



Brightness Loss Prediction for Offset and Couche Papers

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Introduction



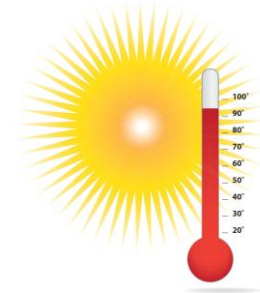
Aging Paper



Hydrolytic



Oxidative



Thermal

Reaction rate = $k_{(\text{therm})}$



Introduction

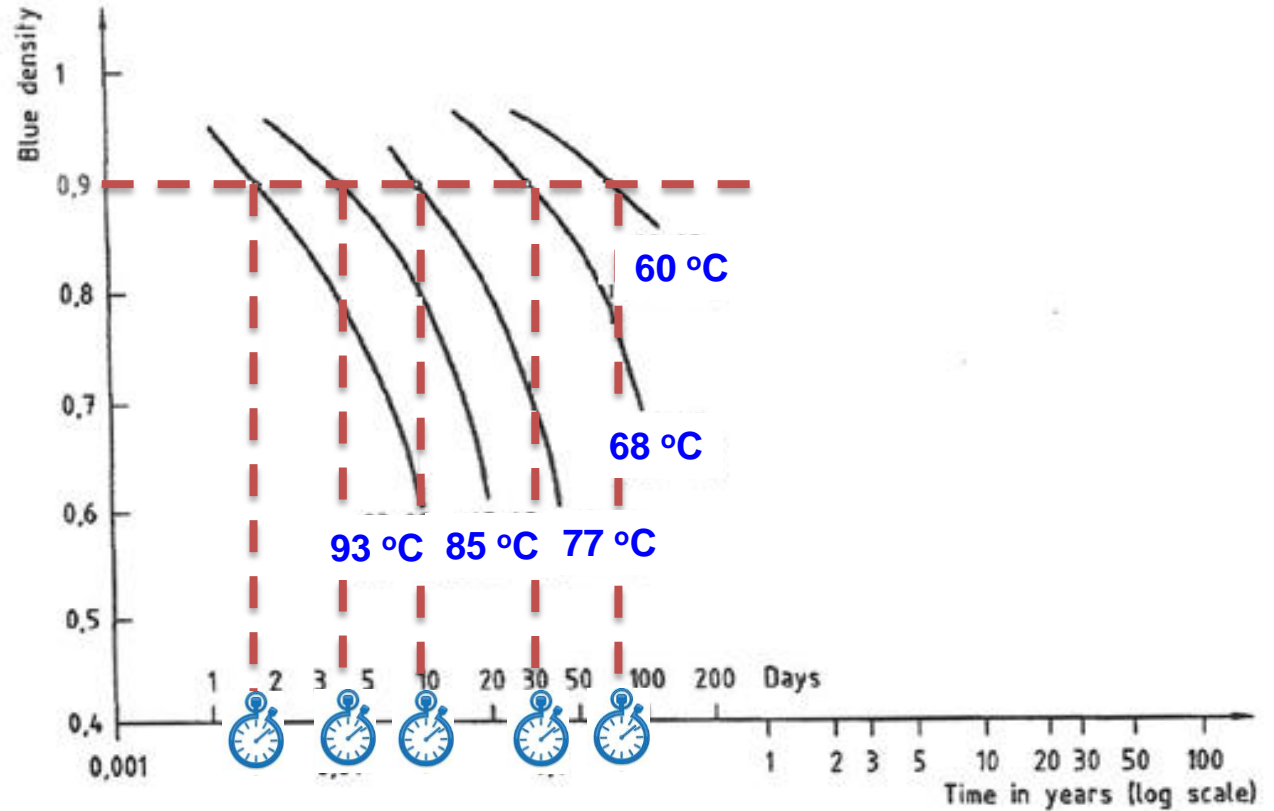
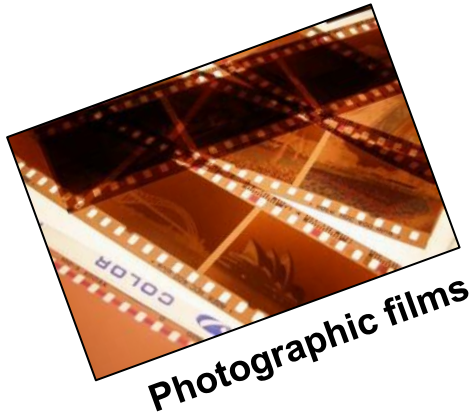
Arrhenius model - assumes that the rate of chemical reactions (k) is inversely proportional to the absolute temperature at which the reaction occurs

$$\log k = \log A + \left(\frac{-E_a}{2.3RT} \right)$$

where k is the reaction rate, A is the pre-exponential factor, a constant that depends on the characteristics of the reaction, E_a is the activation energy in $\text{J}\cdot\text{mol}^{-1}$, R is the universal gas constant ($8.314 \text{ J/mol}\cdot\text{K}$), T is the absolute temperature in Kelvin (K)

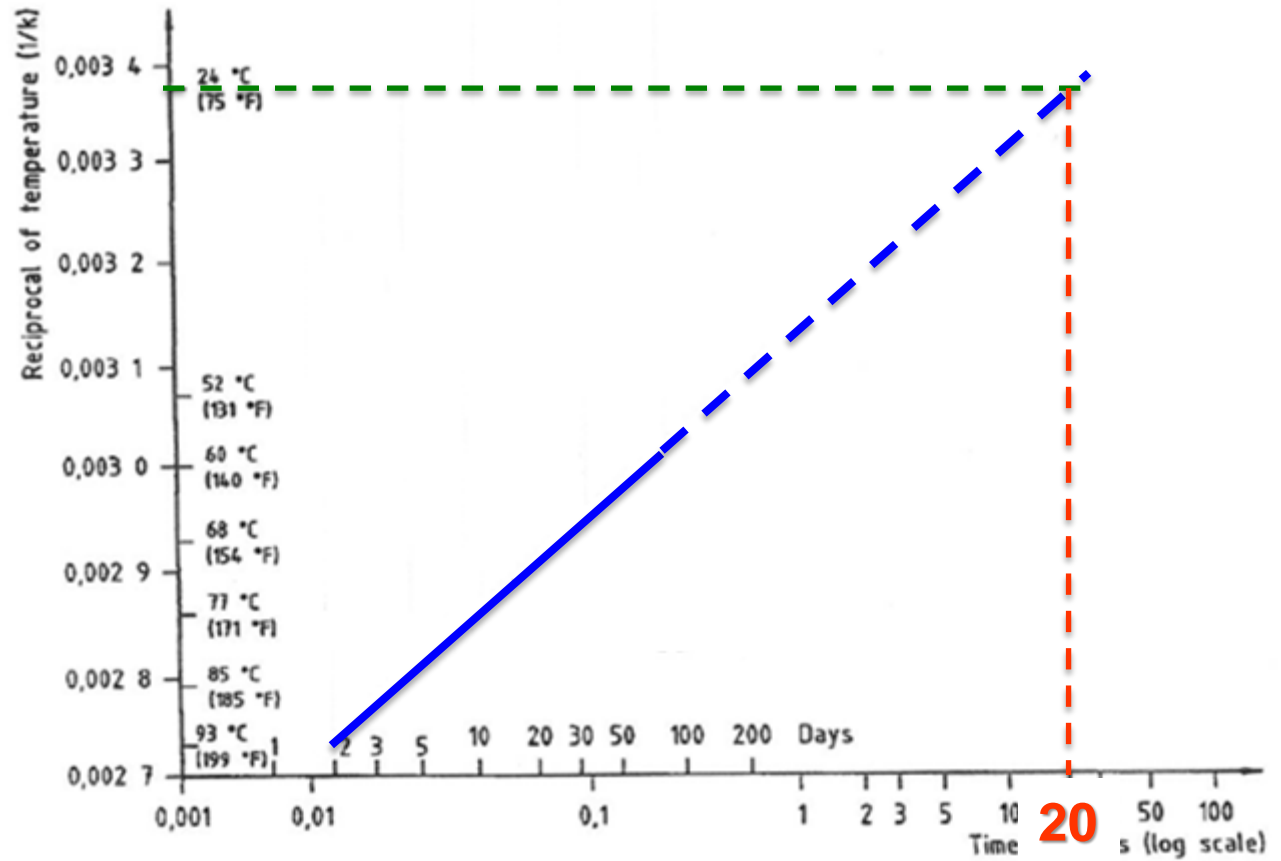
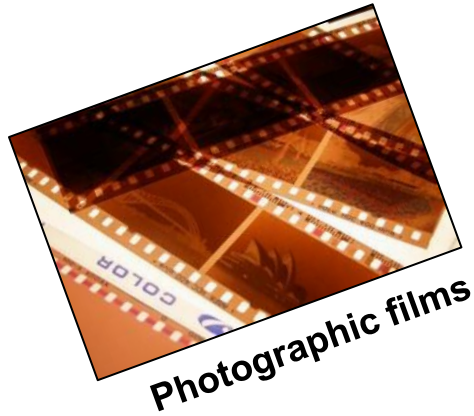


Introduction





Introduction



ISO 18924:2000 - Imaging materials - Test method for Arrhenius - Type predictions.



Goals

Verify the applicability of accelerated aging based on Arrhenius Model to estimate the brightness loss of Offset and Couche Paper.



Methods - Samples

OFFSET PAPER

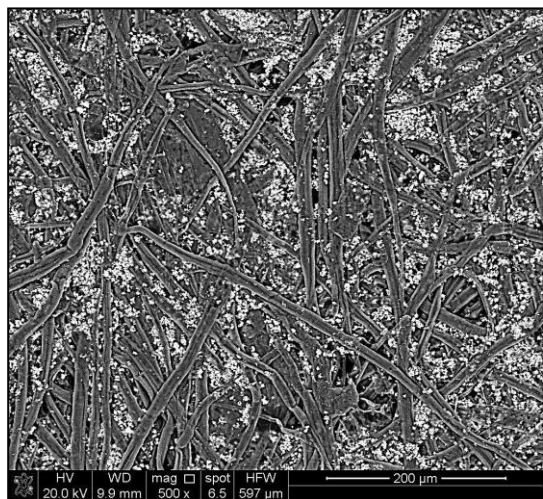
COUCHE PAPER

Grammage (g/m²)	75.7 ± 0.6		115.7 ± 0.6	
Brightness, UV included (%)	104.08 ± 1.10		95.43 ± 0.36	
Brightness, UV excluded (%)	87.79 ± 0.85		87.24 ± 0.46	
Ash content(%)	18.35 ± 0.02		49.36 ± 0.15	
Elemental Composition (% wt.)	Face A	Face B	Face A	Face B
	C = 43.23	C = 50.16	C = 14.40	C = 14.95
	O = 41.95	O = 42.66	O = 30.63	O = 30.35
	Cl = 0.68	Na = 0.36	Ca = 54.98	Ca = 54.70
	Ca = 14.14	Cl = 0.81		
		Ca = 6.01		

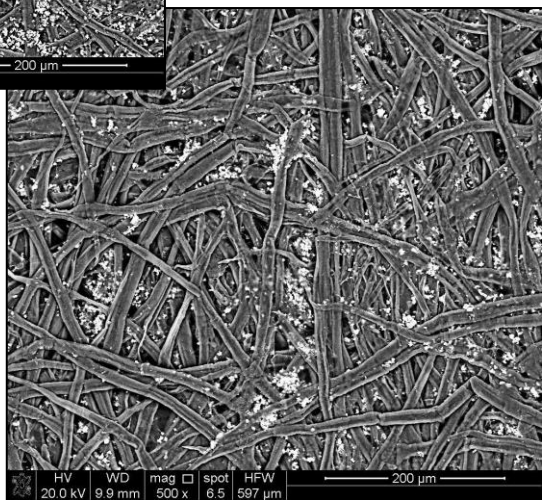
Methods - Samples



OFFSET PAPER

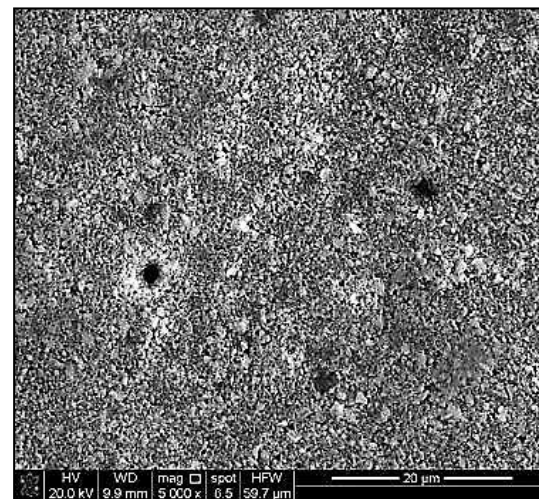


Face A

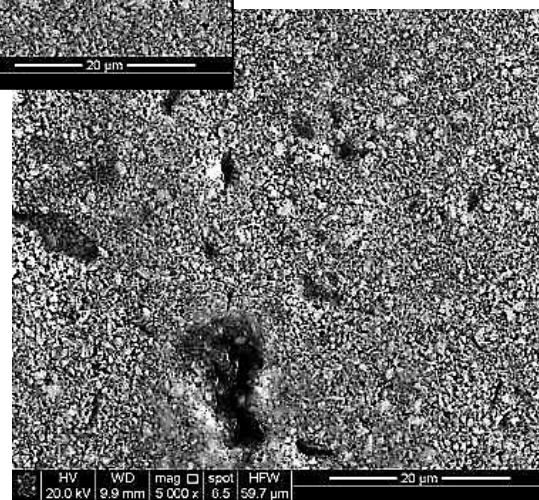


Face B

COUCHE PAPER



Face A



Face B



Methods - Aging

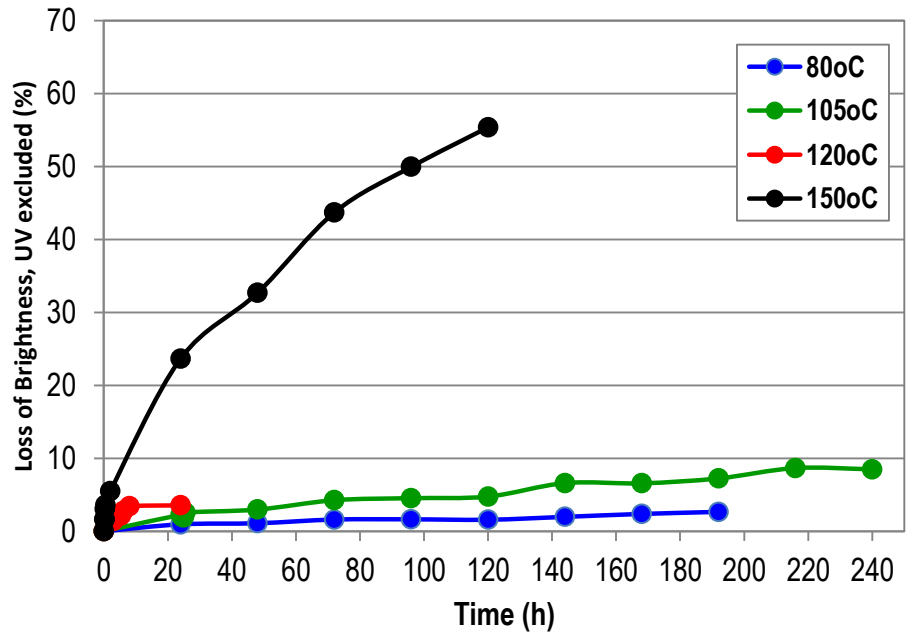
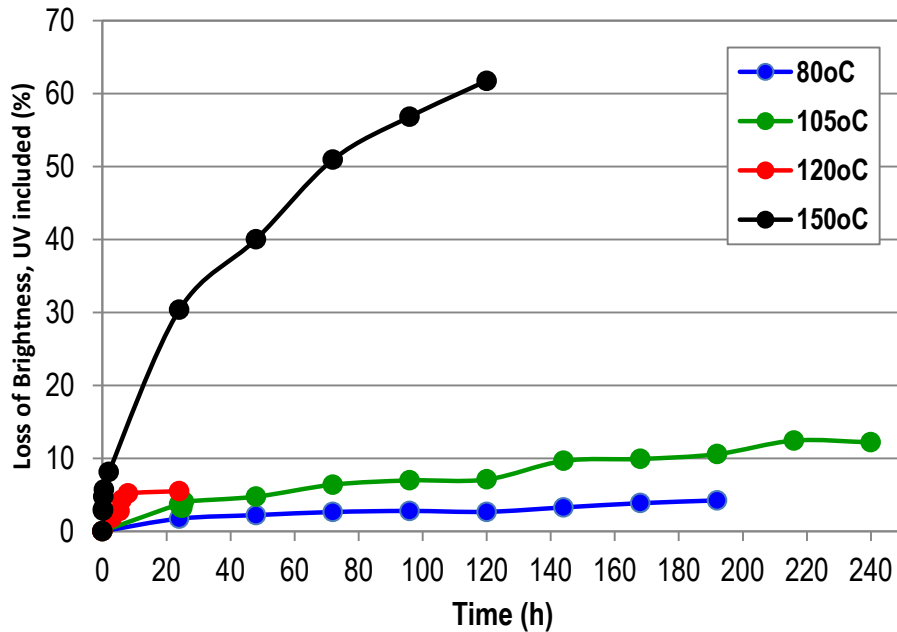
- ★ **Accelerated aging tests - ISO 18924:2000 – Imaging materials – Test method for Arrhenius-type predictions**

Offset Paper	
Temperature (°C)	Time (h)
80 ± 2	192
105 ± 2	192
120 ± 2	24
150 ± 2	120

Couche Paper	
Temperature (°C)	Time (h)
80 ± 2	192
105 ± 2	192
120 ± 2	24
150 ± 2	120

- ★ **Evaluation by Brightness, UV included - ABNT NBR NM-ISO 2469:2004 using an Elrepho 3300 (Datacolor) spectrophotometer.**

OFFSET PAPER

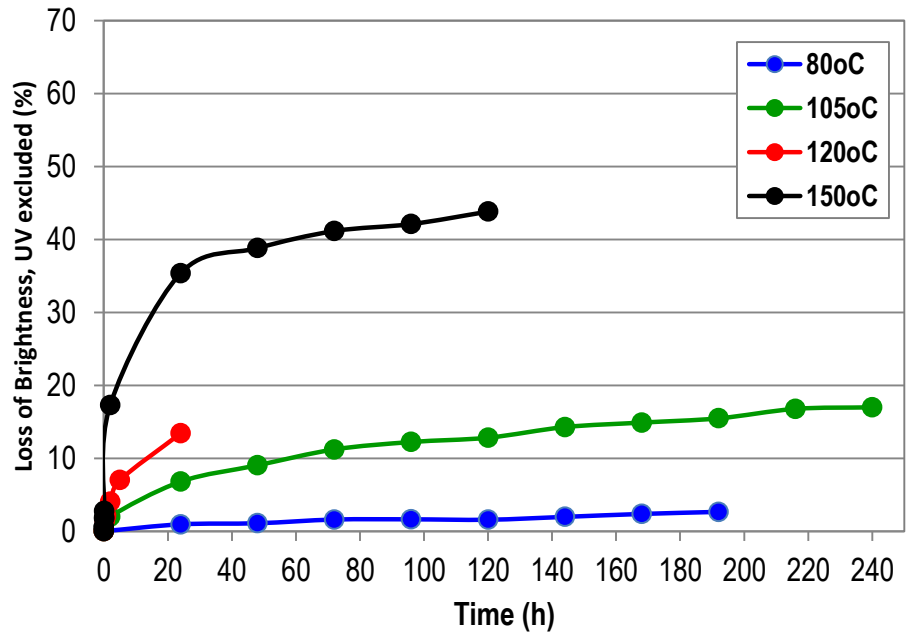
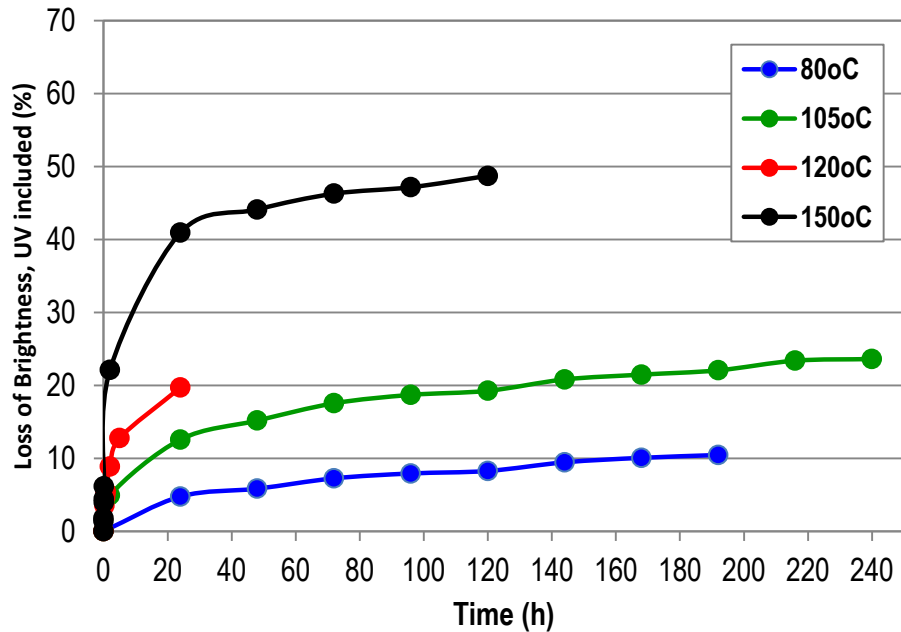


- ★ *Loss of brightness, UV included > Loss of brightness, UV excluded*
- ★ *150 °C: High loss of brightness exposition ≥ 2h → other reactions*



Results

COUCHE PAPER



- ★ **Same behavior of Offset Paper**
- ★ **80°C, 105°C & 120°C: higher loss of brightness than Offset Paper**
- ★ **150 °C: lower loss of brightness than Offset Paper**



Results

Arrhenius Model

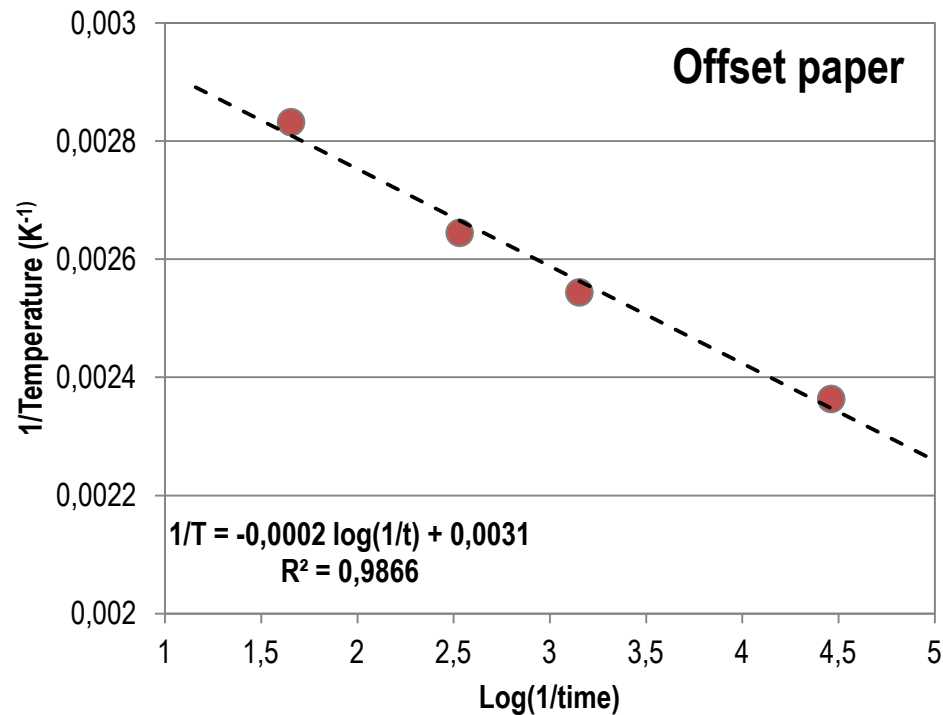
- ★ *Brightness, UV included*
- ★ *Limit: 4% loss of brightness*

Temperature (°C)	Time (h)	
	Ofsete paper	Couche paper
80	192.0	24.0
105	25.5	2.0
120	6.1	0.5
150	0.3	0.1

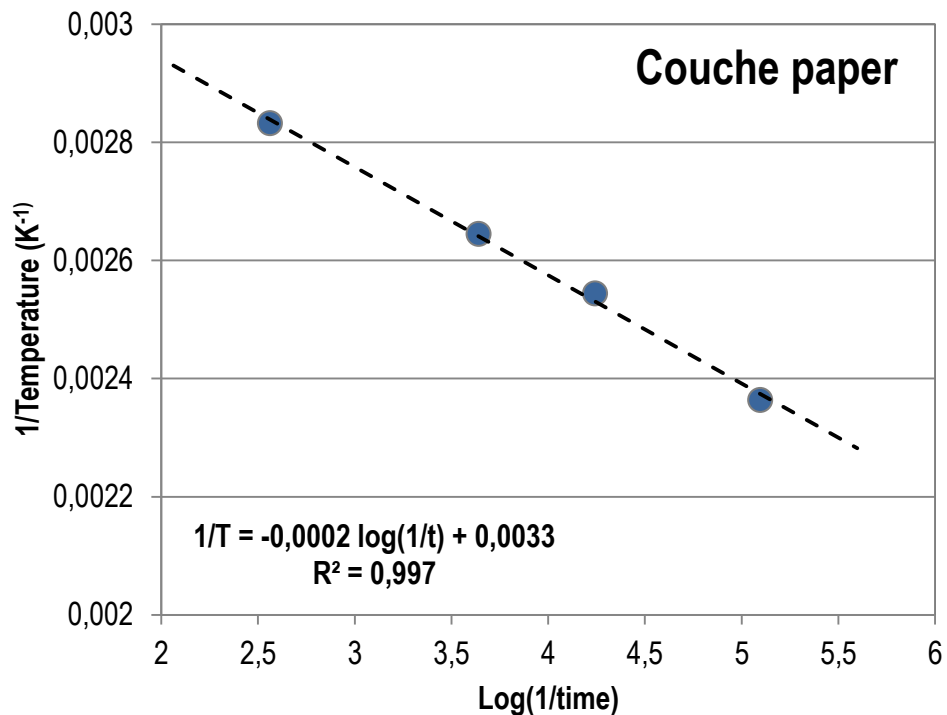


Results

Arrhenius Model



T = 25°C
t = 324 dias



T = 25°C
t = 321 dias



Conclusions

- ★ ***Arrhenius model can be used to estimate loss of brightness in offset and couche papers***
- ★ ***Regardless the difference between the papers, the time requires for the loss of 4% brightness has practically been the same (~320 days), indicating that the reaction rate to lose brightness is the same for offset and couche papers.***



Acknowledgments





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