

**Reproducibility -
The important quality feature for heat build-up tests**

Dynamic heat build-up tests provide a better understanding concerning the thermal aging properties of the corresponding elastomers.

Of course, due to homogeneity fluctuations within different batches of test specimen the most important requirement for a reliable flexometer is the reproducibility of the test results.

Figure 1 shows such a reproducibility test.

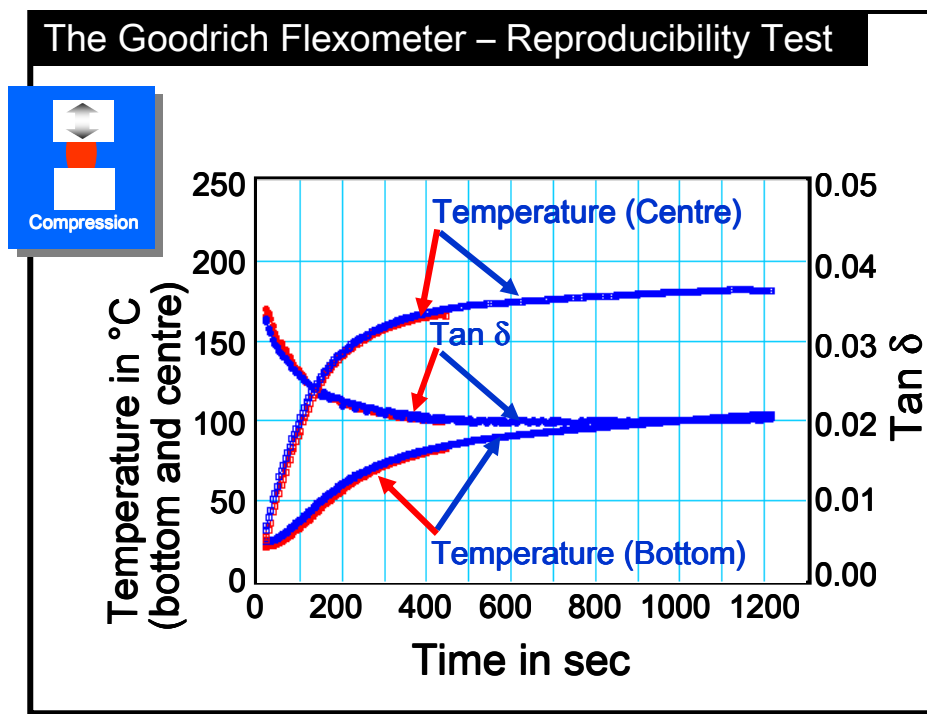


Figure 1: Reproducibility test

Two test specimens (same batch- cylindrical samples for compression load) were tested at 30 Hz under identical static and dynamic load conditions. Both, the heat build-up within the centre of the sample (measurement was carried out with a needle thermocouple - option) as well as the temperature on the "skin" of the sample (corresponding to standard ASTM D 623, DIN 53 333 - recorded at the cross sectional area) are in a quite satisfying accordance.

Even the tan delta (material damping) measurement shows an excellent reproducibility, too.

Tests with practic orientation –

What is the benefit of an additional temperature sensor (needle thermocouple)?

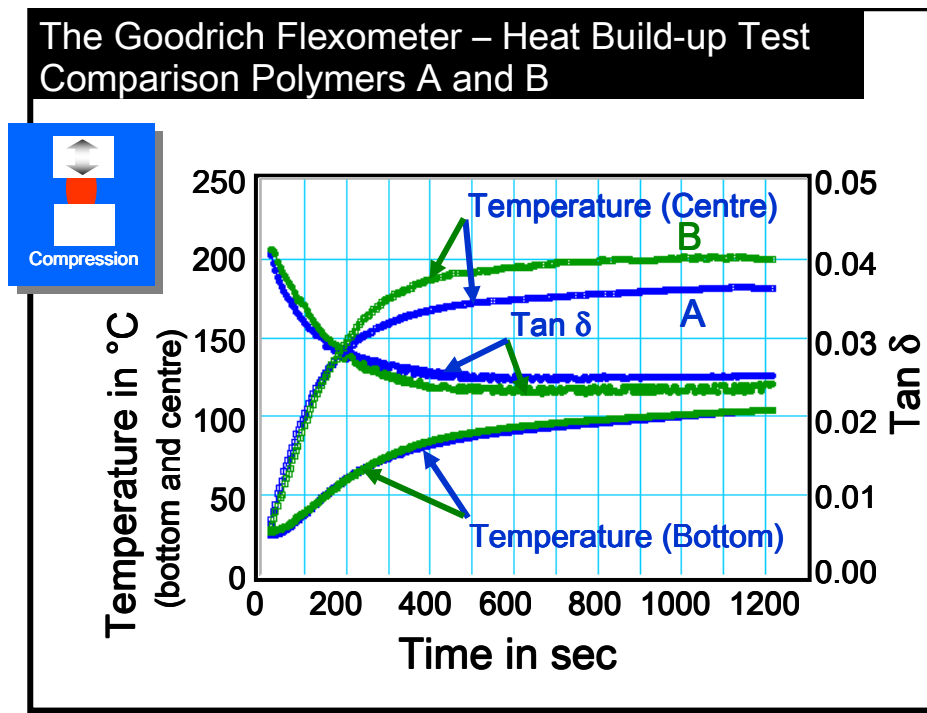


Figure 2: Comparison between compound A and B

Nowadays, heat build-up tests performed with Goodrich Flexometers are quite common.

But however, occasionally with conventional flexometer tests there is lack of information due to resolution problems related to the basic test principle.

Figure 2 show the temperature rise of sample A and B is more ore less identical for the bottom temperature. The bottom temperature sensor only records the temperature on the “skin” of the sample at the samples cross sectional area, but with this sensor no information concerning the “real” temperature in the core of the samples is available.

Results from practical tests show sample A has a better long life cycle compared to sample B. Unfortunately, the conventional heat build-up test did not show any difference.

Only with a second thermocouple, in this case the needle type sensor located in the centre of the test specimen, additional information will be provided. Now the test results show a temperature difference of nearly 20 °C between sample A and B.

But what is the reason for this difference?

The basic compounds for sample A and B are identical. Nevertheless, the heat conductivity of polymer A seems to be much better compared to compound B. The “heat” created in the core of sample A can be transferred much faster to the “skin” compared with sample B. This result could be obtained due to an exchange of the carbon black fillers. In this case the carbon black used for polymer A have a much better heat conductivity compared to the former one. Consequently the heat transfer is much more efficiently. The core temperature is reduced. The duration of the life cycle could be improved.

Tests with practical orientation –
What additional information can be observed by recording of tan delta?

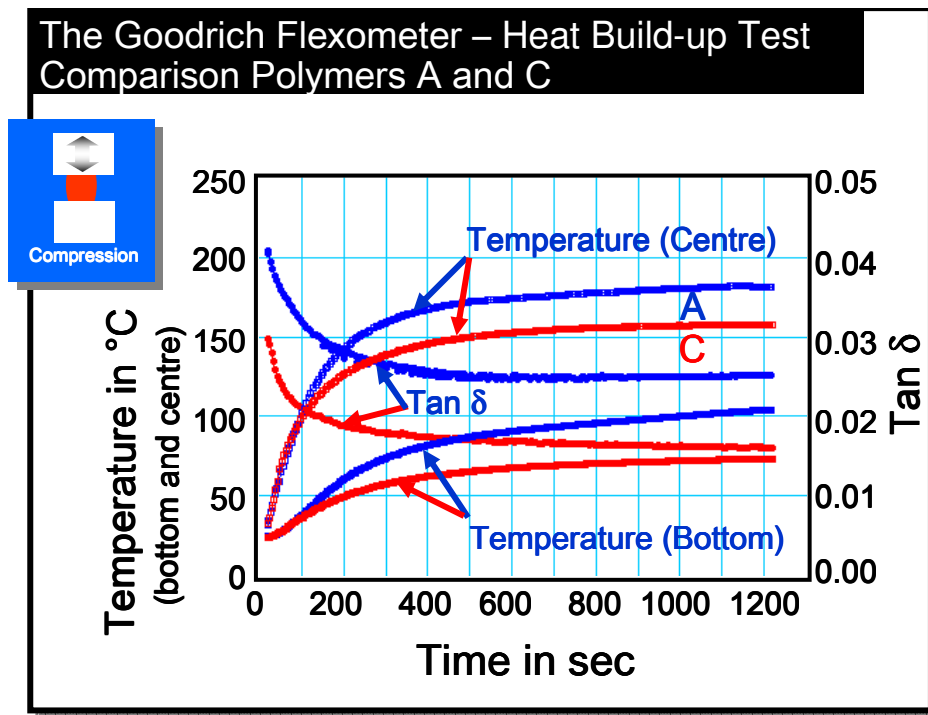


Figure 3: Comparison between compound A and C

Figure 3 shows an additional example for a heat build-up test. For this test different basic compounds are compared. The materials are significantly different. Sample A shows a heat build-up which is about 20 °C above the corresponding temperature rise of sample C.

Consequently, the damping properties (tan delta) of polymers are quite different too, as can be expected for different basic compounds.

Compound C shows a much lower damping value and thus it is substantially more elastic than compound A.