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Evaluation of bio-based additives in architectural paints

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State of the art

The use of bio-based products (i.e. non-food products derived from biomass) in numerous industrial applications is currently arousing increasing interest. The industry is faced with two main challenges with regard to the use of these raw materials in paints. First, only a limited range of bio-based products is acceptable in terms of quality, cost and availability for this application. Second, there is a general lack of information about these products.

Research ideas

This study considers the incorporation of bio-based products that already exist in the formulations of architectural paints. More specifically, it focuses on the use of sugar esters as dispersing agents. Compared with conventional petrochemical components, these sugar-based additives offer a number of advantages, such as being non-toxic, biodegradable, odourless and non-irritating. In this paper, their effect on coating properties is evaluated and their performance compared with that of reference petrochemical additives.

Achievements (implementation)

● Bio-based additives selected

Various commercial alkyl polyglucosides and alkyl polypentosides were selected. These products are not usually sold to the paints sector. For comparison purposes, two bio-based wetting and dispersing additives dedicated to paints were also studied (Table 1).

Disp	non-ionic, modified fatty acid derivative	
Disp 1	non-ionic, modified fatty acid derivative	
Disp 2	aq. solution of a polymer based on a renewable resource	
Disp	Sugar	Chain length
Disp 3	APG*	C4
Disp 4	APG*	C8
Disp 5	APG*	C8-C10
Disp 6	APG*	C8-C10
Disp 7	APG*	C10
Disp 8	APP**	C5
Disp 9	APP**	C5 and C10-C12

Table 1: Selected bio-based additives (* APG: alkylpolyglucoside ; ** APP: alkylpolypentoside)

● Paint preparations with bio-based additives

Dispersant demand curves were measured to determine the amount of additives required to fully wet the pigments and fillers. The petrochemical dispersing and wetting agent (polyacrylic dispersant ammonium salt) of a reference architectural paint was then replaced in the paint formulation by the bio-based additives with the optimized concentration.

● Paint characteristics

→ Resistance to water

24 hours of exposure to water (covered by a watch glass):
reference, Disp 1, Disp 2, Disp 4: OK or very slight trace
Disp 3 and Disp 7: slight trace
Disp 5, Disp 6, Disp 8, Disp 9: trace (turn matt)

→ Storage stability

Storage stability was determined from viscosity measurements after storage of 1 month at 22°C and 1 month at 50°C. All paints were stable except those containing Disp 6.

→ Spreading rate at a hiding power of 98% (ASTM D2805-11)

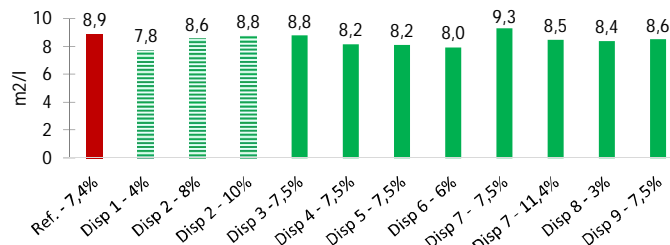


Fig. 1: Spreading rate – Weight ratio % (commercially available dispersant/pigments and fillers)

→ Wet scrub resistance (ISO 11998)

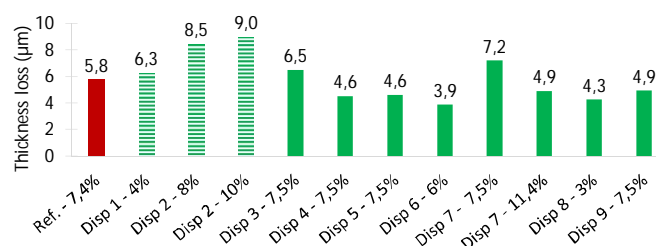


Fig.2: Wet scrub resistance - thickness loss (µm) after 200 cycles
Weight ratio % (commercially available dispersant/pigments and fillers)

→ Drying and open times (ASTM D5895) 200 µm wet - 22°C – 50%RH

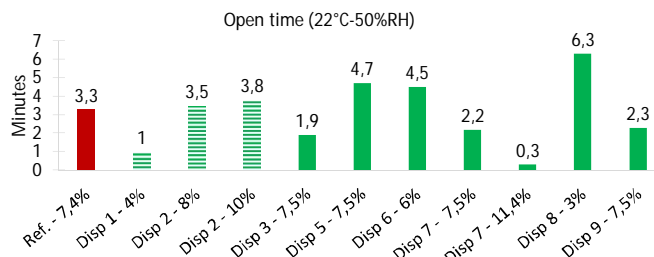
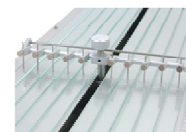


Fig.3: Open time - Weight ratio % (commercially available dispersant/pigments and fillers)

Conclusions

- Spreading rates are equivalent for all of the additives studied. It is slightly greater for Disp 7 (APG-C10).
- Wet scrub resistance may slightly increase or decrease depending of the nature of the sugar ester.
- Some of the APP and APG studied greatly increase the open time.
- Disp 8 (APP-C5) is a good candidate because it increases the open time and wet scrub resistance. Paint containing Disp 8 (APP-C5) has good storage stability and the same spreading rate as the paint prepared with the reference. Only small amount of dispersant is required. The only drawback is the poor resistance of the coating to exposure to water for 24 hours.

Next steps

The characterization of the coatings prepared with bio-based additives is still in progress.