

Functional surfaces produced by foam coating

Eija Kenttä, Hanna Koskela, Sara Paunonen, Tuomo Hjelt, Karita Kinnunen-Raudaskoski

VTT TECHNICAL RESEARCH CENTRE OF FINLAND LTD, P.O. Box 1000, FI-02044 VTT Finland

Corresponding author: *eija.kentta@vtt.fi*

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Foam coating is a technique that allows small amounts of substances to be applied on nonwoven, paper, board or textile webs in an economically viable way. Due to the viscoelastic nature of the foam, a large variety of substances can be coated with various foam application techniques. In this work, foam was fed through a slot die, and killed with absorption and IR-drying. The bubbles collapse mainly due to absorption and leave the coating material on the web surface [1].

The effects of three different foaming agents were studied on the properties of a thin nanosilica pigment coating. Two of the selected foaming agents were molecular surfactants: anionic sodium dodecyl sulphate (SDS), and non-ionic C8/C10 glucoside. Based on studies of surfactant/fibre systems, these two surfactants were classified as fast foaming agents [2]. The third, polyvinyl alcohol (PVOH) is a typical polymer in silica coatings that easily foams as an aqueous solution. The foamability of silica dispersions with these foaming agents, and the stability of the produced foams were studied. To understand the stability of the silica foams, foam half-life time and critical micelle concentration (CMC) were measured. In silica dispersions, the anionic SDS and non-ionic C8/C10 glucoside surfactants decreased the surface tension compared to PVA, as can be seen in Fig. 1 and Tab 1.

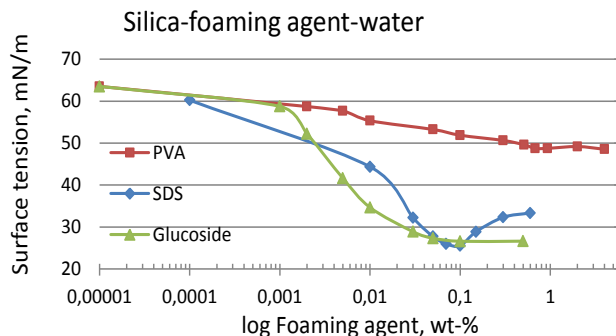


Fig. 1: Surface tension of nanosilica-foaming agent-water dispersions at different foaming agent concentrations.

Tab 1: CMC and surface tension at CMC determined in silica dispersions.

Foaming agent	cmc determined, in silica dispersion*, w-%	Surface tension at CMC, determined mN/m
SDS	0,1 (0,3**)	26 (33**)
C8/C10 Glucoside	0,02	27
PVOH, partially hydrolysed	0,7	49

* silica concentration 10 w-%

**SDS Surface tension value level off at the value given in the brackets

In the following trial run, a thin nanosilica layer was coated on paper with foam coating technique using the aforementioned foaming agents. The foam coating was done at VTT's pilot-scale surface treatment line (SutCo). It was found out that surface hydrophobicity was related not only to silica pigment, but also to the chemical nature of the foaming agent. The surface structure and other properties of the three silica coatings had minor differences.

The authors have applied functionalized cellulose nanofibrils (CNF) on paper [3]. The results show that a thin layer of CNF functionalized by TiO₂/ZnO creates antimicrobial properties to the paper. A layer of CNF-TiO₂ has a significant ability to oxidize NO and NO_x. To conclude, foam coating is a promising and economically feasible technique to add functionality to sheet-formed products such as cosmetics, hygiene and household wipes.

References

1. K. Kinnunen-Raudaskoski, T. Hjelt, E. Kenttä and U.Forsström, *Tappi Journal. Tappi*, Vol.13, N:o 7, 9 – 19 (2014).
2. I. Mira, M. Andersson, L. Boge, I. Blute, G.Carlsson, K.Salminen, T. Lappalainen and K. Kinnunen, *Nordic Pulp and Paper Research Journal*, Vol. 29 No: 4, 679 – 688 (2014).
3. K. Kinnunen, T. Hjelt, E. Kenttä, U. Forsström, P. Sadocco, J. Causio and G. Baldi, *Tappi International Conference on Nanotechnology for renewable materials*, June 24-27, Stockholm, (2013).