Process Analysis during Continuous Mixing on Co-Rotating Twin Screw Extruders

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Introduction

One of the main tasks in the development for the continuous mixing of new powder rubber grades on corotating twin screw extruders is to receive the best physical rubber properties. Therefore it is necessary to get a good dispersion of the filler. In this case a comparison between two dispersiv mixing elements (continous mixer elements and kneading blocks) is shown.

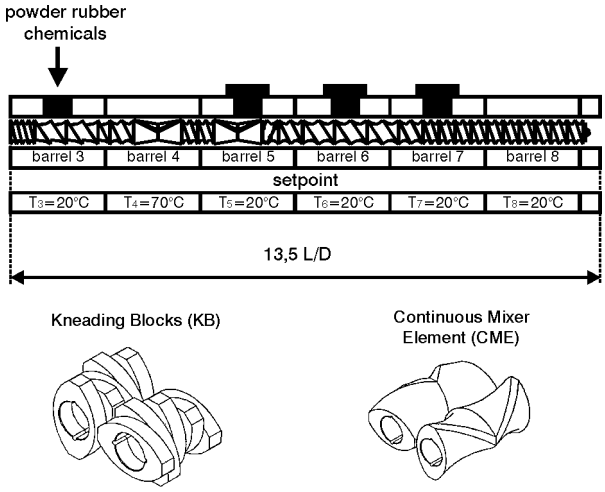


Fig. 1: Screw configuration for the comparison between kneading blocks and CME

Pump-efficiency

At first, the material was conveyed against atmospheric pressure without the use of a die. After that, the same tests were done by attaching a die to the extruder. This meant a 60% reduction in extruder cross section down to that of the die. In order to enable the pressure to be built up for the passage of material through the die, some of the conveying elements before the die were filled to 100% capacity. This has an effect of a raise in compound temperature for each test point. That can be explained by the addiitional energy input that is required to build up the pressure. The additional energy input does not result in a significantly improved compound quality. This means the energy input for pressure built up unfortunately only has the effect of a raise in compound temperature.

CME vs. KB

The fact that dispersion efficiency is better (fig.2) with the same temperature increase of the ‘‘CME‘‘ screw configu-

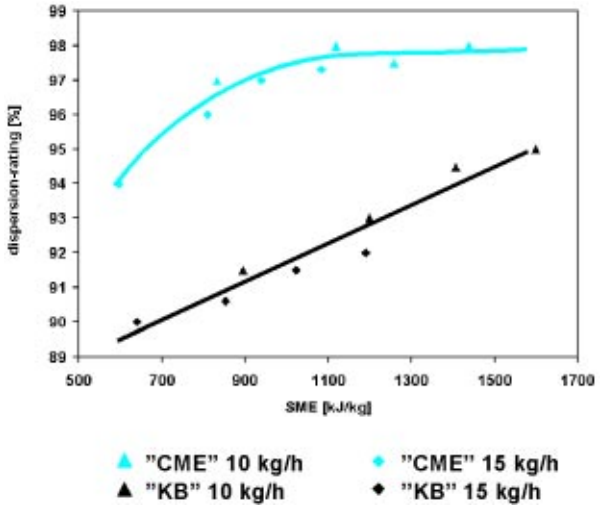
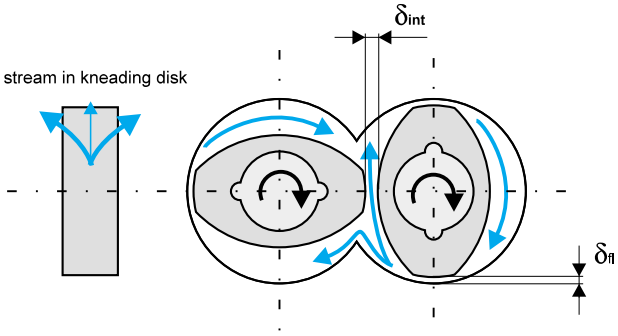


Fig. 2: Dispersion rating vs. SME for kneading blocks and CME

ration can be deduced from the geometry of the mixing elements. If one considers the two shear regions in the lateral area between the extruder housing and the element sides, it is noticeable that, in addition to the flatter angle of compound entry into the shear gap on the “CME”, the width of the shear gap is higher than on the “Kneading Blocks” owing to the asymmetrical design of the element. All constructive measures lead to the pressure loss having to be reduced when flowing through the gap on the ‘‘CME‘‘ than on the ‘‘Kneading Blocks‘‘. This is why, in relation to total throughput, much less material flows through the gap of the ‘‘Kneading Blocks‘‘. The biggest share of the material will deviate from this gap due to the offset arrangement of the kneading disks (fig. 3), and will therefore not take part in the dispersion process between the lateral face and the extruder housing.



	CME	kneading blocks
δ_{int}	1,5	1,25
δ_{fl}	1	0,5

Fig. 3: Cross-section of the TSE