

No. VI Inclusion of Processing Data in Compound Development

Introduction:

Processing conditions have effects on properties which is well known. While the change of ingredients results in change of rheology and physicals at the same time, the influence of processing conditions on physicals, for example in injection moulding, is less severe. Anyhow, if there is a specification with tight tolerances, process parameters can be decisive whether the part is in or off spec.

Process optimization as well as **formula development** can be done with experimental design, but with separate experiments. If it can be combined, it would help avoiding large amount of trials.

If data exists, formula prediction can be done with G^{raf}Compounder. Question is, whether it is possible to solve a processing problem and formula optimization at the same time using the ability of the G^{raf}Compounder software tool?

Example:

In an EPDM compound, filler / oil content was varied. In this trial the effects on the injection process as well as physicals were evaluated.

Optimization of Modulus 300 (M 300) results with compound adjustment via reducing the process aid amount and increase the after pressure. All other properties and process conditions stay almost the same.
M 300 = 5.5 Mpa / Aktiplast PP 3,4 phr (P_{mold 2} = 61 bar)

M 300 = 6.5 Mpa / Aktiplast PP 0,8 phr (P_{mold 2} = 30 bar)
[P_{mold 2} – mold pressure far from gate]

Conclusion:

It is unexpected, that reduction of mold pressure increase modulus, but compound temperature may have increased due to higher pressure loss during injection indicated by specific hydraulic pressure increase [740 bar to 818 bar] which is inline with the HKR viscosity increase. (See also figure 1 and table 1)

H-JG_Consulting
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Hans-Joachim Graf

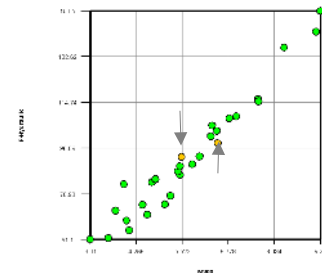


Figure 1: Hydraulic pressure over M300:
Arrows indicating
M300 – 5.5 MPa and M300 – 6.5 MPa

| | Recipes: | |
|---|------------|------------|
| | Mixture2 | Mixture4 |
| Ingredients: | | |
| EPDM C2 55/ 60Mooney | 100 | 100 |
| CB N550 | 109 | 108 |
| PARAFFIN OIL | 53 | 53 |
| AKTIPLST PP | 3 | 1 |
| Properties: | | |
| HKR-Viscosity | 1590 | 1626 |
| Moulding weight | 114 | 114 |
| Hardness | 59 | 61 |
| Tensile | 10 | 12 |
| Elongation | 675 | 610 |
| M300 | 5,5 | 6,5 |
| | | |
| T-Mass | 111 | 112 |
| P-Hydraulic | 93 | 99 |
| PNz | 370 | 365 |
| PR1 | 20 | 10 |
| P _{mold 2} | 61 | 30 |
| P_{Hydr-specific}-P_{Nozzle} | 741 | 819 |

Table 1: Trial data

Source: K. Mattern, Diploma Thesis, 1995