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PII: S1385-8947(17)31267-6
DOI: http://dx.doi.org/10.1016/j.cej.2017.07.120
Reference: CEJ 17386

To appear in: *Chemical Engineering Journal*

Please cite this article as: M.A. Ramírez-Cabrera, P.J. Valadés-Pelayo, C.A. Arancibia-Bulnes, E. Ramos, Validity of the Six-Flux model for photoreactors, *Chemical Engineering Journal* (2017), doi: http://dx.doi.org/10.1016/j.cej.2017.07.120

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Abstract

In the literature for photocatalytic reaction modeling engineering, several simplified schemes applicable to ambient temperature radiative transfer for scattering media are available. A popular strategy is the Six-Flux method because it is simple and is not computer time demanding but its accuracy is not always explicit. In the present work we assess the accuracy of low order methods, including six flux case, by solving the radiative transfer equation in dimensionless form within a cubic enclosure, for i) a collimated beam and ii) a diffuse beam. Radiation enters the cube through a square window centered on one face and with an area one quarter the area of the face. The simulation considers fully absorbing walls, and isotropic scattering. The deviations of simplified models based on Discrete Ordinate or Finite Volume schemes, are compared to the mesh independent solution. The results indicate that for a collimated beam boundary condition the Six-Flux model and more refined models are moderate. The error of the total rate of energy absorbed (TREA) and that of the local volumetric rate of energy absorption (LVREA) with respect to a mesh independent solution are below 5% and 22% respectively. In contrast, it is found that for diffuse boundary conditions the Six-Flux model is very inaccurate since the corresponding errors are larger than 120%.

Nomenclature

A area of control volume face
$\mathcal{A}$ radiation input area [m^2]
D projection of the elemental solid angle

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