

STSM REPORT

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STSM Topic: FOOD CONTACT ANALYSIS OF OFFICE RECOVERED PAPER GRADES

Host: VERA RUTAR, Pulp and Paper Institute, 1000 Ljubljana, SLOVENIA (SI)

Purpose of the visit

The completed scientific mission is of interest to the research of using recycled paper and board as food contact materials.

Environmental considerations have created a growing trend toward increased utilization of recycled fibers. Food board manufacturers, responding to the environmentally driven pressures, often try to include secondary fibers in their furnish.

Secondary fibers can be a source of various contaminants which are believed to be possible carcinogen. Recovered paper and board may vary in origin and could include paper containing residues of printing inks, adhesives, trace elements, waxes, fluorescent whitening agents and dyes, sizing agents, organochlorine substances, plasticizers, aromatic hydrocarbons, volatile organic compounds, curing and grease-proof agents, amines, biocides and surfactants. Chemicals from these sources may migrate into foods and potentially cause a risk to human health.

In Croatia, in the production of white top linerboards (used as a top layer of pizza delivery containerboards) the white ply is usually made by deinking the offset printed wood free paper grades. That means that the layer intended to come in direct contact with food is made of deinked fiber furnish.

In this study different types of office print-outs were submitted to a chemical deinking flotation and laboratory made handsheets were tested for food contact suitability. The flotation yield, as well as the optical properties of deinked handsheets, was measured in order to evaluate the deinking flotation efficiency. The experiments done within this STSM were performed in order to determine the possible suitability of the office print-outs as an alternative fiber supply in the production of white top linerboards.

Description of the work

Certain types of digitally printed papers are not easily deinked using conventional deinking methods, meaning that the insufficiently removed pigments and dyes have influence on poor visual appearance of deinked handsheets (specs, low brightness and pronounced color shade).

For this experiment, three different types of office print-outs were chosen for the deinking by chemical flotation process. The ink jet prints (printed with black pigmented ink), as well as the laser prints (printed in black and in color using dry toner ink), were deinked by means of laboratory deinking flotation. All the samples were printed using the same test page (Ingede A4 letter Gray Testpage) with exception of the color prints for which the Ingede A4 letter CMYK Testpage was used. The Navigator brand office paper was used as a substrate for all printing trials. The office paper characteristics are shown in **Table 1**.

Table 1, *Office paper characteristics*

Brand	Navigator Universal Office Paper
Composition	72% chemical pulp, 20% fillers, 4% moisture, 4% binders
Grammage	80 g/m ²
Ash Content	14.5 %
Bulk	1.31 cm ³ g ⁻¹

Ink jet prints were printed using the Canon iP4300 printer (which uses black toner ink for printing text) and the printing mode was set to text grayscale printing. Laser prints were printed using HP 1010 printer (black) and CMYK prints were printed using LEXMARK C920 printer.

For the **deinking flotation procedure** four samples of recovered paper were prepared: black ink-jet prints, black laser prints, laser color prints and mix of 50% of laser black and 50% of laser color prints. The samples were submitted to an accelerated ageing for 72 hours at temperature of 60±3°C before doing the chemical deinking flotation. The samples were then separately recycled following the same routine: 75 grams of absolutely dry paper was cut in 2 x 2 cm strips and was put in the pulper. By adding two liters of deionised water at temperature of 60 °C consistency of pulp was set to 3.75%. Then, the deinking chemicals were added (22.9 ml of sodium hydroxide, 20 ml of hydrogen peroxide, 17.3 ml of sodium silicate Na₂SiO₃, 0.38 g of DTPA and 2.25 g of surfactant). The industrial deinking process was simulated with these amounts of added chemicals. The obtained pH was between 11.5 and 11.7.

The pulp was desintegrated (beaten) in the pulper at 3000 rpm for 30 minutes and was afterwards stored for 90 minutes. After the storage time has elapsed the pH was measured again and it remained nearly the same.

After that, 400 ml of suspension was separated and diluted with water up to 5 liters and the undeinked pulp handsheets were formed according to TAPPI 205 standard method. The rest of the suspension (1.6 liter) was diluted with water up to the volume of 11 liters and was then transferred to the flotation cell and floated for 10 minutes. During flotation process, flotation froth was collected manually in order to be filtrated afterwards for the determination of flotation yield. After the flotation process, the suspension was divided in two parts – one part was used for formation of deinked pulp handsheets and another part was screened (poured through a screen/wire mesh) and afterwards diluted with water for the formation of another set of deinked pulp handsheets. All the handsheets were made according to the TAPPI 205 standard method.

For all samples the deinked pulp handsheets were made following the above mentioned procedure with small variation regarding the mix sample. The other half of floated suspension of the mix sample was not screened but was mixed with virgin chemical pulp in ratios of 50% and 75% of dry fiber matter instead - as it was planned to determine how the addition of virgin pulp improves food contact suitability.

In order to evaluate the chemical deinking flotation efficiency, besides the flotation yield calculations, the optical characteristics of deinked handsheets were measured as well.

The cleanliness of pulp was evaluated by optical measurements of deinked pulp (**ISO brightness** in accordance with ISO 2470, **CIE whiteness** in accordance with, **CIELAB** color coordinates: **L***, **a***, **b*** in accordance with ISO 5631) as well with the ink measurements of deinked pulp (ink removal efficiency – **IE₇₀₀** according to DIN 54500).

The determination of the number of dirt particles and the total area covered by those particles was conducted in accordance with the standard ISO 15755: 1999.

The **Microtek** scanner was used for scanning the handsheet and the **Proton** computer program with automated setting of grey treshold was used for data processing.

Food contact analyses were done in order to determine the suitability of recycled papers for food contact applications. **The fastness of fluorescent whitened paper** was determined according to DIN 53991 standard. In this test procedure the sample is brought in contact with glass fiber papers which have been saturated with a test fluid and placed under a load for a given time. The staining of the glass fiber paper is evaluated by comparison with a series of fluorescent whitened comparison papers. The test fluids used were deionised water, diluted acetic acid, soda and olive oil.

Main results

The results of **CIE whiteness measurements**, expressed for upper side of the handsheets, are presented in **Figure 1**. After deinking flotation procedure, the whiteness of the laser (black and color) handsheets is increased from 79.2% and 74.8% to 82.2% and 82.9% respectively, while the whiteness of the Ink Jet sample is increased only slightly ($\Delta=1.1$). The certain amount of the fillers was washed away after the screening of the pulp. That is visible from the whiteness measurements of screened pulp handsheets of both laser samples - their whiteness values are slightly decreased after the screening stage - with the Ink Jet sample being the exception.

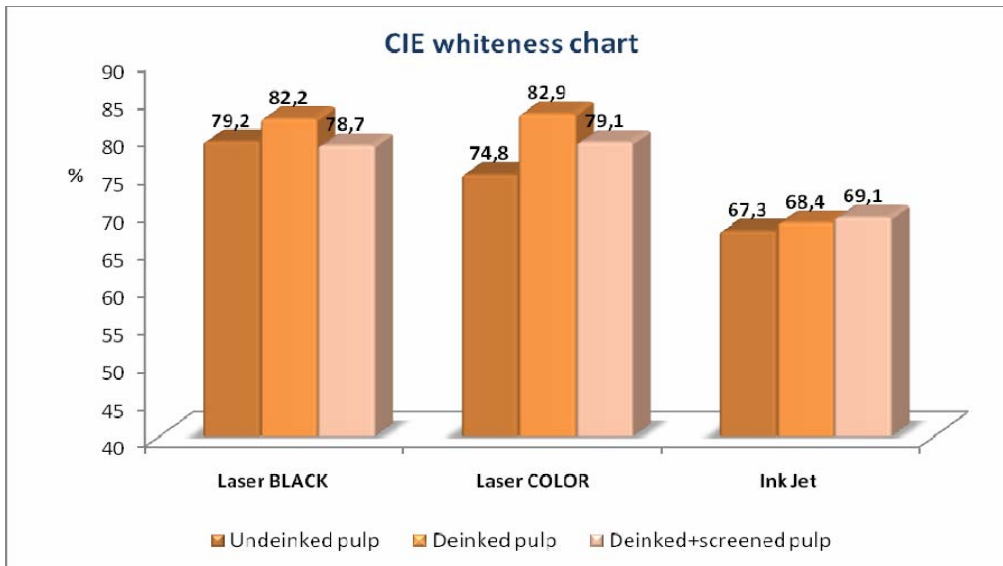


Figure 1, CIE whiteness chart

The results of **ISO brightness measurements**, expressed for upper side of the handsheets, are presented in **Figure 2**. After deinking flotation procedure, the brightness of the laser (black and color) handsheets is increased from 80.7% and 76.9% to 86.7% and 87.4% respectively, while the brightness of the Ink Jet sample is increased only slightly ($\Delta=0.3$). The results also show that screening of the pulp has positive influence only on the Ink Jet sample, as the brightness value of the ink jet screened pulp increased from 77.0% to 82.7%.

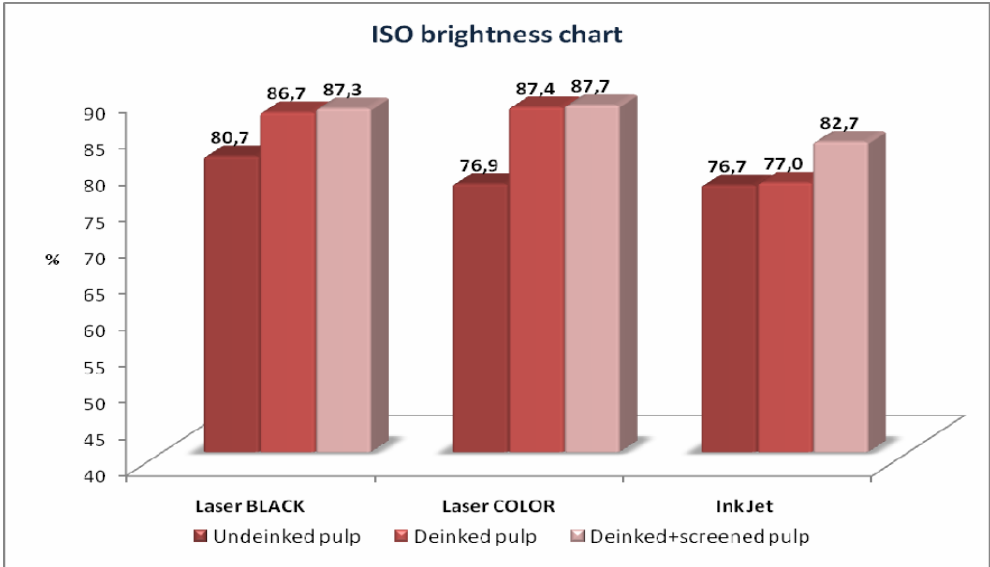


Figure 2, ISO brightness chart

Image analysis (**Figure 3**) shows that black laser sample disintegrated into the 7540 ink particles, while the laser color sample disintegrated into 13737 ink particles. Flotation removed the majority of visible particles, leaving 280 and 421 ink particles on deinked pulp handsheets. Screening of the pulp led to a slight increase in number of ink particles (349 and 501, respectively).

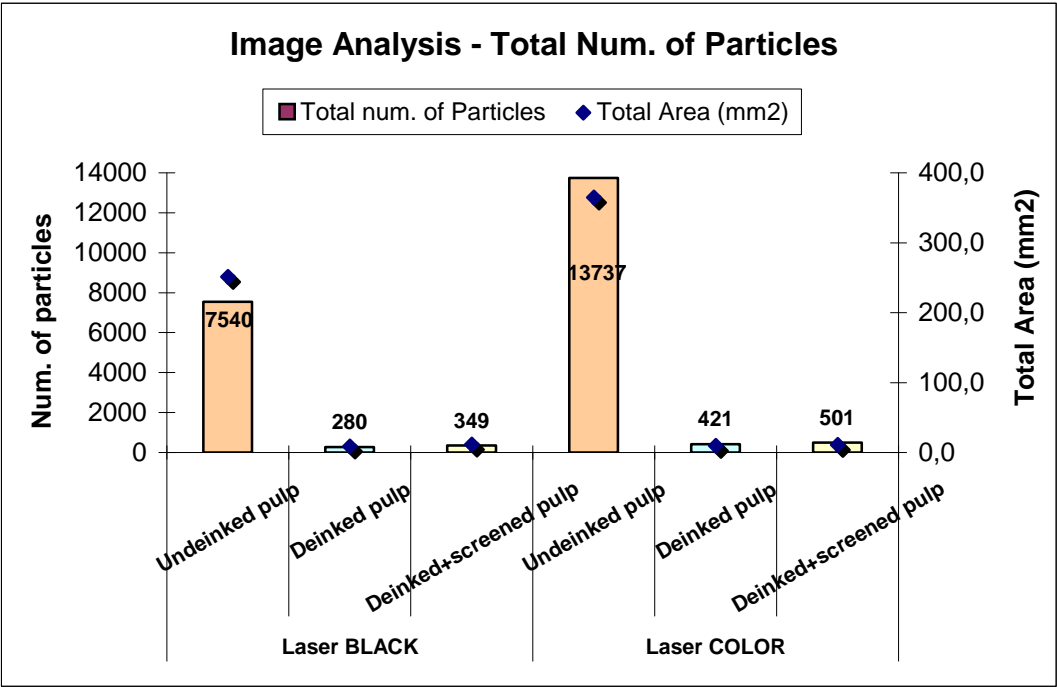


Figure 3, Total number of particles obtained by image analysis

Regarding the **food contact suitability**, the fastness of fluorescent whitened papers (bleed fastness) was determined. The original paper sample “Navigator”, as well as the laser black and color deinked handsheets, were subjected to the bleed fastness analysis and only the original paper samples showed very severe bleeding of the fluorescent whitening agents (FWA). The result of the analysis of deinked handsheets show that the FWA did not migrate into the food.

Other food contact analyses (such as **detection of heavy metals** in deinked pulp handsheets) are yet to be done at Croatian food hygiene laboratory in Zagreb and will be presented in the scientific paper that we plan to publish as a result of a successfully completed STSM.