 

# A Study of the Print Gloss of Ink Jet Glossy Photo Papers

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## Abstract

Many commercially available ink jet media claim to deliver photograde image quality, i.e. high image quality including a uniform high print gloss. Although many glossy papers show a high gloss in unprinted areas, the gloss in the printed areas is often much lower, especially in areas with high ink loads. This is the case for both Narrow Format ink jet printing (SOHO printing, printing at home) and Wide Format ink jet printing. It is a problem for thermal as well as piezo ink jet printers.

In this paper is presented a study of print gloss for Narrow Format printing with both thermal and piezo ink jet printers.

First, a few examples are given of print gloss of commercial glossy photo papers. Then, the paper describes how the combination of different binders can influence the gloss in unprinted and printed areas.

## Introduction

Home ink jet printing has developed from document printing towards printing pictures with near photo image quality, especially when printing on so-called photo ink jet papers. RC paper-based ink jet papers can have the look and the feel of the traditional photo, but the image quality is often lower than that of the "old" photo. Image quality has many aspects, one of which is print gloss. Many ink jet pictures show "matting" defects with different parts of the ink jet print having a different gloss, especially in the darker areas (high ink loads). This is also a major problem for many Wide Format poster ink jet media. The ink jet receiving layer composition can have a great influence on the print gloss. A model study was performed to investigate the combination of different binders in the image-receiving layers.

## Experimental

### Sample Preparation

Aqueous coating solutions of binder and binder mixtures were prepared and coated on a RC paper; the amount of binder(s) was constant in all experiments: 10 g / sqm.

### Sample Printing

Prints were made on two printers, one thermal printer (HP 895Cxi from Hewlett-Packard) and one piezo printer (Epson Stylus Color 740 from Epson).

Printing modes: HP895: paper selection: HP Photo paper; mode; print quality: best; color smart: automatic; Epson740: main mode: automatic, 720 dpi; media type: photo paper.

Print samples: patches of secondary colors (Red, Green, Blue) and K (pure K in case of Epson740, but composed K by CMY for HP895) (size of print patches = 5 x 3 cm).

### Gloss Measurements

Gloss measurements were performed according to Standard Test Method for Specular Gloss D 523-89 with a so-called Dr. Lange apparatus. Gloss measurements were done under an angle of 60 degrees.

## Commercial Photo Papers

Nine commercial photo papers (RC paper support) were printed with HP895 and Epson740 and gloss measurements were performed. The results are presented in figure 1.

The first six media (nos. 1-6) are very glossy media when unprinted, and they all need some time (some to several minutes) to dry. The last three photo papers (nos. 7-8-9) are recently introduced media that are completely or almost completely dry immediately after printing. The unprinted gloss of these media is lower. Papers no. 7 and no. 9 show no matting defects, material 8 gives a very high print gloss on Epson740.

The gloss values on HP895 are similar for all the print patches (R, G, B, K=CMY). This is not the case for most of the media printed on Epson740: the print gloss is mostly very similar for R, G and B patches, but often different for the K patch; sometimes the K patch has a so-called bronzing defect (metallic bronze surface gloss effect); this is the case for the papers nos. 5 an 6.

The photo papers nos. 1-6 are given in order of unprinted gloss (from high to low), but the print gloss results on both HP895 and Epson740 do not follow the same order. The papers nos. 2, 3 and 4 show clear visual matting defects.

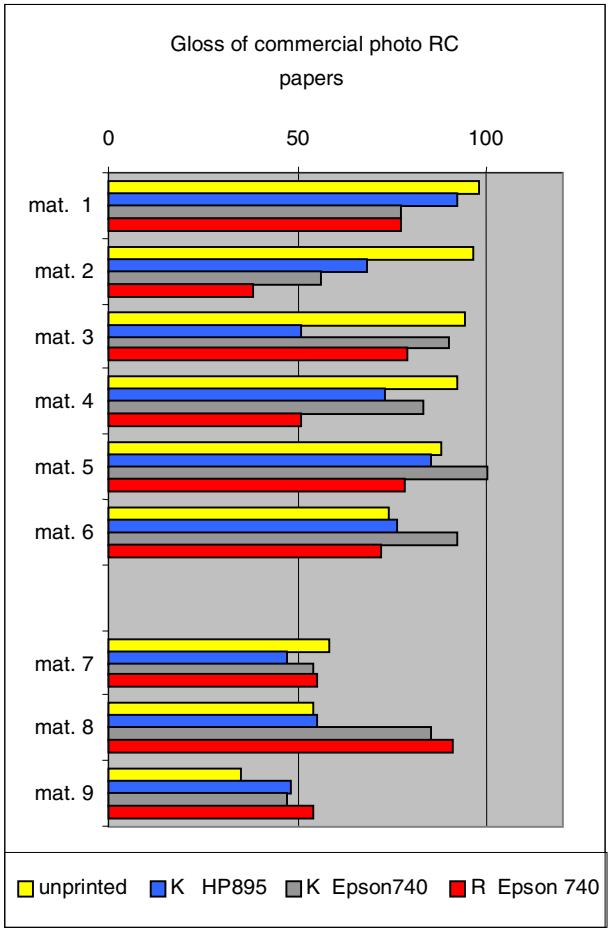


*Figure 1. Gloss of commercial photo RC papers*

## Ink Jet Receiving Layers

### Choice of Binders

Many different binders are being used for ink jet receiving layers, including gelatin, PolyVinylAlcohol (PVA) types, Poly(2-ethyl-2-oxazoline), PolyVinyl-Pyrrolidone, copolymers of VinylPyrrolidone, polyure-thanes, cellulose derivatives, polyethylene glycols, latices and others.

### Gelatin

Gelatin is a very special binder. In the SilverHalide materials (inculding traditional photography) the gelatin binder is very important for many quality aspects.

Gelatin is also an interesting polymer for ink jet receiving layers. Gelatin-based receiving layers can deliver good uptake of the ink, high gloss and very high image quality.

### Combinations of Binders

An ink jet receiving layer based upon one single binder is not likely to deliver all the needed qualities like image quality, short drying time, water fastness, light stability, and so on. To obtain a photo image quality the combination of different binders is necessary; one aspect of this image quality is the print gloss. This is also the case for combinations of gelatin with other binders, as was studied here.

## Results and Discussion

### Gelatin / Polymer 1 Combinations

In a first experiment gelatin was combined with a polymer (polymer 1) which gives better ink uptake. Material 1 contains pure gelatin. Material 2 has 90 % of gelatin and 10 % of polymer 1; materials 3 and 4 contain a gelatine/polymer 1 amount of 80/20 and 60/40 respectively. Figure 2 gives the gloss values.

The gloss unprinted and printed is very good for the pure gelatin layer. The combination with polymer 1 gives lower gloss values when using over 10 % of polymer 1. This is the case for both unprinted gloss and printed gloss.

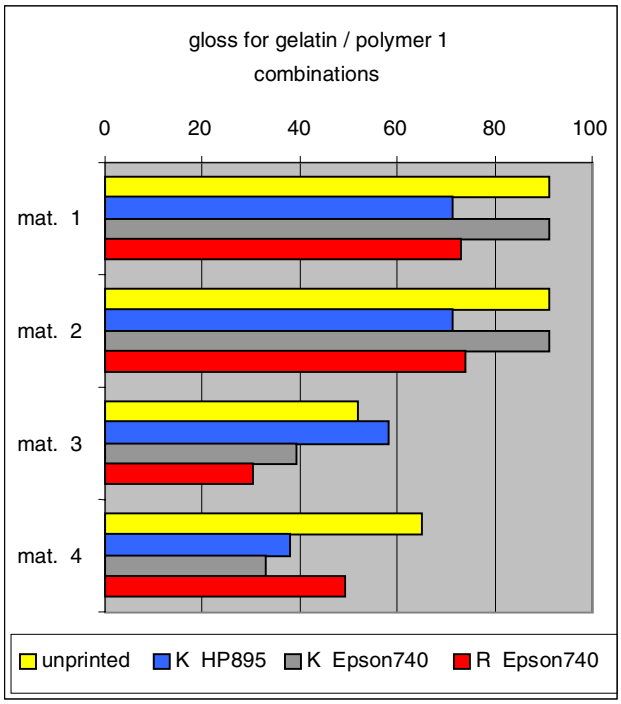


*Figure 2. Gloss for gelatin / polymer 1 combinations*

### Gelatin / Polymer 2 Combinations

The combination of gelatin with another polymer that also improves the ink uptake and therefore the dry time (polymer 2) was studied next. The combination of these polymers is possible over a broad ratio. Material 1 is the pure gelatin layer, materials 2, 3, 4 and 5 have a gelatin / polymer 2 content of 80/20, 60/40, 40/60 and 20/80 respectively. The gloss values are given in figure 3.

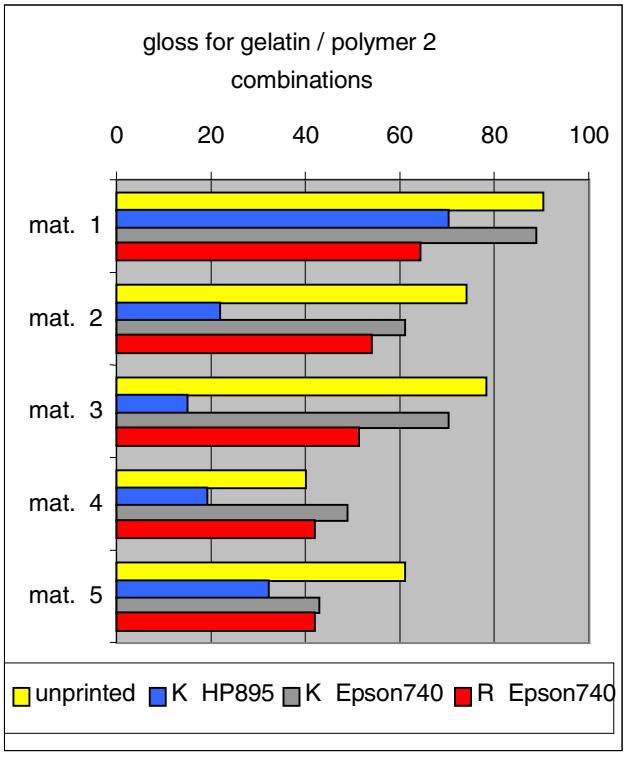


*Figure 3. Gloss for gelatin / polymer 2 combinations*

This combination also gives lower unprinted and printed gloss values than pure gelatin layers, especially for HP895 print gloss; print gloss on Epson740 is always higher and rather close to that of the unprinted material.

More experimental work was carried out for the combination gelatin/polymer 2 because of the positive effect on the other characteristics. The preparation of the coating solution (way of mixing gelatin with polymer 2 and other experimental parameters) was optimized and the pH of the coating solution was changed. The effect of the pH change is given in figure 4.

Figure 4 shows that the combination of gelatin and polymer 2 can give very high unprinted and printed gloss values for both thermal (HP895) and piezo (Epson740) printers. The sample with the highest pH value of the coating solution gives the highest gloss value, without any negative effect like the bronzing defect in the case of Epson740.

**PVA Layers**

PolyVinyl Alcohol binders are also commonly used for ink jet receiving layers. They can give a good uptake of the ink solvents and are also often used in instant dry pigment/binder systems. Figure 5 shows gloss results for layers of different PVA types.

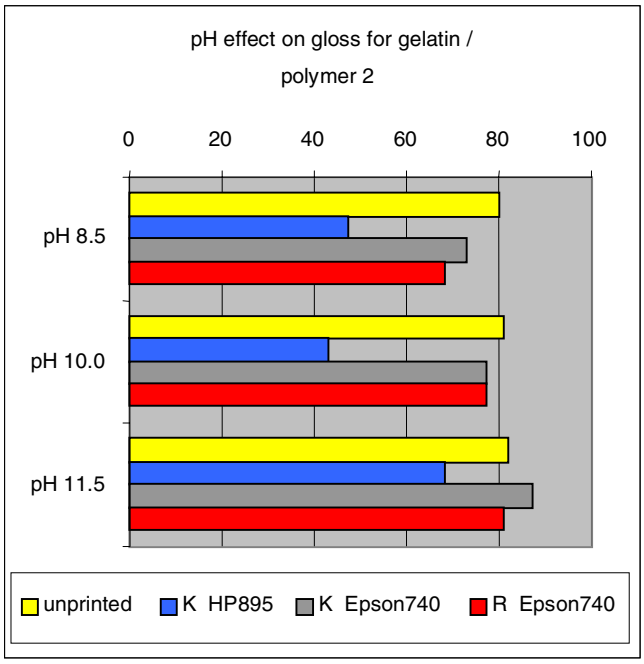


*Figure 4. pH effect on gloss for gelatin / polymer 2*

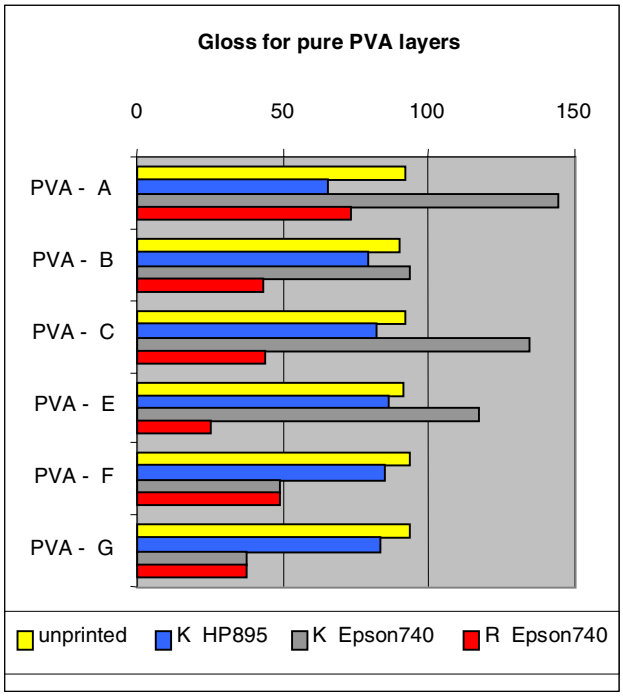


*Figure 5. Gloss for pure PVA layers*

The unprinted gloss of pure PVA layers is acceptably high, but print gloss on Epson printers is very critical. The secondary colors R, G, B patches are not very glossy, while the K patch often shows very high gloss due to a strong bronzing defect. Once again, combining PVA types with another binder could be the solution.

**Gelatin / PVA Layers**

The combination of gelatin with PVA types is only possible for modified gelatine with a coating pH of around 4.0 (combination of 80 % of gelatin and 20 % of PVA). Figure 6 shows the gloss values for these combinations.

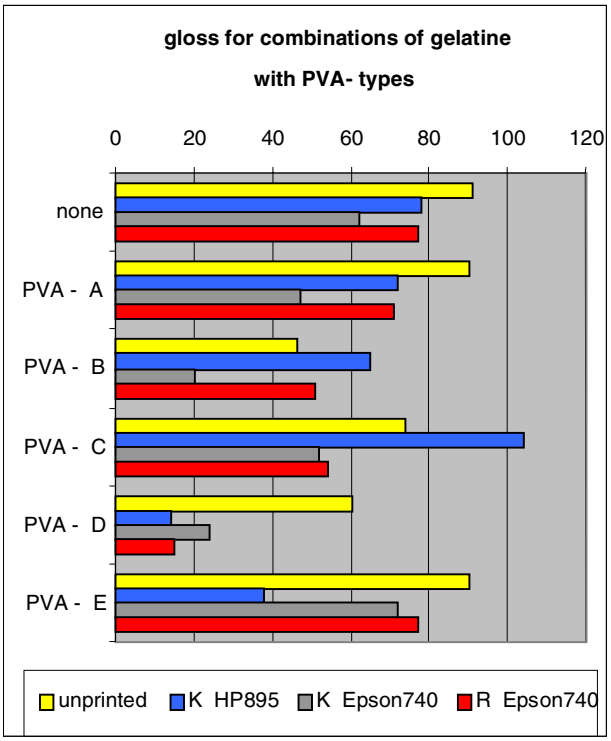


*Figure 6. Gloss for combinations of gelatin with PVA types*

Figure 6 shows that the gloss unprinted and printed of the gelatin/PVA type combinations very much depends on the PVA type. These PVA types are of different classes (different degrees of hydrolysis, unmodified or modified (cationic or reactive) ); there is no general rule found that a specific PVA type gives better gloss values. The best case for HP895 is the combination of gelatin and PVA type C, for Epson740 the highest print gloss is obtained for gelatin/PVA type E.

## Conclusion

The use of ink jet media for photo printing leads to a customer expectation of very high image quality being as close as possible to that of the traditional photo. One aspect of the image quality is high print gloss that is often disrupted by matting (or gloss defects like bronzing), lowering the image quality perception.

The model study of combining different binders in the image-receiving layer shows that combinations of binders can be optimized to give very high unprinted and printed gloss values for both thermal and piezo ink jet printing.

## Biography

Marc Graindourze got a Ph. D at the K.U. Leuven, Belgium (physical chemistry). In 1988 he joined Agfa-Gevaert N.V., Belgium, where he started as a project manager R&D for prepress materials (contact and camera films). Since 1996 he is one of the project managers R&D ink jet media, working on photo ink jet media for both narrow and wide format ink jet printing.