SL 5.2

Evaluation of Distributive Mixing Efficiency of Ko-kneader by Means of the Temperature Distribution as a New Criterion

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The Buss Ko-kneader, due to its great dispersive and distributive mixing efficiency, has been used as one of the most versatile continuous compounding machine in polymer industry. However because of complexity of flow field in Ko-kneader, the mechanism of mixing and the role of effective parameters have not been fully understood. In the present work an attempt was made to evaluate the distributive mixing of kneading element of Buss Ko-kneader by means of temperature distribution as a new criterion. A three dimensional non-isothermal viscous flow analysis was performed with taking into account both rotating and reciprocating motions of the screw. The predictions were made for eight selected times within a complete period of reciprocating action in the adiabatic condition. The predicted results showed a temperature rise of 4ºC for the axial and 1ºC for down channel directions, while in the absence of reciprocating action these values were found to be16ºC and 2ºC. The temperature gradient through the channel cross section was very smooth in the presence of reciprocating action whereas distinct hot points were found in the absence of this motion. These results, which are mainly attributed to axial flow imposed by screw reciprocating motion, can be considered as strong reasons why Ko-kneaders have been preferred for compounding the shear and heat sensitive materials. These result were also compared with those estimated using other criterion such as mean total strain ($\bar{\gamma}$) and weighted average total strain (WATS) and it was demonstrated that the temperature distribution is much more sensitive criterion for evaluating the distributive mixing and detecting hot point in the Ko-kneaders.