EAG LABORATORIES | Eurofins Materials Science

MATERIAL RELIABILITY

PRODUCT RELIABILITY
COMPONENT RELIABILITY

Reliability test approach:

Test plan definition (define CtQ & pass-fail criteria) => experimental phase => data analysis => prediction model

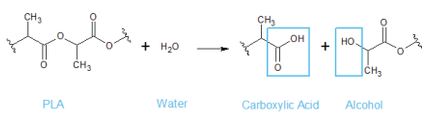
Material reliability test example:

Degradation of polylactic acid (PLA) polymer – predictive life-time modelling for different use scenarios

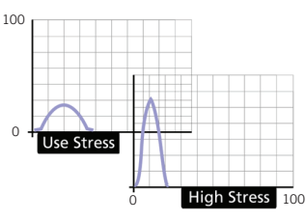
Test plan definition — accelerated testing:

PLA based polymers degrade when exposed to moisture, this chemical degradation process is accelerated by temperature.

Hydrolysis reaction of PLA:

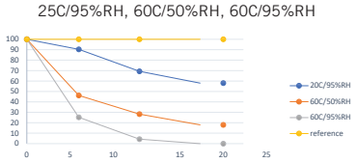


Test plan: Damp-heat storage tests at 3 T%RH combinations
Response Parameters: Mechanical degradation (tensile stress measurement) & Chemical degradation (FTIR measurement).

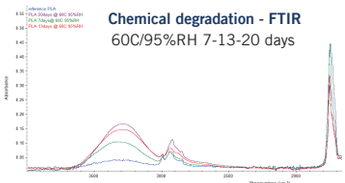


Experimental phase

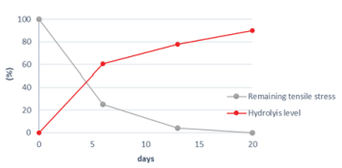
Mechanical degradation - tensile test
25C/95%RH, 60C/50%RH, 60C/95%RH



Chemical degradation - FTIR
60C/95%RH 7-13-20 days



Chemical vs. Mechanical degradation
60C/95%RH



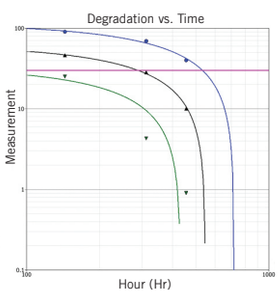
Data analysis

The mechanical degradation data, the chemical degradation data or both can be analyzed using Reliability software.

Damp-heat test *25°C/95%RH - 60°C/50%RH - 60°C/95%RH*

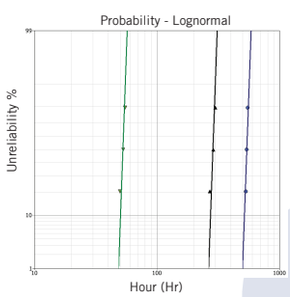
1A: Find degradation model that fits the experimental data set

1B: Definition fail level (for example 30% remaining strength or 30% chemical degradation

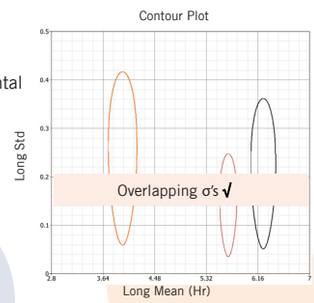


2A: Choose a reliability failure mechanism acceleration model (Arrhenius, Eyring, Temp-humidity…)

2B: Choose life distribution that fits the fail data (Weibull, lognormal, exponential)

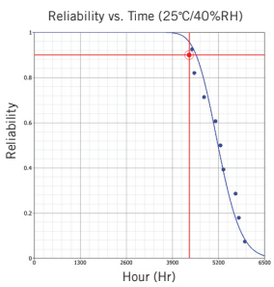


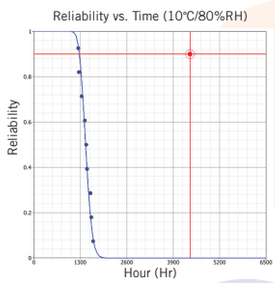
3: Check validity of experimental data



Prediction Model

4: Generation of a prediction model to predict reliability parameters for different use scenarios Specification PLA reliability: ≥90% at 4500 hour





5: Calculate reliability parameters for different use scenarios

PLA polymer reliability parameters *for 30% remaining strength*	25°C/ 40%RH	25°C/ 70%RH	10°C/ 80%RH
Reliable life (R=90%)	4570 hours	650 hours	1275 hours
B 50% life	5180 hours	740 hours	1450 hours

The prediction model predicts the material lifetime under the chosen operating conditions.