Comparison between one step and multistep fire retardant coating processes by Life Cycle Assessment

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CyME - Life Cycle Thinking and New Business Models - Hauts-de-France Research Cluster

Introduction

The design of a functional coating on a substrate usually requires **different layers**, each of them having a **specific role**.
So, the development of **innovative coatings** with **multifunctional properties** is very challenging. **Self-stratification** can be an alternative as it is an eco-efficient process allowing the formation, in only **one application**, of a **multi-layer film**.

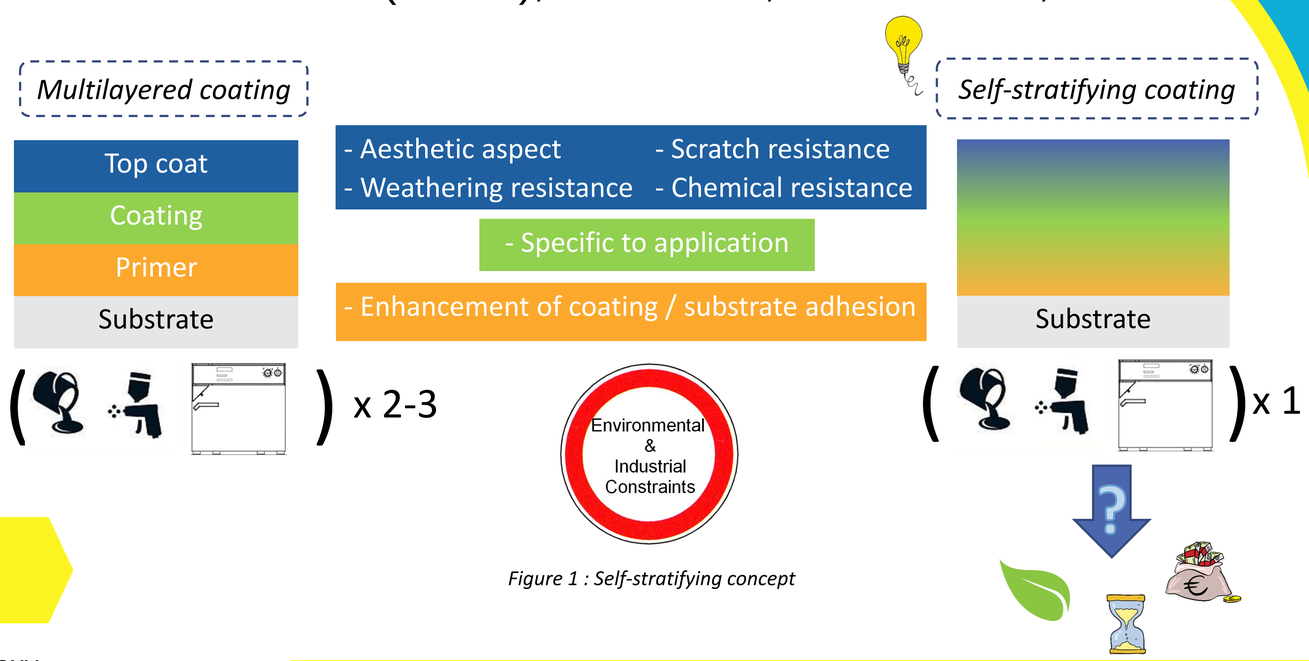


Figure 1 : Self-stratifying concept

Coatings properties

The **reference system (REF)** is made of **two distinct layers** : epoxy resin as bottom layer and silicon resin as upper layer.
In the **self-stratifying coating (AS),** silicone and iron oxide migrate to the upper layer (Figure 2).

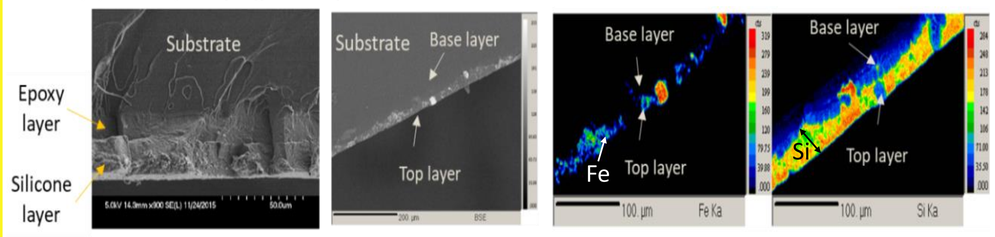


Figure 2 : Cross section pictures of self-stratifying coating

The samples were tested to a **fire test UL-94** (Figure 3). It evaluate the tendency of a material **to extinguish or to spread the flame after ignition** of a material.
Other characteristics have been evaluated in order to compare both systems (Figure 4). The **global performances of the AS system** appear **more interesting** than those of the REF system.

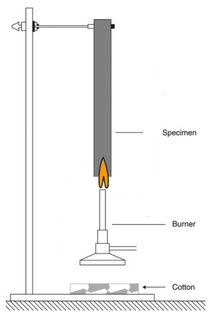


Figure 3 : Fire test UL-94

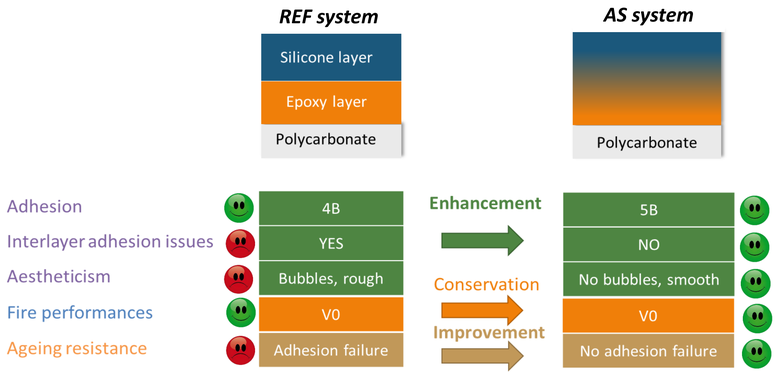
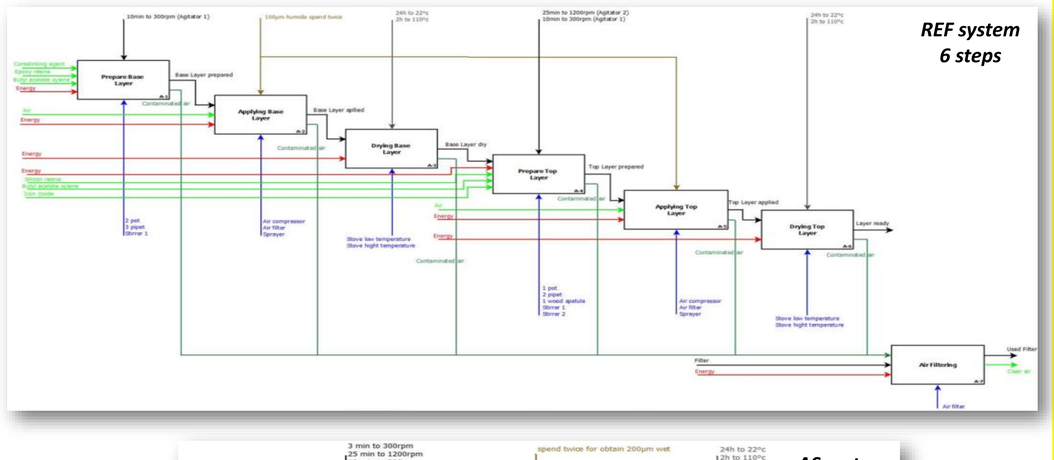


Figure 4 : Comparison of the characteristics of the two systems

Functional analysis

LCA was carried out on **two lab scale coating processes**.
Functional unit (FU) : "Deposit on a 100cm² polycarbonate plate a coating allowing reaching a V0 rating at UL94"
Calculation method : Recipe E 1,12 (Europe)



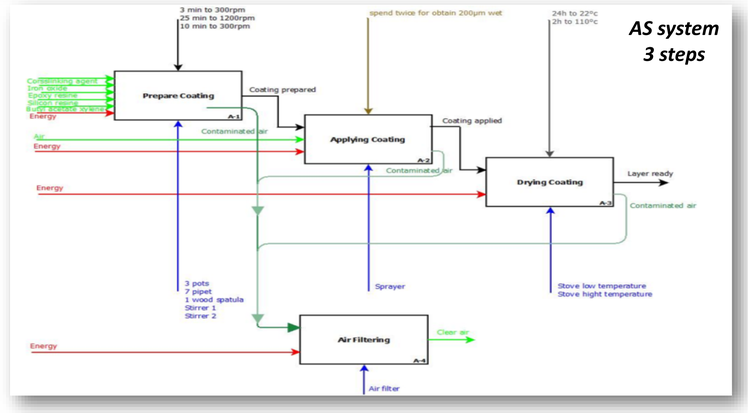
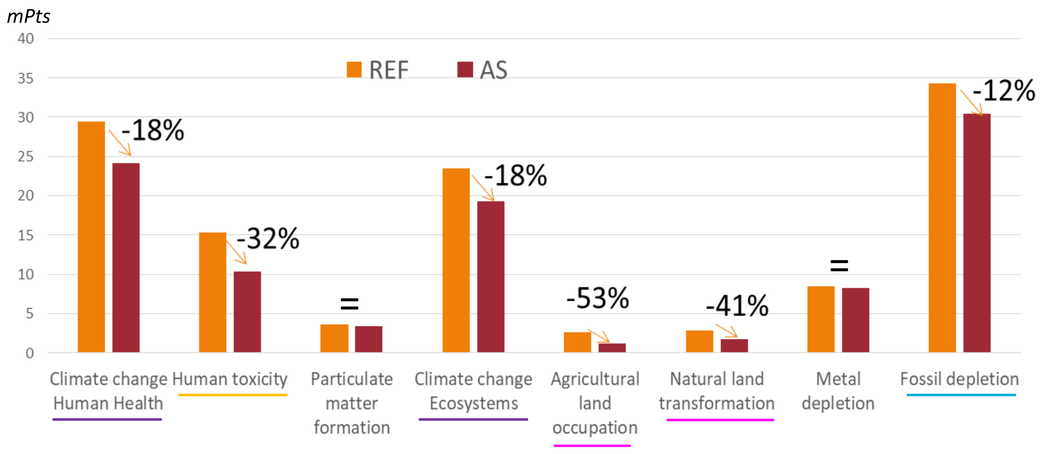


Figure 5 : Inventory of main steps and inputs / outputs for each process

Results of LCA



Chemical products
Curing procedures
Application steps

Electrical consumption

Coating layers
Curing steps

Oil based products

Figure 6 : Comparison of environmental impacts (over ten years) for major indicators for REF and AS systems

Conclusion

Figure 7 : Comparison of total environmental score for REF and AS systems

Less power and chemicals consumption

*The **next step of this work** is to carry out the same study on a **flame retardant self-stratifying coating** based on **eco-friendly products** (bio-based epoxy resin, green solvent …) to see the influence on the global environmental impact.*

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