Measuring of the Water Layer Thickness in the Offset Printing Process

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Abstract

Water is an important part of the offset printing process. Only a few attempts to control the amount of water on the printing plate were tried over the years. This paper reports about a new approach to measure and control the amount of water on the printing plate.

Introduction

Offset printing works on the polarity of water and grease. The effect that water and grease does not bond, but reject each other is the basis of offset printing. On the flat printing plate are water friendly (hydrophilic) and grease friendly (lipophilic) areas present. The water friendly areas are at the same time grease rejecting (lipophobic) and the grease friendly areas are at the same time water rejecting (hydrophobic).

If you put water on such a printing plate, it will set on the hydrophilic areas and amplifies the effect of the ink, which is greasy and sets down only on the lipophilic areas.

Like this, the ink is set to the right areas on the printing plate and can be transferred from here to the rubber blanket and finally to the paper.

This is the offset process, which is described here only very simple. In reality many parameters influence this process. The wetting of offset plates with water is described with the technical term dampening.

Dampening is a very important and basic part of offset printing. Press manufacturers have rated the problems in offset printing like shown in figure 1.

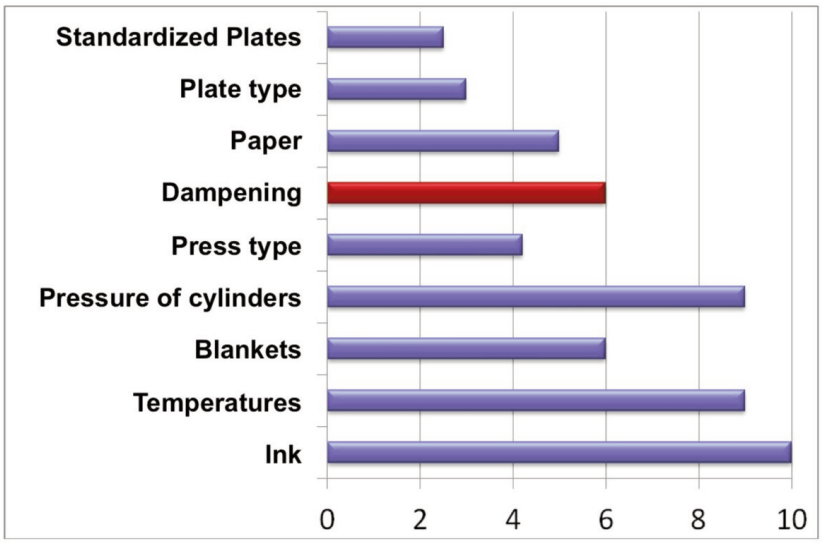


Figure 1: *List of problems in offset printing*

Dampening is not the most important problem in the offset printing process, but it is among the important problems. Therefore, experts researched since years to control the influence of dampening.

During the last 50 years the offset printing was developed and the parameters were narrowed down one by one.

During the last 20 years the standardization of offset printing was in progress. In this attempt almost every institute and many manufacturers invested in systems to measure the color on the paper. To hold the water amount constant on the plates was not of high interest.

Nevertheless there were some attempts to control the water amount on the plates. In the years between 1960 and 1970 Fogra developed a method to control the water content on the plates through the measurement of printed halftone patches. Unfortunately this method never found broad understanding and no control tool did or does use it. Finally the idea got lost.

In the time frame between 1970 and 1980 manroland developed a method to measure the water amount on the plates. This development never reached the market.

In 1981 at the TAGA conference in Rochester Mr. L. Balducci of EFPG Grenoble, France reported about laboratory work with a device, which is able to measure the water amount on the printing plates. This development never saw the market.

In 2010 the company Gamag AG from Berne, Switzerland developed a measuring device to measure the water layer thickness on the printing plates based on an idea of Dr. Klaus-Peter Dotzel of GVT GmbH. The device is installed on two newspaper presses and a sheet-fed press at the moment. The results of this development are very interesting and subject of this paper.

Description of dampening systems

A common dampening system works like shown in figure 2. Freshwater is sent through a reverse osmosis. After this process the water has no reactive components in it anymore. The hardness is maybe too soft and has to be hardened to a certain amount again. Adding a defined amount of buffered dampening solution controls the pH and the conductivity values of the water. If necessary some alcohol (IPA) is added. This mixture is put in a container, where it is cooled down and controlled. From this container the water is circulated to the printing station. The used water flows back to this container, where it is filtered, cooled and replenished.

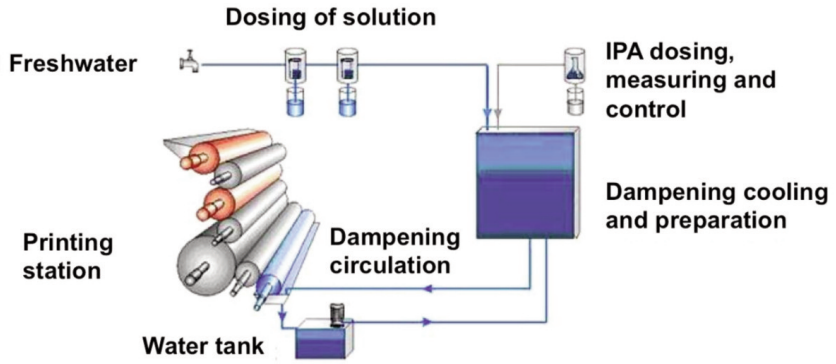


Figure 2: *Principle of a common dampening system*

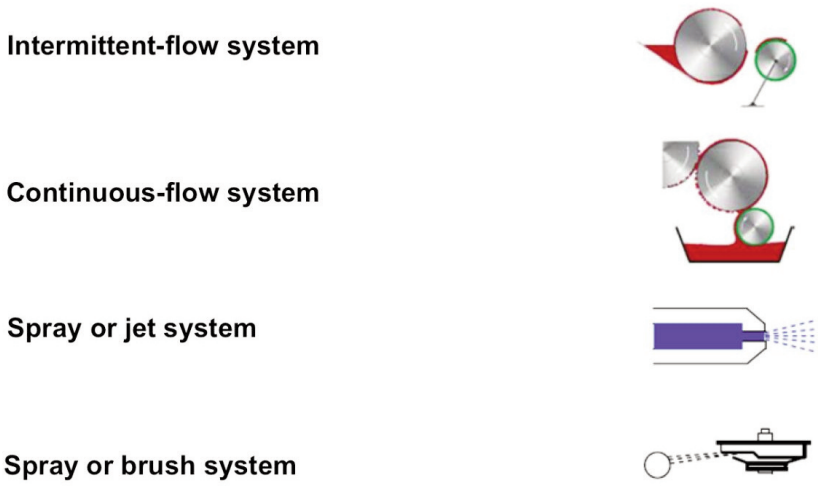


Figure 3: *Different dampening systems in use*

The water has to be brought to the printing plate. Different systems as figure 3 shows are used to do this. The intermitted-flow system is not used in today's printing presses anymore. On sheet-fed presses normally the continuous-flow system is used, whereas on web presses very often the jet or the brush system are in use.

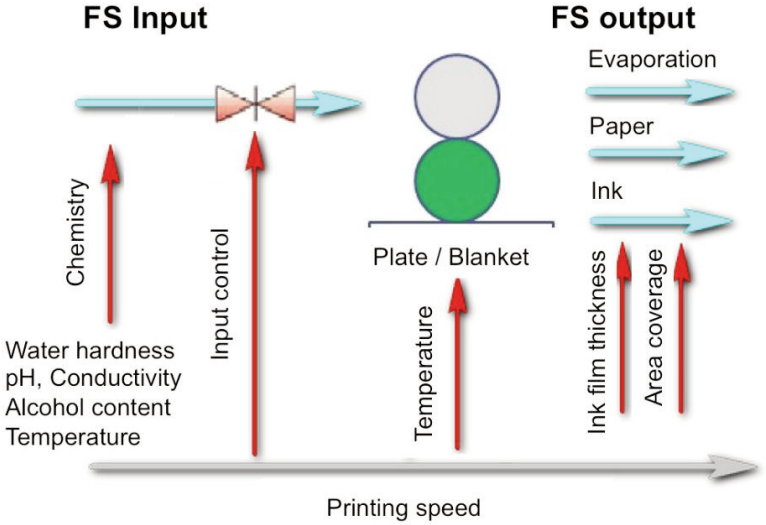
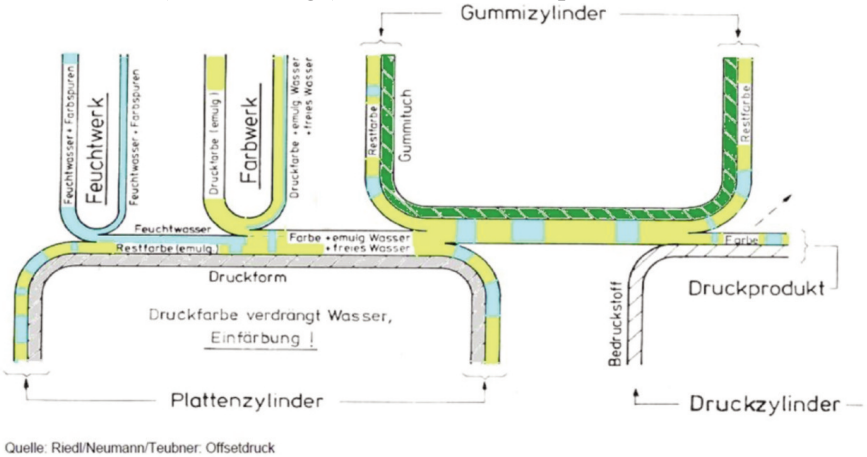


Figure 4: *Influences to the amount of water on a printing plate*

There are many influences to the effect of the dampening as figure 4 depicts. First the chemistry of the mixture is critical. It has to be controlled and maintained very accurately. Then, the amount and the temperature of the water on the plate have a very important effect on the printing result. The amount of water is changing with the printing speed. In order to have a constant amount of water on the printing plate the temperature of the environment defines the evaporation. The paper and the ink define how much water has to be on the plate in order to get a good printing quality. They define the size of the water ink film thickness on the plate and this defines what tone values (area coverage) will result on the print.



Quelle: Riedl/Neumann/Teubner: Offsetdruck

Figure 5: *Systematic of the water flow in the printing system*

Already many years ago German scientists studied the flow of water and ink in the printing system (see figure 5). The water is brought in by the dampening system (Feuchtwerk) to the plate (Druckform). Not 100% of the water is transferred to the printing plate. The ink is brought in by the inking system (Farbwerk). Not 100% of the ink is transferred to the printing plate but some water is taken over. Some of the water emulsifies into the ink and some of the water stays free. The water and ink from the plate are then transferred to the blanket (Gummituch), whereas not 100% is transferred. Then the last transfer to the paper (Bedruckstoff) follows. And also this transfer is not a complete transfer. With this diagram the system can be studied and the amount of water, which has to be brought into the system estimated.

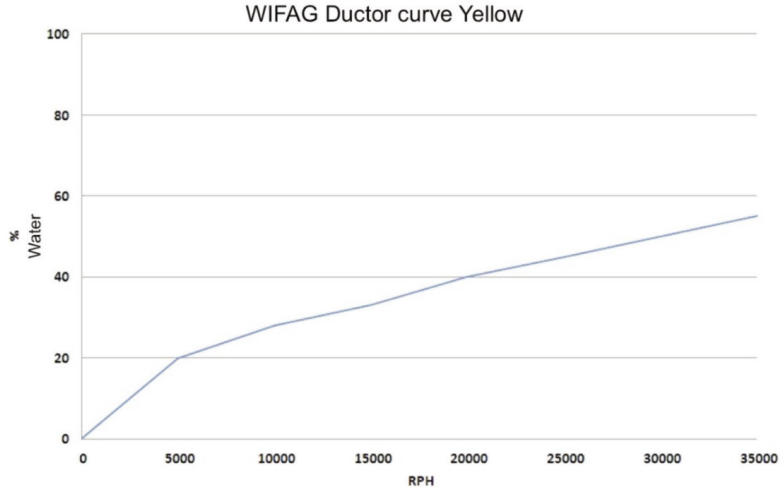


Figure 6: *Water doctor curve used on WIFAG printing presses*

There is no system on the market, which does measure the water amount on the plates. But what is often done in practice is to use presetting curves in order to compensate the amount of water in the printing system in relation to the speed of the press (see figure 6). The setting for all other influences is done manually after visual assessment of the print. This needs a lot of experiences of the printer to set up the water amount right. To control the water amount the printer has information about the solid tone density and the tone value increase on the print. The water and the ink setting influences both parameters. There is no information if the ink or the water setting has to be changed. Therefore very often errors are made, which lead to scumming (not enough water on the plate) or emulsification (too much water on the plate). Such errors may lead to press stoppings and cleaning of the inking system.

The new system

Dr. Klaus-Peter Dozel found a way to measure the water layer thickness on plates. The company Gamag AG constructed with this knowledge a first prototype of this measuring system. Ugra was involved in creating control values by using special test forms.

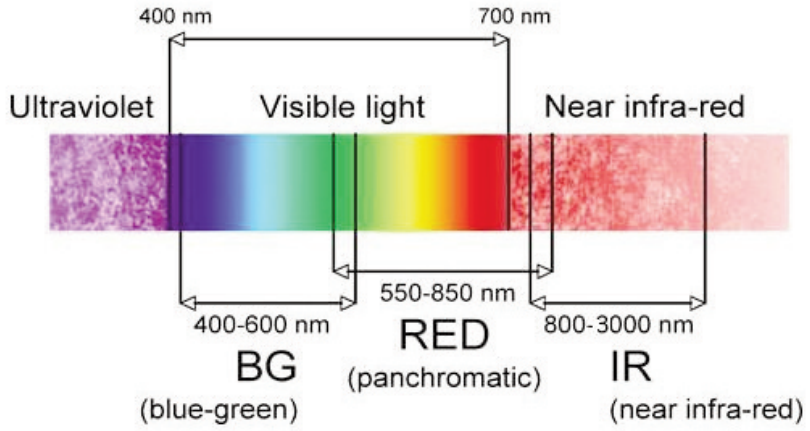


Figure 7: *The new system does use a near IR measuring system*

The measuring system does use a head, which is able to measure in the near infrared wavelength of light (see figure 7). In this wavelength water does reflect the light. If there is no water or not enough water on the plate the reflection signal is zero or is low. Is much water on the plate there is a strong reflection. By calibrating this signal the system is able to know when the right amount of water is on the plate or if a correction signal to increase or decrease the input of water into the printing system has to be given to the press.

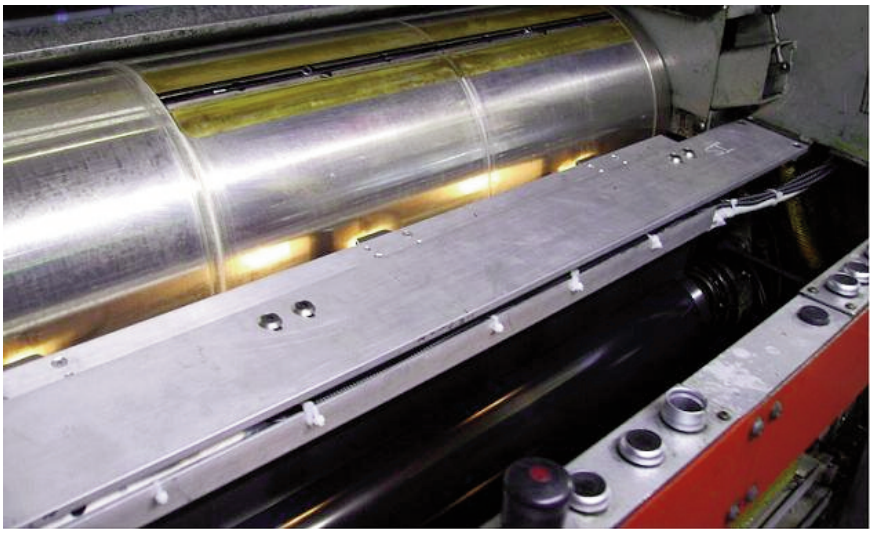


Figure 8: *The measuring head bar is mounted on a newspaper press*

Newspaper presses are able to control the water for each plate section across the plate cylinder. Normally there are two plates behind each other in one section and 4 plate sections across the plate cylinder. This means the system needs a measuring head for each plate section. In figure 8 is shown that the measuring heads are placed in a bar, which is mounted into the press.

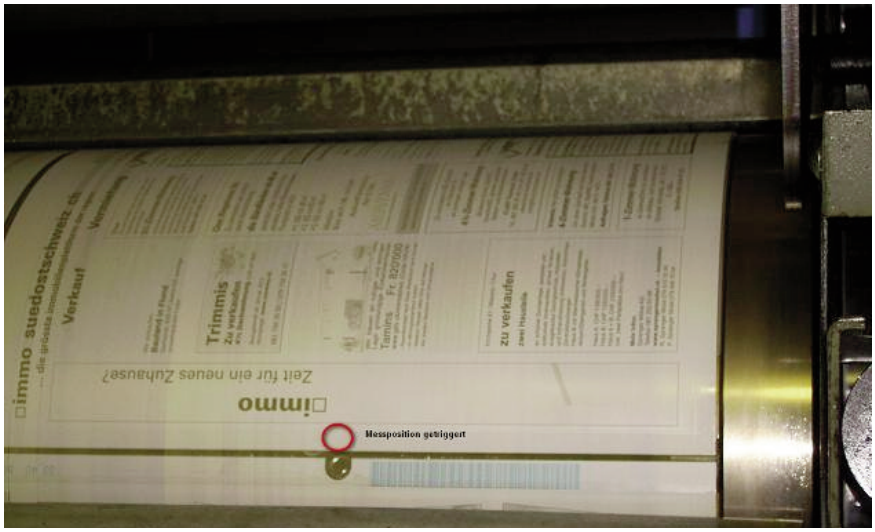


Figure 9: *Placement of the measuring spot outside the printed area*

Figure 9 shows where on a plate the measurement is made. It is placed outside the printing area. This approach assures that the measurement is always made without including some inked parts on the plate.

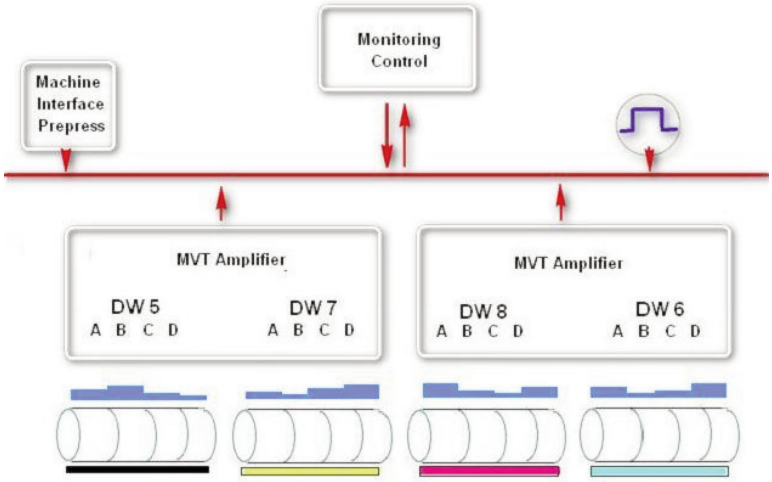


Figure 10: *The measurements are used to control the water inlet into the printing system.*

The measuring system is only the first part of the water control system. The measured values are fed into a controller, which calculates the needed change of the in-feed of water into the printing system. These values have to be forwarded to the press control system in order to change the water in-feed to the printing system.

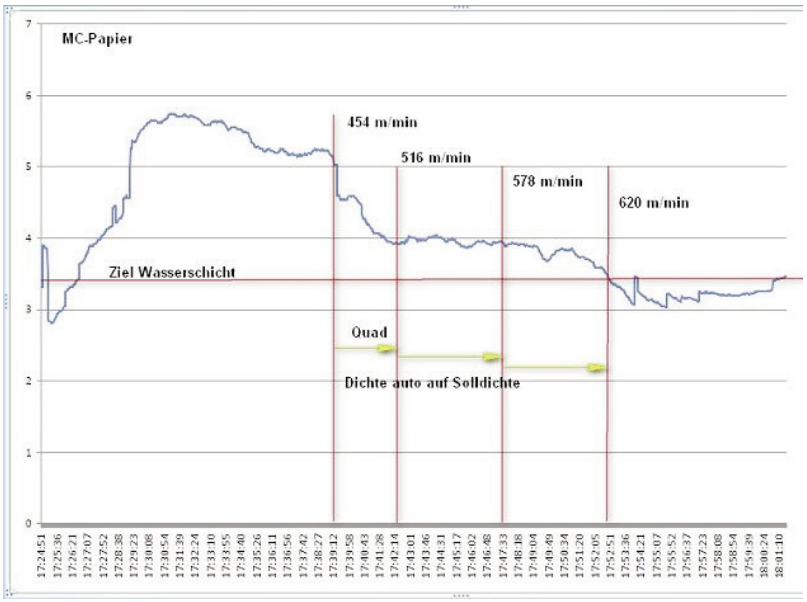


Figure 11: *This is a measurement without control*

The system was first used just to measure how the printer does set up the water manually. The example in figure 11 shows that the printer did use too much water at the start of the production. Printers do this very often, because they fear that by speeding up the press there could occur scumming, which leads to bad printing quality. The high water content makes the solid density degreasing. Since it is difficult for the printer to know how to correct for this problem, very often more ink is fed into the system, what leads to emulsification. The right measure would have been to reduce the water in-feed.

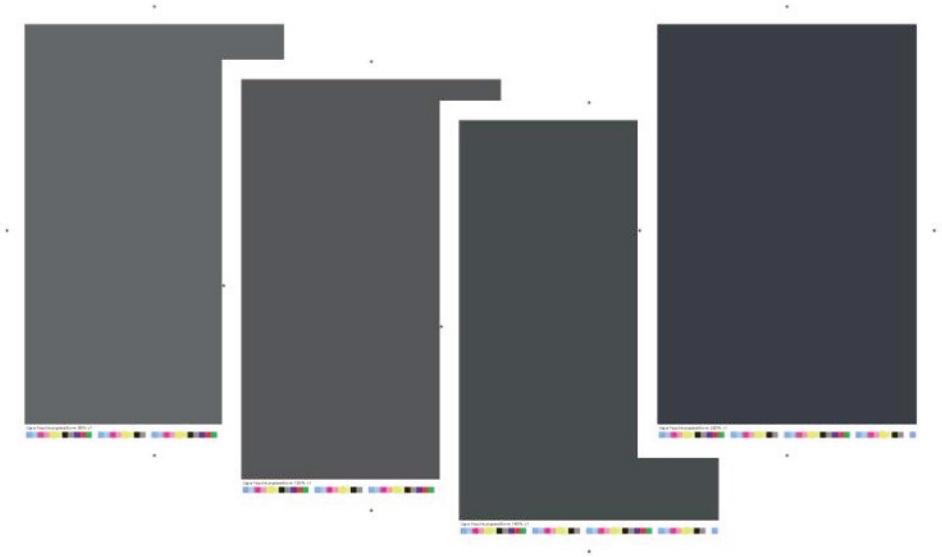


Figure 12: *Ugra designed a set of special test forms to calibrate the system.*

Ugra developed a series of test forms to calibrate the system. The test forms in figure 12 contain different tone values. With these test forms the measuring system can be calibrated in order to be able to measure the right values for all different printing situations.

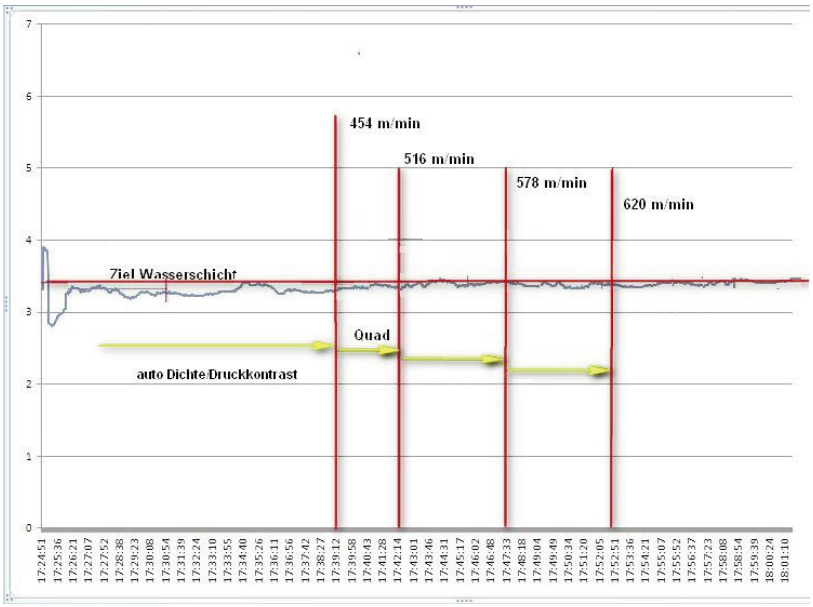


Figure 13: *Result after calibrating the measuring system*

After a testing period of half a year on two newspaper presses and a sheet-fed press, it is clear, that the used paper has the most influence to the water layer thickness. Most paper needs a water thickness layer of 3 µm. The paper in figure 13 needs 3.5 µm. If the water layer gets thinner as the aim thickness there is danger of scumming, if the layer is thicker emulsification is the result. Figure 13 shows how the water thickness layer was set very fast to the aim of 3.5 µm and was kept at this level over the whole print run.

Results and conclusions

After being able to calibrate the system and measuring and controlling the water layer thickness on the plate the following results were found:

1. By controlling the amount of water on the printing plate, the ink consumption is controlled indirectly too. The printing results becomes more even over the print run without using a color control system.

2. Point 1 leads to the question if color control systems are still needed if the water layer thickness is controlled on the plates. The first results lead to the conclusion that such systems are no more needed. This would be a valuable information for newspaper printers, since color control systems for all paper ribbons are very expensive.

3. Could a color and a dampening control system work together and lead to better results as with the today used color control systems? This question can't be answered today, since this was not tested yet.