De Neef Construction Chemicals bv
Industriepark 8
2220 Heist-op-den-Berg
Belgium

HA Flex LV AF : longevity of cured material

Introduction

This report describes tests to estimate the longevity of cured HA Flex LV AF; the principle is to expose cured HA Flex LV AF to high temperatures (80°C and 50 °C) and to monitor the eventual decrease in tensile strength under both storage conditions. In this experiments the chosen critical level of the tensile strength is 70 % of the original value. If the rate in decrease in both conditions is different, the results can be put in an Arrhenius plot. With this equation it will be possible to extrapolate the time needed to decrease the tensile strength to 70 % of the starting value at e.g. 20°C.

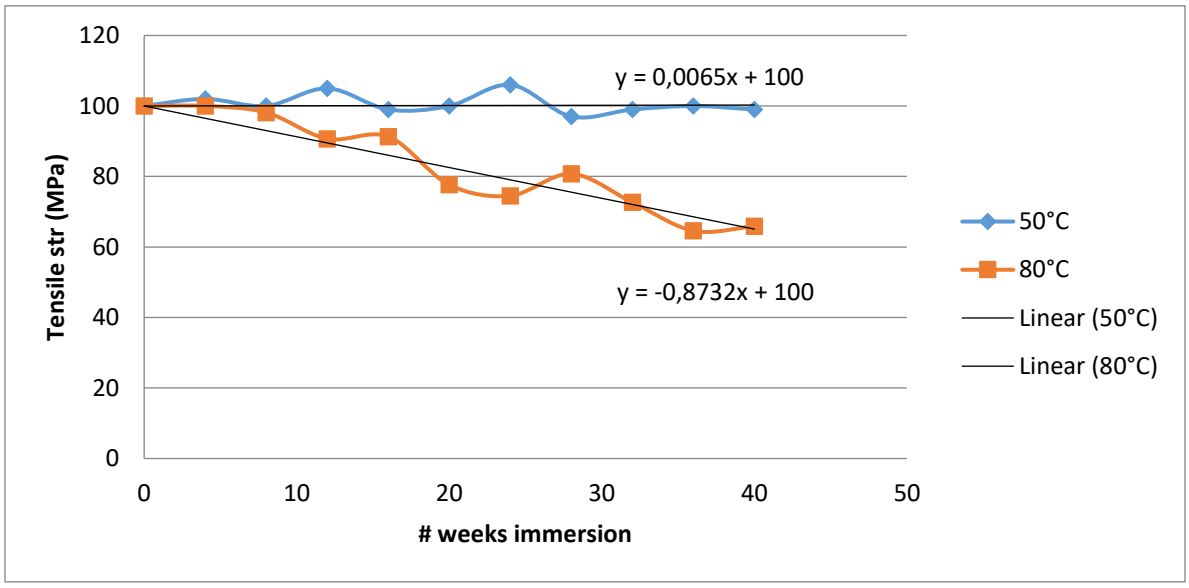
Method

HA Flex LV AF is cured in confined conditions to avoid foaming. Samples of approx. 2 mm. thickness are cut after 7 days curing at 23°C. Profiles for tensile testing are made according ISO 527.
All the samples are stored in tap water during 7 days at ambient temperature (20 – 23 °C). Then the tensile strength according ISO 527, rate 50 mm/min, is measured on 6 samples of HA Flex LV AF; this is the starting value. The other samples are divided in 2 groups; 1 group of samples is stored in water at 50°C, the other group is stored in water at 80°C. At regular time intervals the tensile strength is measured on 3 samples stored at 50°C and on 3 samples stored at 80°C; each value in this report is the average of 3 individual measurements.

The test started on 16/02/2020 and ended on 16/02/2021.

Results

The following graph shows the change in tensile strength of HA Flex LV AF samples stored at 50°C and at 80°C.



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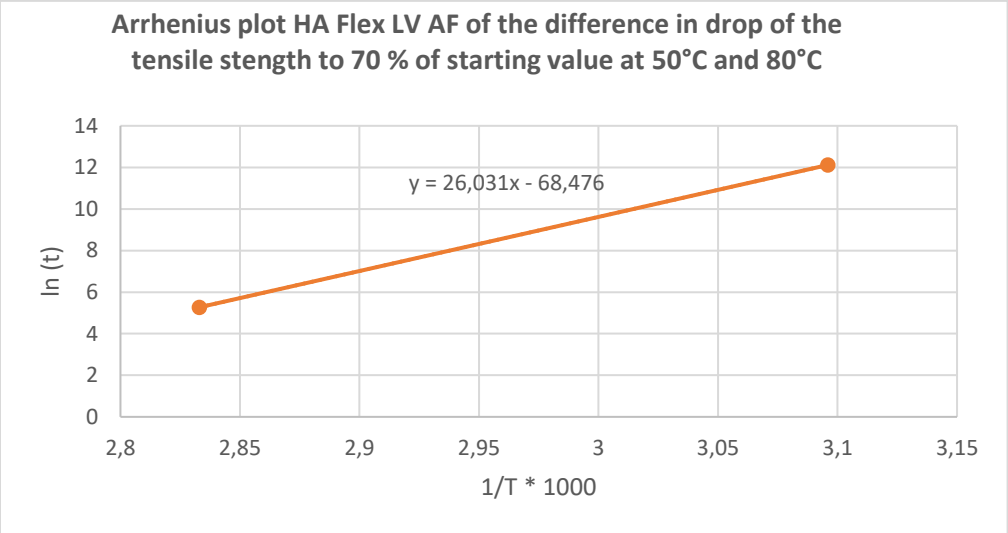
With the equations of both trend lines the time for the tensile strength to drop to 70 % of the starting value can be calculated :

At 50°C it will take 183077 days for the tensile strength to drop to 70 % of the starting value.
At 80°C it will take 195 days for the tensile strength to drop to 70 % of the starting value.

An Arrhenius plot can be made by putting the temperatures in 1/K * 1000 and taking the logarithm of the time in days. The Arrhenius plot for the decrease of the tensile strength of HA Flex LV AF is given in the following graph :



In this way it can be calculated how long it would take at 20°C for the tensile strength of HA Flex LV AF to drop to 70 % of the starting value :
20 °C = 293 K, and 1000*1/T = 1000*1/293 = 3,413. Replacing x in the equation by 3,413 gives y = 20,37 or ln(t) = 20,37. Therefore t = $e^{20,37}$ = >43800 days, or > 120 years.

Conclusion

In order to try to assess the life expectancy of cured HA Flex LV AF, the tensile strength of samples stored in water at 50°C and 80°C was monitored. The minimal value allowed for the tensile strength is a decrease to 70 % of the starting value. At 50°C a very slow rate of decrease was measured; at 80°C the rate of decrease was more significant. Using the Arrheniusplot for the difference in decrease of the tensile strenght at both temperatures, resulted in a very high number of expected years for the tensile strength to decrease to 70 % of the original value. Therefor it can be concluded that the expected time for the tensile strength of HA Flex LV AF to drop to 70 % of the starting value will be at least 120 years.

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Ir. Piet Kempenaers
R & D Manager