Optical Brightener-Free Paper for Inkjet Contract Proofing

The purpose of optical brighteners in the paper and printing industries is to remove the yellowish appearance of the raw materials used in paper manufacturing. In addition, optical brighteners increase the brightness of the paper so that a white paper appears even whiter. However, this cannot be achieved without influencing the printed colors.

One possibility to reduce the yellowish paper color is the use of dyes or pigments in the pulp. In most cases blue dyestuffs are added to the paper. By absorption of the longer wavelengths of the visible spectrum – yellow and red – the reflectivity of the paper is matched to a neutral white shade. The brightness of the resulting paper is, however, reduced by the addition of the dyestuffs but the color shade of the paper is visibly whiter than a slightly yellowish paper.

Optical brighteners (see chemical structure in Figure 1), on the other hand, do not change the absorption characteristics of the paper but increase the intensity of reflected blue light. The functionality of “whitening agents” – as optical brighteners are also called – relies on their ability to emit blue light by conversion of UV radiation invisible to the human eye. This fluorescence is added to the base reflectance of the paper fibres themselves. Fig. 2 shows the reflectivity curves of a brightened and an un-brightened proof paper. With the optical brightened paper an increased reflectivity is apparent in the blue visible range at 430 nm.

Optical brighteners increase whiteness by converting UV light energy to blue light. The more UV light a light source has the more bluish and, for the human eye apparently whiter an optical brightened paper appears.

Papers for contract proofing are particularly critical as the final result has to match the press exactly. It is necessary, therefore, that colors be reproduced with the lowest possible color difference (Delta E). Precise color measurement, calibration of the proofing system and a visual color match are essential for this application and here optical brighteners in the paper can cause problems:

1. When the base color of the printing paper stock is simulated on the proof. As printing paper stock normally contains optical brighteners an accurate color match to the press would only be possible if the brightening of the proof paper were absolutely equal to the color appearance of the printing paper. To achieve this, the actual printing stock would have to be used and this is generally not

possible with ink jet printing as the paper is too absorbent. A good compromise, and match to the press, is achieved by using a paper as neutral in color as possible, which is optical brightener free and when the background color of the printing paper is simulated for a controlled light source, e.g. D50. In order to be able to simulate many commercially available printing papers, the proofing paper should have a neutral shade with a brightness as high as possible (see Lab-Values of proof papers in Table 1), as is described in, for example, ISO 12647-2.

2. Color measurement is influenced by the optical brighteners and this can lead to errors in the measured values. This is particularly true for ink jet printing inks because these inks are transparent and do not hide the base paper color in contrast to the less transparent inks used in offset or gravure printing. Due to the absorption of UV light by the yellow dyes the influence of the optical brightener in yellow is less than, for example, cyan. In Fig. 3 the color shift in cyan is plotted against the amount of optical brightener in the paper. The deviation of color (Delta E) caused by the optical brightener is greatest in areas of low ink coverage and decreases as one approaches 100% full tone color. This means that calibration on papers with brighteners is non-linear as the brightening effect varies with ink coverage with the result that color measurement and calibration are distorted. Overall the brightening of papers leads to a shift of the color gamut in the blue direction.
3. Optical brighteners are sensitive to environmental influences, particularly UV light. Therefore, the long term stability of proof papers, especially concerning yellowing, can only be guaranteed, if optical brighteners are omitted.

These are the main reasons to use papers without any optical brightener for contract proofing applications. For this reason it was necessary to develop special resin coated papers with tailored ink jet receptor coatings. It was especially important to achieve a neutral white paper shade with extreme brightness in order to simulate printing paper stock and to cover the color gamut of the different printing processes.

If other printing standards such as SWOP or GRACoL are to be matched a different paper shade is required. These types of papers are also available without optical brighteners.

Paper	L	a	b
Without Brightener	**96.5**	**– 0.2**	**– 0.8**
With Brightener	**96.9**	**+ 1.2**	**– 3.0**

Table 1: Comparison of color values of 2 different proof papers (Spectroscan, D50, 2°)

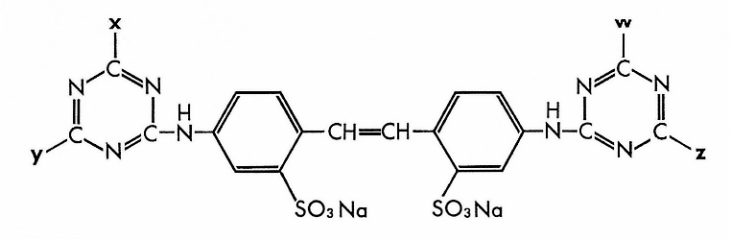

Figure 1: Basic chemical structure of the most common optical paper brighteners

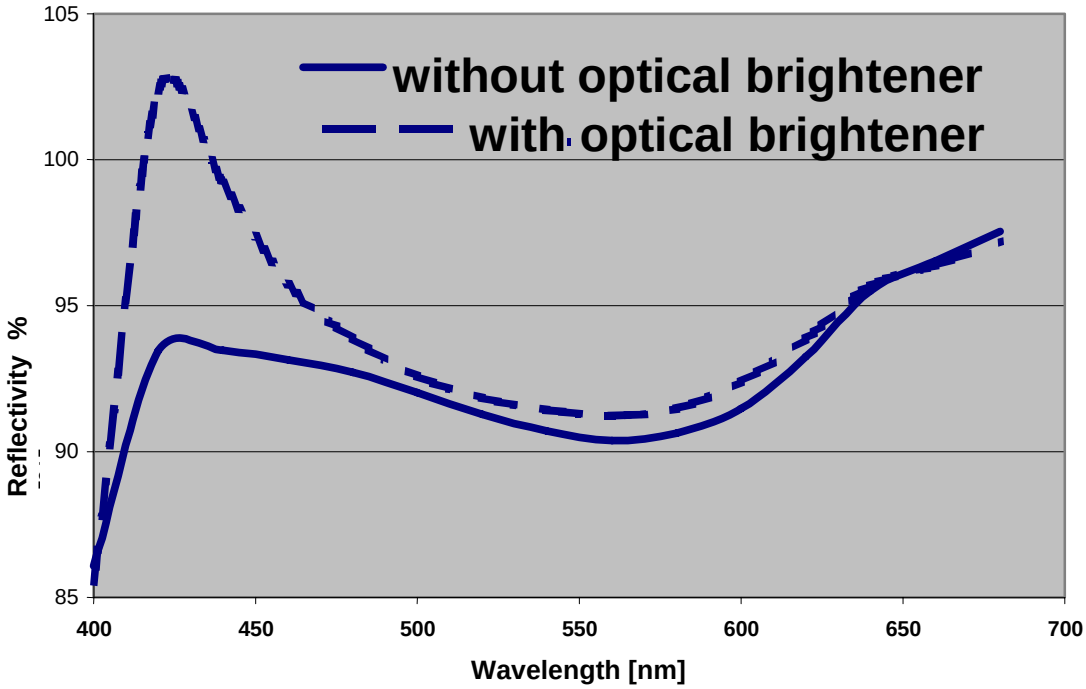

Figure 2: Amount of reflectivity in the visible wavelength range for 2 different proof papers

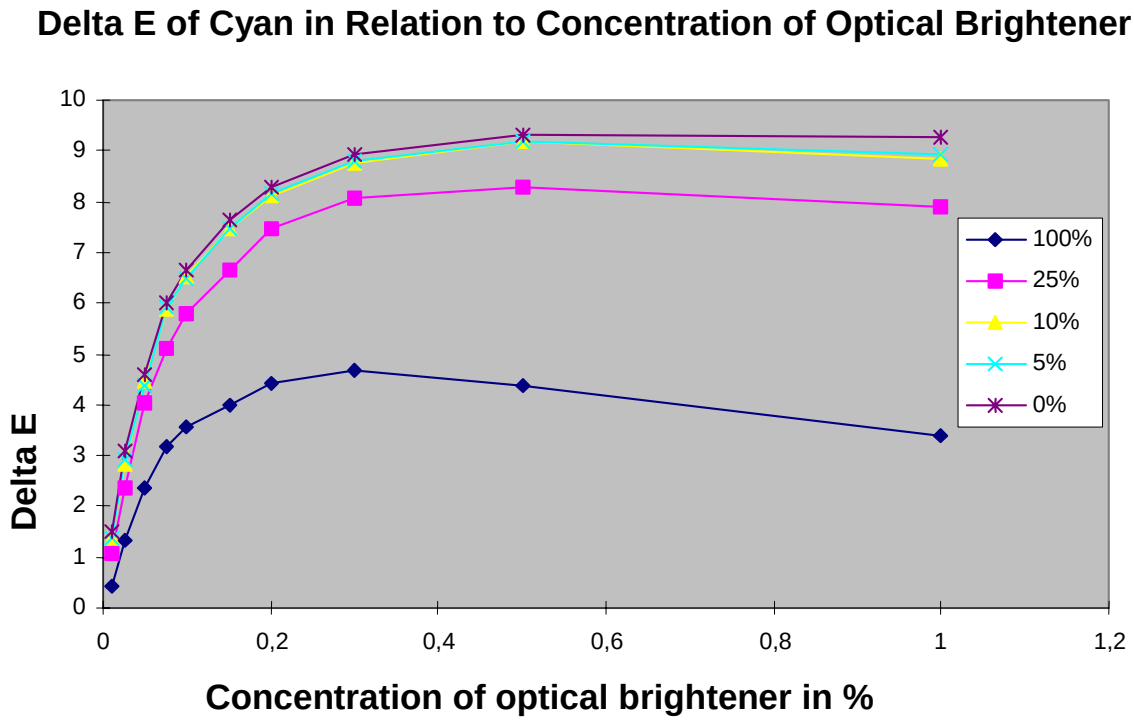

Figure 3: Color shift (Delta E) of cyan printed areas with ink coverage between 0% and 100% in relation to the concentration of optical brightener in the coating (reference color: without optical brightener)