The Influence of Paper Roughness and Toner Properties on Fusing Quality

Reinhard Apel, Joseph Knott, Martin Schleusener and Benno Petschik
Siemens Nixdorf Informationssysteme AG, Poing, Germany

Abstract

In one of our recent papers we have reported about the visual print quality of a high speed electrophotographic process depending on toner particle diameter distribution and paper roughness [1].

In this paper we examine the fusing quality versus paper roughness and toner formulation.

Introduction

The trend towards higher print quality requests finer toners and better paper qualities. An important print quality parameter is the fusing quality. The fusing process influences the visual print quality because of the toner image deformation during the fusing process.

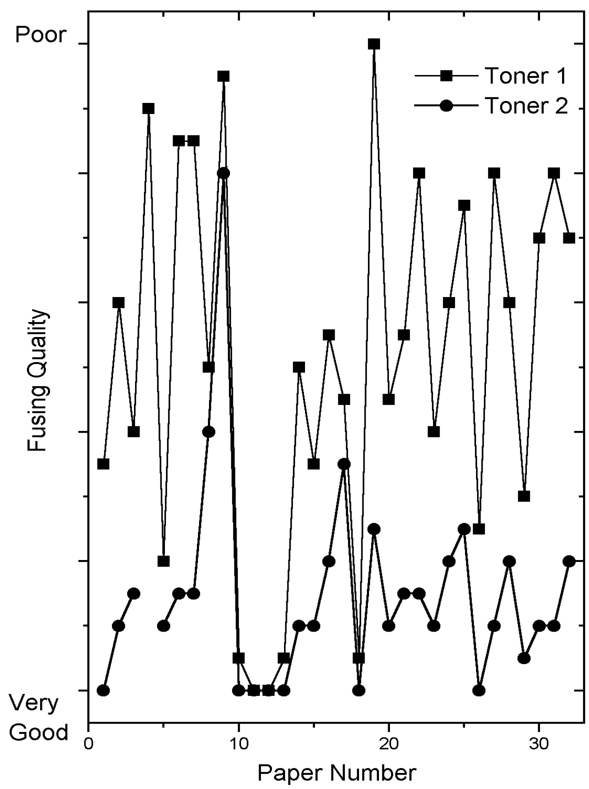

Figure 1. Fusing quality: Scotch tape test for 32 papers and two different toners.

At hot roller fusing, toner cold offset on the roller surface may cause a partial pick up of toner particles from image dots which leads to nonuniformities of halftone areas. On the other hand, the durability of the toner image on the paper surface is an important print quality feature.

The aim of this paper is to get information on what extent the paper roughness influences the hot roller fusing quality of electrophotographic halftone images.

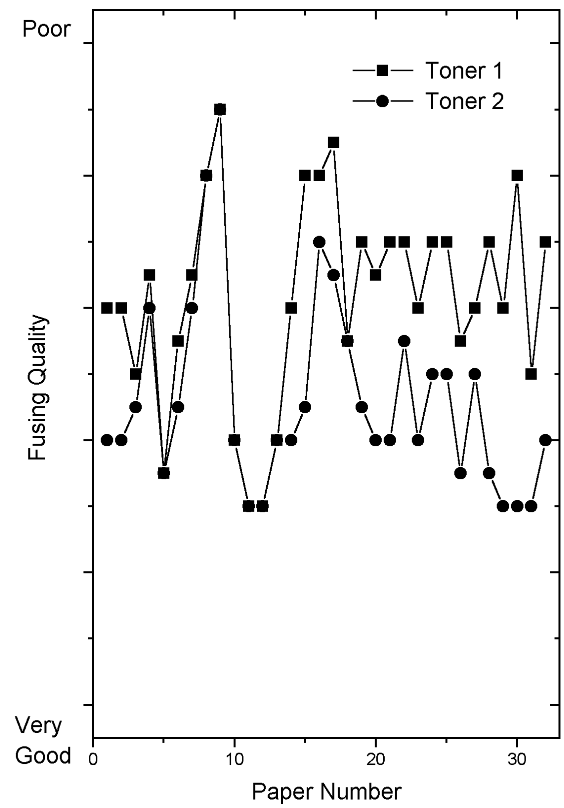

Figure 2. Fusing quality: Fold test for 32 papers and two different toners.

Experimental

We have investigated a set of 32 papers with surface roughness between 20 ml/min and 370 ml/min Bendtsen. Toner 1 and toner 2 have nearly the same diameter distribution. The hot roller fusing energy demand of toner 1 is higher than the energy demand of toner 2 because of different resins.

The fusing quality was evaluated by three test methods: scotch tape test, fold test, friction test.

Scotch tape test: a scotch tape was pressed onto the fused toner image and then pulled off. The toner amount adhering at the tape was evaluated in relative units.

Fold test: a paper carrying a fused toner image (uniform black area) was folded down and pressed at the fold. The paper was smoothed out and the fold line was evaluated in relative units regarding the width of the toner free area at the fold.

Friction test: the fused toner image was rubbed by a tissue. The nonuniformities of halftone image areas resulting from this treatment and the toner amount adhering at the tissue were evaluated in relative units.

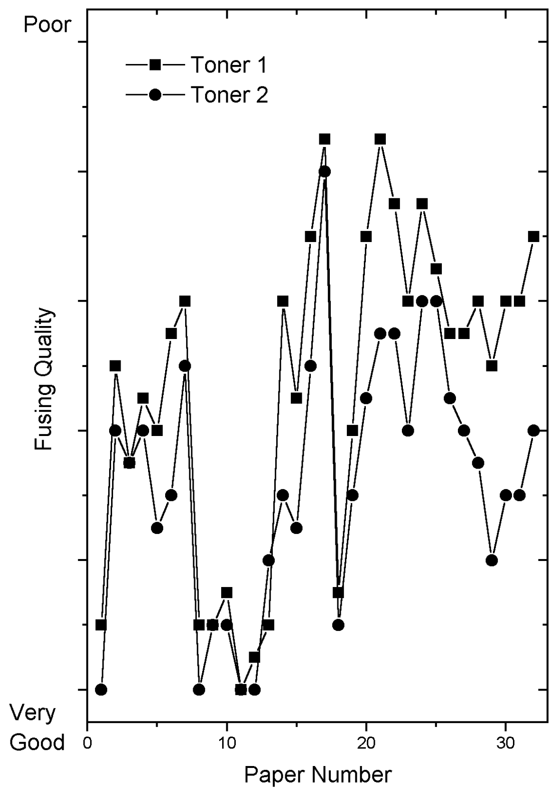

Figure 3. Fusing quality: Friction test for 32 papers and two different toners.

Results

Figure 1 shows the plot of the scotch tape test results for 32 different papers achieved with toner 1 and toner 2. From the plot is evident, that the scotch tape fusing quality of toner 2 is better compared to the toner 1. The better fusing quality of toner 2 is caused by the lower melting range and the different chemical composition of the two toners.

For most of the papers the fusing quality relationship with toner 1 and toner 2 is very similar.

The shapes of the plots for toner 1 and toner 2 look very similar.

In Figure 2 the folding test results are plotted for the same 32 papers. Again, the toner 2 shows better test results than the toner 1, but the difference of both plots is less significant compared to Figure 1. That means the brittleness of both toners differs not so much like the toner to paper adhesion responsible for the scotch tape test results.

The friction test results shown in Figure 3 exhibit a very similar fusing behavior of both toners on the papers under investigation. Toner 1 shows only a slightly better fusing quality compared with toner 2. The paper roughness dominates the durability of the toner image against tangential forces.

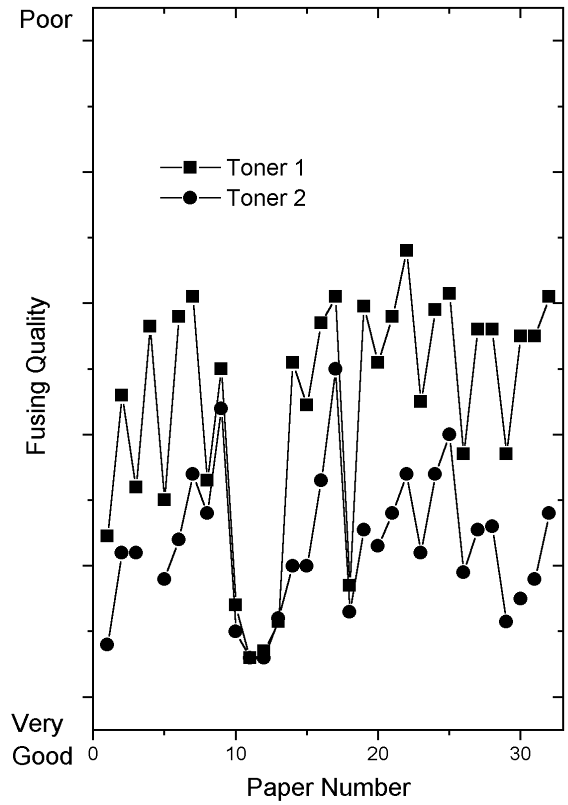

Figure 4. Integral fusing quality for 32 papers and two different toners.

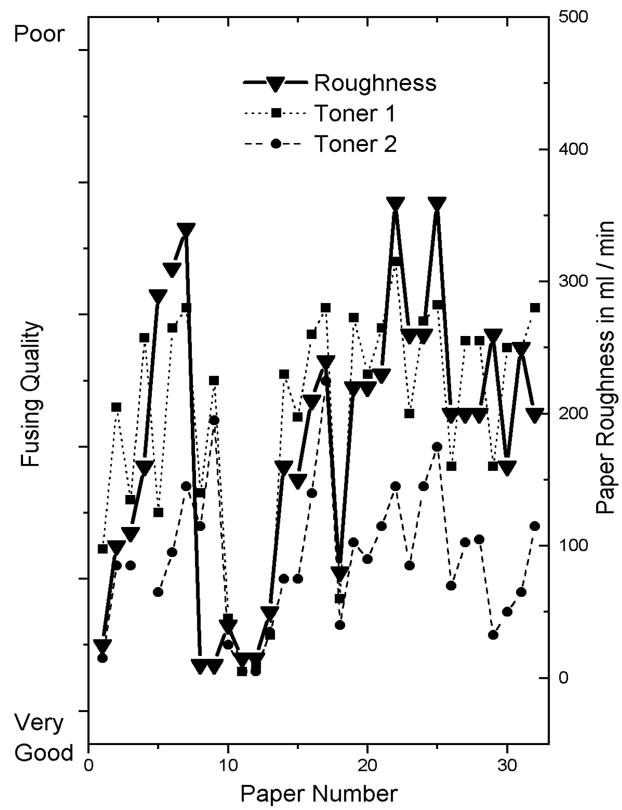

Figure 5. Integral fusing quality for 32 papers and two different toners superimposed by the paper roughness plot.

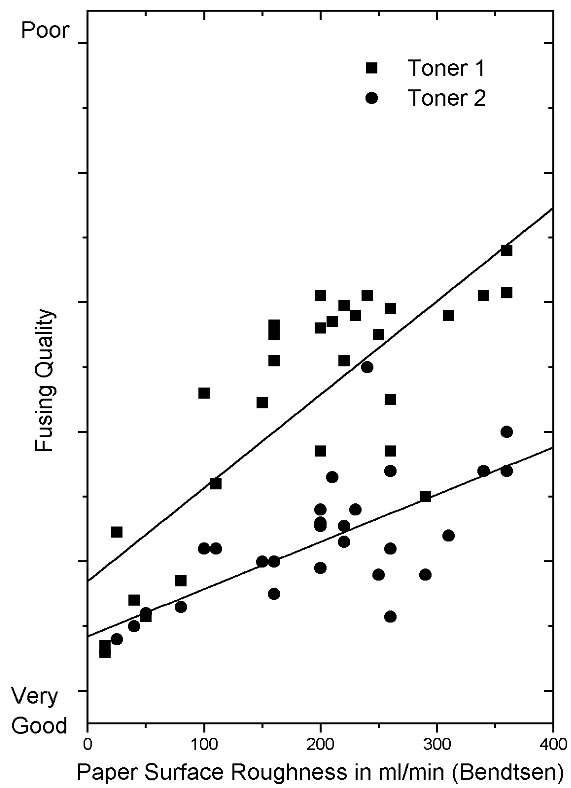

Figure 6. Integral fusing quality versus paper roughness

Averaging the results of the scotch tape test, the folding test and the friction test we have got the integral fusing quality that is plotted in Figure 4.

In Figure 5 the paper roughness data are added to the diagrams of Figure 4. From those plots is evident that for the most of the papers the paper roughness determines the fusing quality. This is obvious for toner 1. The toner 2 fusing quality follows qualitatively the paper roughness. The relative changes of fusing quality compared with the roughness differences is less for toner 2 because of its lower melting temperature range and the better chemical bond between toner and paper materials.

Figure 6 shows the integral fusing quality versus paper roughness for the 32 papers referred to above. The experimental data were fitted by linear functions. The regression coefficients are R = 0.79 for toner 1 and R = 0.72 for toner 2 respectively.

At very low paper roughness the fusing quality for both toners is very good. The higher the paper roughness the poorer is the fusing quality. The tighter toner to paper bond of toner 2 leads to better fusing results.

Summary

Hot roller fusing quality is primarily defined by the melting temperature range and the chemical bond between toner and paper materials. Under constant material and temperature conditions the fusing quality decreases with higher paper roughness in a nearly linear relationship. On very smooth papers good fusing quality is achievable even with toners demanding higher fusing energy.

References

1. M. Schleusener, R. Apel, The Influence of Toner and Paper Properties on Electrophotographic Print Quality, *Proc. 10th Int. Congr. on Advances in NIP Technologies*, pp. 545-548 (1994); (see page 356, this publication).