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Combinatorial Compounding: an Innovative Method for the Fast Development of New Plastics

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The need for fast and low cost processes for material development first has led to combinatorics in the pharmaceutical industry and is now having its first appearance in the plastics processing industry with a new method for Combinatorial Compounding.

Usually many variations are needed for the systematic study of interactions among additives and to find the optimum mass content of each known additive or even new additives which have not been used so far. Furthermore this research is almost never done with costly production machines. A consequence of this is the use of decade old formulations and limitations to the spread of knowledge due to scale-up inhibitions.

To solve this problem the DKI developed a new method for Combinatorial Compounding.

A production size twin screw extrusion line (MegaCompounder Mc32 by Coperion Werner & Pfleiderer) was combined with gravity feeding (by Brabender) for a number of additives and masterbatches. The process control was altered and allows continuously varying feeding of the components. The compounding line itself feeds a flat film extrusion line (by Collin) and a melt channel where specially chosen experimental techniques such as rheometry, IR- and UV-vis-spectroscopy, gas chromatography, ultrasonic spectroscopy, light scattering, mechanical tests as well as reflection and colour determination will allow High Throughput Screening (HTS) online. The HTS equipment will provide first rough information about the performance of compounds. This need not necessarily be data which is readily interpretable in a physical sense. Rather, all the process and testing data is handed over to a data bank and analysis system which by means of e.g. main component analysis returns measures of significance (MOS). The MOS or individual data is used to optimize a given formulation by variation of the components and their mass contents. This process will be one or two orders faster than conventional development of plastic material today.

The contributed presentation will introduce the concept of Combinatorial Compounding and High Throughput Screening. The experimental setup will be explained, first results and possible applications will be discussed.