

## No. VII What Process Aids Are Really Doing.

### Introduction:

Process aids (PA) play an important role in rubber compounding, but their action is not fully understood neither in the compound nor in processing. In former files I found an interesting experiment, which may shed some light on the action of an PA. These experiments were performed as a DoE, but the analysis of the data with G<sup>raf</sup>Compounder give more clarity on the effect of the PA in an injection moulding trial of an EPDM compound.

### Experiment:

An EPDM (amorphous type, 60 Mooney) compound was investigated using a Design of Experiments (DoE). The chosen factors for investigation were the oil/filler and a zinc salt (Aktiplast PP, Lanxess). Viscosity measurements were conducted using a high-pressure capillary rheometer (HKR), as depicted in Figure 1. The graph illustrates stages of 3 data points each, with the lowest at 5.0 phr and the highest at 0.0 phr of Zinc salt, indicating a decrease in viscosity.

To reflect the measured viscosity changes, adjustments to certain process parameters of an injection molding machine should be noticeable. (For these experiments a DESMA 80to machine was utilized).

Hydraulic pressure, pressure at the nozzle entrance (Fig. 2), and pressure loss in the runner accurately mirror the viscosity measurements obtained with the HKR laboratory equipment. This correlation also extends to the mass temperature (TM), not shown here.

Additionally, certain mechanical properties are influenced by the zinc salt content, and a similar pattern like that observed in the aforementioned graphs should be expected. Indeed, all fundamental physical properties measured in these trials exhibit a comparable pattern, as exemplified by the modulus 300 (M 300 z-axis) (Fig. 3).

### Conclusion:

Using the features provided by the GrafCompounder tool, it is possible to design a process encompassing both machine parameters and compound formula. This entails setting limits on either process parameters or compound ingredients within the criteria window of G<sup>raf</sup>Compounder. The tool calculates the effects of the specified limits on the compound and presents them in the output window. It's essential to conduct a confirmation experiment to validate the results obtained from the tool.

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Source: Kim Mattern, Diploma Thesis, DIK Hannover, 1995

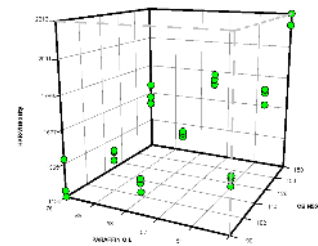


Fig. 1: HKR-Viscosity over CB 550 and Oil content

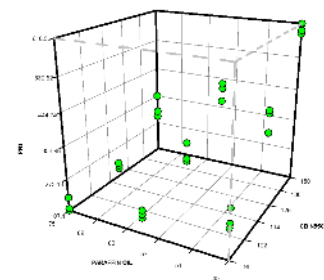


Fig. 2: Pressure at Nozzle over CB 550 and Oil content

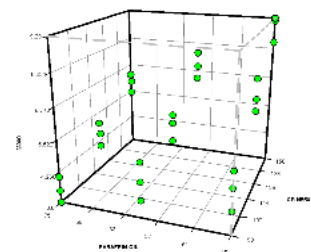


Fig. 3: M300 over CB 550 and Oil content