Tips&Tricks with G^{raf}Compounder

H-JG Consulting

No. V
How to visualize the influence of Polymer on Properties

Introduction:

Properties of a compound depend not only on filler / oil content and cross link density, but on polymer molecular weight, distribution and structure as well.

It is of interest to separate the influence of the polymer from the other ingredients to better understand their impact on properties and to be able to conclude on compound design.

In this example it is shown the use of the 2D diagram and the 3D diagram for this purpose. The dataset is based on Chloroprene Rubbers containing blends of Chloroprene, with different filler loading and cross link systems.

Procedure:

There are a limited number of properties in the data. A correlation between hardness and modulus allows the demonstration of the impact of polymer on properties. Hardness / modulus correlation makes sense, because hardness is a measurement at very low modulus due to the short indentation of the hardness needle while the modulus is a measurement at much higher elongation. Therefore we should expect a good correlation between the modulus at 100 % (Fig.: 1) and 200 % (Fig.: 2) elongation. The graph hardness over modulus 200 gives more clarity due to a greater distance between the two levels.

A look at the compound formulas tells, that there are two different Chloroprene rubbers and their blends in the database. This allows the use the 3D diagram to see the impact of the polymer blends. The plot of modulus 300 on x-axis and hardness on y-axis with one of the polymer on z-axis shows three different levels (Fig 3). The lines indicate a 25%; 50% and 75% blend of the polymers. The points in the upper 100% level belonging to another polymer in this data set.

Conclusion:

- The influence of polymer on modulus – hardness can be seen and quantified.
- The influence of Oil / Filler is of minor influence compared to the polymer
- It should be noticed, that the nature of oil (HAR Oil resp. DOS) does not show up like the polymer.
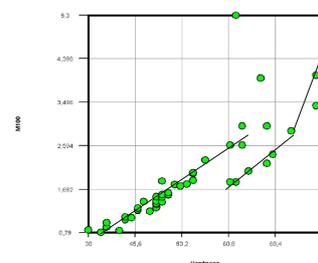

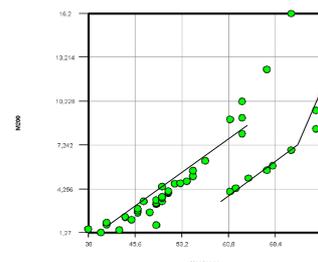*Figure 1: Data set of CR Compounds - Modulus 100 over Hardness*

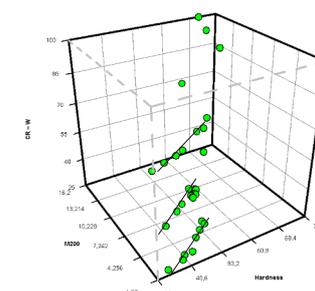*Figure 2: Data set of CR Compounds - Modulus 200 over Hardness*

Figure 3: Data set of CR Compounds - Modulus 300 over Hardness and one of the Polymers

Source: DuPont, Company Communications

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2023-04-18
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