Gelatine for Mat Inkjet Paper

Berthold Köhler and Dirk Kisters, GELITA AG, Eberbach, Germany; Josef Eckl, PTS, Munich, Germany

Abstract

Gelatine as receptive coating of photo paper is known for high quality prints with high gloss. The light fastness and color density of prints on gelatine coatings can hardly be beaten by any other coating.

On the other hand mat inkjet papers very often suffer from poor color density of the prints, resulting in pale colors. GELITA has investigated combinations of pigments like silica or carbonate with gelatine. Mat papers were obtained with excellent color density of the prints. In detailed investigations we have identified several formulations which give mechanically stable coatings (no dusting) and result in instant dry prints. Increase in color density of more than 30% in comparison to office paper could be detected. The high color density in combination with the other properties of the coatings offer the papermaker a lot of new options to create either high end mat inkjet paper with better performance cost ratio or 'upgraded' inkjet paper with interesting economy. The formulations can be applied by blade coating or film press device. Therefore different coating weights and paper qualities can be produced. The findings presented here have been filed as patent application. The experiments have been performed on a lab scale and further improvements by scale up can be expected.

Introduction

Gelatine is the material of choice for the classical photo industry. The polymer is indispensable in silver halide applications like color negative films as well as for the fabrication of photo paper. In the course of the digital revolution gelatine also has gained major importance as receptive coating for inkjet inks. Gelatine is used as coating, if high end quality inkjet prints are needed. Therefore when looking for photo glossy paper, gelatine coated papers can be often found on the shop shelf. With gelatine coatings prints with very high gloss and brilliant colors are obtained. The protection of sensitive dyes from fading by gelatine[1] has become the benchmark for all other coatings in this field.

New Applications for Gelatine

Nevertheless we thought that the properties of gelatine can be also useful for other paper applications. In preliminary tests in our lab we observed strong interactions between pigments e.g. silica and gelatine. This can be explained by the many different functionalities of the various side groups of this protein, e.g. amino groups, hydroxyl groups or carboxylic groups[2]. Therefore good binder properties for all kind of inorganic pigments can be expected for gelatine.

Gelatine is able to take up the multiple of its own weight of water by swelling, which is important when large amounts of aqueous ink have to be bound in the coating. This is in contrary to highly porous papers, which take up the ink very fast but cannot cope with large amounts of solvent resulting in a significant strike through of the ink. The open structure of porous media is also responsible for the low color fastness of the prints. Gelatine coatings protect the dyes by forming a closed film around the dyes and therefore preventing them from attack of atmospheric gases.

As a polyelectrolyte gelatine is able to fix the anionic dyes of inkjet inks[3] and keep them rather close to the surface instead of letting them penetrate through the paper. This is in our opinion one of the reasons why colors on gelatine coatings appear so vivid and brilliant. This property can be measured by high values of color density.

Taking these properties into account the idea came up to use gelatine as additive or binder for mat inkjet paper. Together with the PTS (Paper Technology Specialists) a renowned paper research institute in Munich, Germany we started a project to check the feasibility of preparing mat inkjet paper with gelatine and evaluate the options which such a new binder offers to the papermakers.

Experimental

All experiments described here have been performed in the labs of PTS in Munich.

Several different pigments: Silica, Bentonites, Carbonates and Zeolites have been tested. The properties and quality (indicated by the costs) of these pigments differ very much. This has been done deliberately to get an overview of the interactions and compatibility between different pigments and gelatine.

Various cobinders and additives like starch and polyvinyl alcohol have been tested and their influence on the performance of the coating has been checked.

To improve dye fixation different cationization agents have been used.

The first experiments were performed manually in the lab. In a second step we checked different coating processes on a small semi-automatically lab coater (Jagenberg coater). This device can simulate film press application as well as blade coating.

For all tests the same base paper was used.

Test prints were made with an EPSON Stylus Color 880 printer in the '360 dpi Inkjet paper' mode. The papers and the prints were tested for their mechanical stability (folding endurance, coat adhesion), smudge and water resistance.

The color density was checked by Gretag SPM 50 densitometer.

Image quality was evaluated by a test panel. Quality parameters like bleeding, mottling or feathering were taken into account.

Results and Discussion

After checking many formulations 4 different coatings were identified which show very good performance. See Table 1.

Table 1: Coating Recipes

Paper Coating	Appl. Weight	Appl. Device	Pigment (Major comp.)	Binder (Major comp.)
A	8 g/m2	Blade	Bentonites	Gelatine
B	7 g/m2	Blade	Carbonate	Gelatine
C	5 g/m2	Film press	Silica	Gelatine
D	4 g/m2	Film press	Zeolites	Gelatine

The table indicates that we have not only developed coatings with different pigments but also different coating weights by using different coating devices. The performance of these different coatings on the same base paper has been checked in various respects.

Mechanical Properties

The folding endurance has been tested by folding the printed and unprinted paper several times. The adhesion of the coating and the ink was evaluated by assigning school marks (1 is best 5 worst). See Figure 1.

Coat adhesion has been tested by visual assessment of papers after removal of an adhesive tape. See Figure 2. School marks were assigned to evaluate the performance in the same way as for folding endurance. See Figure 2.

Smudge resistance was checked by smudging a drop of water on a printed area with the finger. See Figure 3.

Water resistance was tested by immersion of the printed area in water for 30 minutes. The color change was assessed visually. See Figure 4.

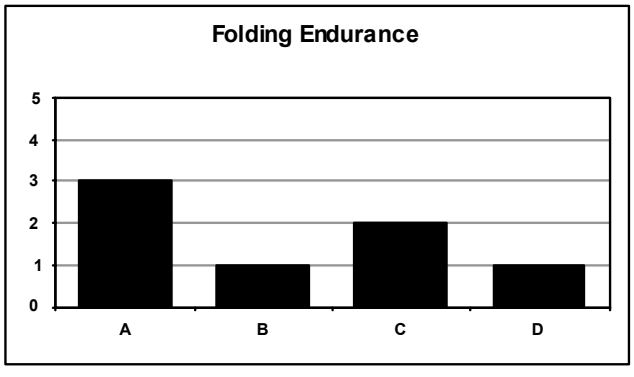

Figure 1. Folding endurance of coatings A-D. Evaluation by school marks: 1 is best 5 worst.

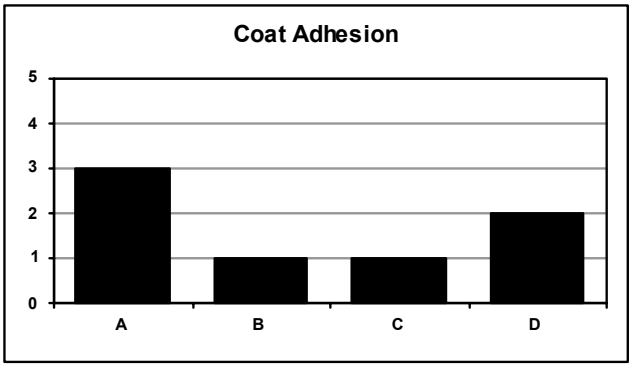

Figure 2. Coat adhesion of coatings A-D. Evaluation by school marks: 1 is best 5 worst.

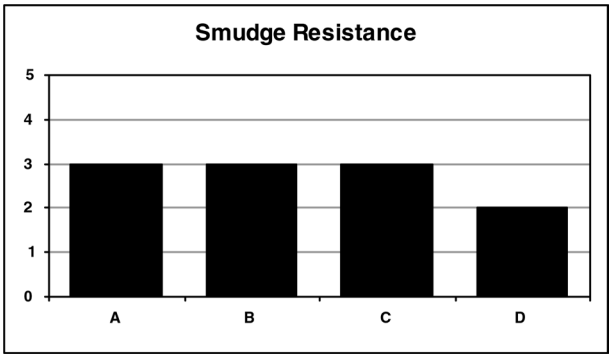

Figure 3. Smudge resistance of coatings A-D. Evaluation by school marks: 1 is best 5 worst.

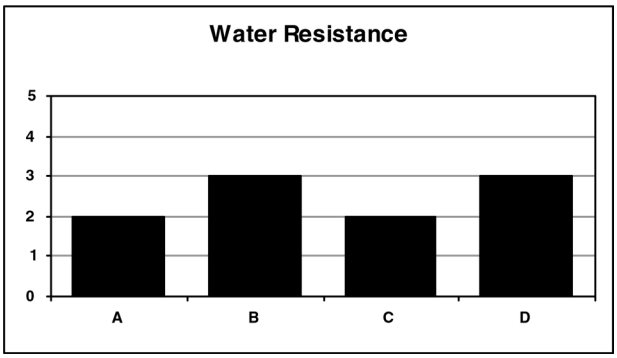

Figure 4. Water resistance of coatings A-D. Evaluation by school marks: 1 is best 5 worst.

These investigations proof that gelatine can be used for paper coating providing at least the same performance and stability to the paper than other binders do.

Image Quality

When we checked the color density of the gelatine papers we detected remarkable high values. In this case an office paper was used as a lower benchmark and a high end mat inkjet paper was used as the upper benchmark. Both papers are commercially available. Figures 5a to d show the color densities of the test papers printed with the EPSON Stylus Color 880 printer in the '360 dpi Inkjet paper' mode.

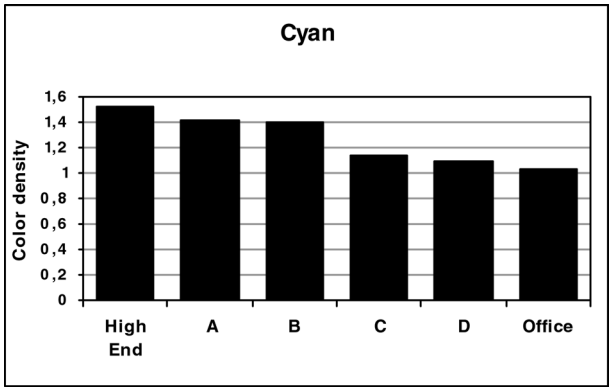

Figure 5a. Color density for cyan ink for coatings A – D, upper and lower benchmark.

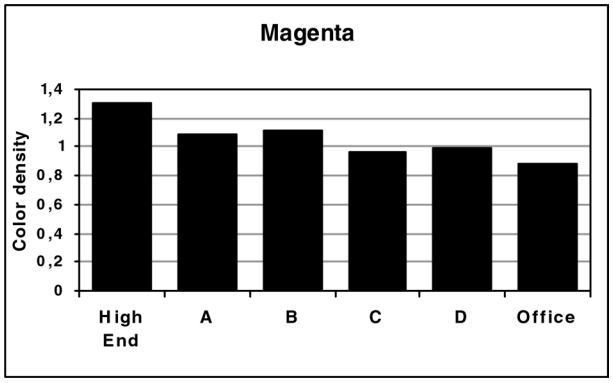

Figure 5b. Color density for magenta ink for coatings A – D, upper and lower benchmark.

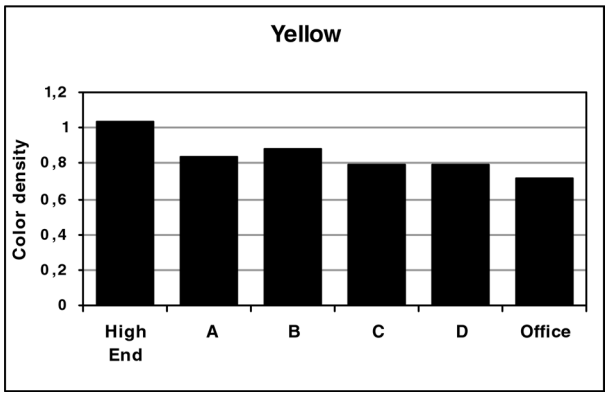

Figure 5c. Color density for yellow ink for coatings A – D, upper and lower benchmark.

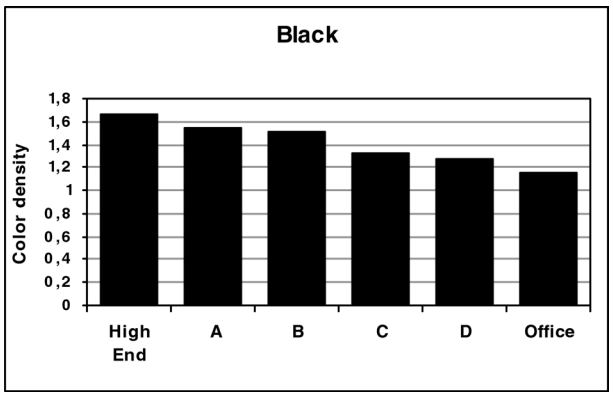

Figure 5d. Color density for black ink for coatings A – D, upper and lower benchmark.

The figures reveal that the various gelatine coatings can cover the whole quality range from office paper to high end mat inkjet paper. Comparing this to other non gelatine papers we see the high color density of the prints as the major advantage of the gelatine papers over the others.

Market Aspects

Color density is a big issue in the mat inkjet market. Many papers in the market suffer from pale colors of the prints. The whole market for mat inkjet paper can be divided in three segments:

- High end -specialized products, rather small market size
- Medium quality -segment with high cost pressure
- Growing segment we would like to call 'upgraded inkjet paper' -these are papers which have low coating weight but are optimized for inkjet applications.

With the improved color density provided by gelatine containing inkjet papers we see options for all market segments. Some of these are: In the high end segment the quality of the paper can be improved by making the colors of the prints more vivid. The medium quality segment can benefit from this development by using more cost effective pigments and maintaining the same quality. Finally the performance of low weight papers can be improved for inkjet applications by using gelatine as binder or additive. Another major advantage of the recipes C and D is that they can be applied online by film press directly after the paper formation. This procedure saves the costs for applying these coating weights in a separate process step.

Summary

The investigations have revealed that gelatine can be used as a binder for mat inkjet paper. Papers with high and low coating weights have been prepared. Different pigments and binders give good results. The coating can be applied by blade or film press. The main advantage of gelatine over other binders is the high color density of the prints. This offers the papermaker two attractive options: He can either produce a paper of improved quality or a paper with similar quality more economical by using gelatine. All papers have been prepared on a lab scale. Further improvements by scale up can be expected. The findings presented here have been currently applied for patent.

References

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Author Biography

Berthold Köhler studied Chemistry at the University of Karlsruhe (Germany). He received his PhD in Chemistry at Prof. János Rétey, Chair of Biochemistry, Department of Organic Chemistry, University of Karlsruhe in 1997.

Since October 1999 he is member of the R & D Department of GELITA AG in Eberbach, Germany. His main research interests are inkjet applications, chemical and enzymatic modification of gelatine.