Abstract

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Silica pigment produced from silicate mining sidestreams for ink-jet paper coating application

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Abstract

Silica pigment has shown favourable properties in the ink-jet paper coatings. Silica has typically high surface area providing a coating layer with high porosity to hold relatively large volumes of ink-jet ink solvent. Silica pigments may have intra-particle pores, which allow different scale pore diameter development into the coating structure. The hydrophilic nature of silica pigment enhances solvent absorption of water based ink-jet inks. Ink-jet printing technology is expected to continue growing rapidly, and to be commercially viable, cheaper pigment formulations are needed. The target in this work is to study the possibility to use low- cost silica pigment produced from silicate mining industry sidestreams as a coating pigment of ink-jet paper. Pigment and coating layer properties of produced silica are compared to commercial silica pigments and their coating layers.

After initial screening Olivine $(Mg,Fe)_2\ SiO_4$ was selected as the silicate mineral to be used for the production of nanosilica. Generally the resources are worldwide abundant and huge amounts of olivine rich rocks, dunites, are found in many countries on every continent. Nitric acid was used as a solvent in the silica pigment production using an acidic dissolution method. Based on the element composition analysis produced silica pigment contained 94 % of silica (SiO_2). Infrared (IR) and X-Ray diffraction (XRD) analysis indicated that the produced silica is in the form of amorphous hydrated silica ($SiO_2 * X\ H_2O$).

Laboratory coating colors that contained silica pigment with PVOH were made and the coating colors were applied to a commercial base paper (80 gm^{-2}) with a laboratory rod coater. The paper coating of the produced silica pigment was compared to corresponding laboratory coatings of commercial colloidal nanosilica, fumed nanosilica and a precipitated silica pigment.

Opacity of paper is improved by all silica coatings. Based on the gloss results, silica pigment coated papers are mat like having very low gloss. Only the coating of commercial fumed silica pigment improved the gloss of the paper slightly. This could be due to the fact that fumed silica pigment particles had the smallest particle size and tend to orient and pack together more tightly leading to higher gloss. Coatings prepared from commercial silica pigments increased slightly brightness, but the coating of produced

silica did not improve brightness. Produced silica contained a small amount of iron, which is obviously the reason for the lower brightness of the coating.
In ink-jet printing a fast absorption of ink is beneficial. Liquid absorption speed of ink-jet ink was determined with nozzle application. The results indicated that the coating layer of produced silica and commercial precipitated silica pigment had higher ink-jet ink absorption speed than the coatings of colloidal silica and fumed silica. Scanning electron microscope (SEM) images of coating surface show that coating has both large pores and smaller pores when produced silica or precipitated silica is used, figure 1.

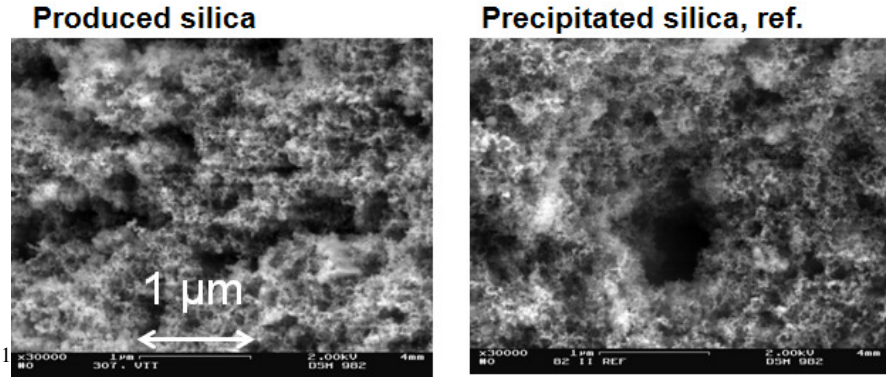

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Figure 1 Topographic image (SEM) of silica pigment coating, magnification 30 000x.

Results show that the silica pigment produced from the olivine of mining industry sidestreams could be used for matt coated ink-jet papers. The coating structure of produced silica pigment coating was close to that of commercial precipitated silica coating.
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[1] Silica pigment produced_2.doc