelos, Santa Fe Cuajimalpa, CDMX, 05348, México.*

Abstract

The best-known paper on non-Newtonian fluids in mixing systems is the Metzner and Otto´s work. A central idea of their contribution is based on the assumption that in laminar flow there exists an average shear rate ($\dot{\gamma}_{av}$) around the impeller (whose exact location and geometric shape is not clearly specified), and that it is proportional to the impeller speed (N), i.e., $\dot{\gamma}_{av} = K_s N$, where K_s is the Metzner-Otto constant. In this work, an in-depth investigation of this assumption is carried out by using computational fluid dynamics (CFD) to calculate the three-dimensional flow induced by a Rushton turbine (RT). It was found that the volume swept by the blades is the region where K_s may be computed explicitly as $K_s = \dot{\gamma}_{av}/N$ directly from non-Newtonian flow simulations. The obtained K_s values in this region were found in good agreement with reported data. Furthermore, power number measurements and data from literature were used to validate the simulations. The CFD method developed in this study can be used to readily and reliably evaluate K_s of industrial mixing impellers without resorting to power data of Newtonian fluids.

Keywords: Metzner-Otto constant; shear rate; non-Newtonian fluid; Rushton turbine; CFD simulations.

[*] Corresponding author. Phone: +5255-5318-9056; Fax: +5255-5394-7378
E-mail address: jrm@correo.azc.uam.mx (J. Ramírez-Muñoz)