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QUALITY OF THE PRINTING PLATES AS A FUNCTION OF CHEMICAL PROCESSING

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Abstract: *The conventional printing plate making process consists mainly of following processes: exposure of the photoactive coating on the printing plate through the film (mask), followed by chemical processing in developing solution and washing out process. Diazo positive printing plates were used in this research. The exposure and processing conditions of the all samples were equal, except the molar concentration of potassium alkali which was varied. The results obtained in this research have showed that molar concentration of alkali in the processing solution has significant influence on characteristics of image as well as non image areas.*
Key words: *offset, plates, processing, molar concentration*

1. INTRODUCTION

The offset printing technique is based on different physical and chemical properties of image and non image areas on the aluminium printing plate (PP). The image (printing) areas have hydrophobic properties and mostly consist of photosensitive organic material. The non image areas have hydrophilic properties in order to ensure selective adsorption of molecules of different formulation on the printing plate surface (Fiebag & Savariar, 2003). In the printing process non image areas are damped with fountain solution whose molecules are of polar character, and the printing areas are covered by ink which contains non-polar molecules of the higher fat acids (Aurenty et al., 1997). The quality level of the imprints mostly depends on the water-ink balance on the printing plate in the printing process. In the printing plate making process with positive type of photosensitive layer, plate has to be exposed to the specific irradiation, due to which it becomes soluble in processing solution. The result of a chemical processing is a printing plate consisting of areas covered with photoactive organic layer (image areas) and aluminium oxide surfaces (non image areas).

The plate making process for the offset printing plate is shown in Fig. 1.

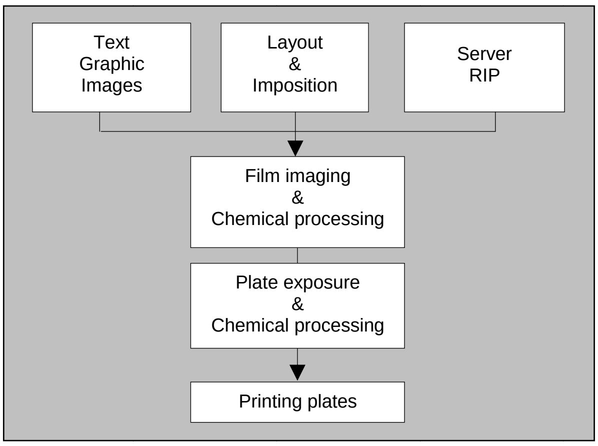

Fig. 1. Conventional printing plate making process

In the printing plate making process with positive type of photosensitive layer, plate has to be exposed to the specific irradiation, due to which it becomes soluble in processing solution. The result of a chemical processing is a printing plate consisting of areas covered with photoactive organic layer (image areas) and aluminium oxide surfaces (non image areas). In this process there are a number of parameters which could have an influence on the quality of the printing plate surfaces (Mahovic et al., 2005). Some of these parameters are concentration of the processing solution components, physical and chemical characteristics of the processing solution, after treatment of printing plates like gumming, speed and processing temperature etc. (Lovrecek et al., 1999).

The aim of this paper was to define the quality of the printing plates obtained in controlled plate making processes with variation of the molar concentration of alkali in the processing solution.

2. EXPERIMENTAL PART

The foreseen research is based upon the fact that the platemaking process based on chemical processing prevails today in graphic industry. One can say that processing phase of the PP is the one of the most influential phase which could cause the degradation of the quality level of the printing plates.

The aim of the paper was directed to this, processing phase, due to the fact that composition of the processing solution, temperature and duration of the chemical processing can easily oscilatte during the plate making process. PPs used in this paper were thin aluminium foils (AA1050) (Limbach et al., 2003; Hutchinson, 2001). Electrochemical graining process of aluminium surface is carried out in order to improve the water adhesion on the aluminium oxide film during the printing process and to enhance the adhesion of the photosensitive layer.

Samples of the PPs were cut to dimensions 150x205x mm and exposed to the irradiation for the same period (60 sec). Exposure device was PLURI METAL EXPO 74 with the metal halogenated lamp. The specially designated film with raster fields from 10, 20, … to 100% of surface coverage were used for exposing. After exposure the samples were processed in alkaline solution (potassium alkali) for the period of 5 sec in freshly prepared solution at temp. 26.3±0.2°C. The molar conc. of potassium alkali was varied. It was used molar conc. of 0.2 $moldm^{-3}$, 0.4 $moldm^{-3}$, 0.5 $moldm^{-3}$, 0.6 $moldm^{-3}$, 0.8 $moldm^{-3}$, 1.0 $moldm^{-3}$ and 1.5 $moldm^{-3}$.

Characterisation of the processing solutions was obtained by pH and conductivity measurements. pH values were measured by pH meter 330/SET from the company WTW GmbH with standard electrode with previous calibration. Electric conductivity of the solution samples were measured by the conductometer LF 330/SET by WTW GmbH.

The influence of different molar conc. of the processing solution on the quality level of the PPs was defined by measuring two different characteristics. First one was measurement of contact angle by applying of the dampening solution on the non image areas. The second one was by measuring the surface coverage of the image areas.

Videobased, optical contact angle measurement was performed by DataPhysics OCA30 device. It ensures the static and the dynamic characterization of liquid/solid interfaces by contact angle measurement procedure, the requirement for the calculation of surface free energy. Surface coverage was measured by plate reader device Gretag Machbeth iCPlate II.

3. RESULTS AND DISCUSSION

In Tab. 1 results of the pH value and conductivity of processing solutions before and after the processing of the samples are presented. One can see that by increasing the molar conc. of the processing solution the pH and conductivity values increase too. On the other hand the initiall pH values of potassium solution are in highly alkaline area. After the processing of the PP samples in solutions of different conc., pH value has become insignificantly lower, as well as conductivitiy. These results are probably the consequence of appearing of the dissolutted particles of the photosensitive layer in the solution which cause the lowering of observed parameters.

The contact angle results are presented in Fig. 2. Results are showing the changes in physical-chemical characteristics of the non image surfaces in relation to the used processing solution. One can see that by increasing the conc. of solution from 0.2 $moldm^{-3}$ to 0.5 $moldm^{-3}$ the contact angle decreses and that by further increase of conc. that the contact angle increases, too. This is probably the result of insufficient conc. of potassium alkali in processing solution which causes insufficient solution of the exposed photoactive layer. Higher conc. dissolute all exposed areas of photoactive layer and the peakes of the aluminium oxide layer, as well. The results of measurement of surface coverage are shown in Fig. 3. One can see that the molar concentration of alkali in the processing solution has significant influence on characteristics of image areas. Due to higher conc. the surface coverage values have became lower. These results are probably the consequence of term known as "undercopying" which occure during the exposure phase. Namely, the exposed area has become greater in the relation to the raster areas on the film due to the wave lightening theory. This resulted with photochemical reaction and dissolution of the edges of raster elements in the processing phase.

Processing solution conc. ($moldm^{-3}$)	pH value		Conductivity (χ / $mScm^{-1}$)	
	before	after	before	after
0.2	13.19	13.17	33.1	32.7
0.4	13.47	13.43	63.5	63.1
0.5	13.65	13.52	79.1	78.6
0.6	13.55	13.55	92.4	91.8
0.8	13.70	13.66	121.8	121.1
1.0	13.82	13.77	146.6	146.1
1.5	13.93	13.94	207.0	206.0

Tab. 1. pH value and conductivity of processing solutions

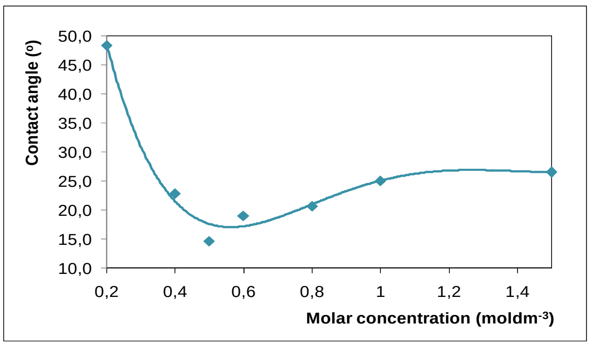

Fig. 2. Results of the contact angle values

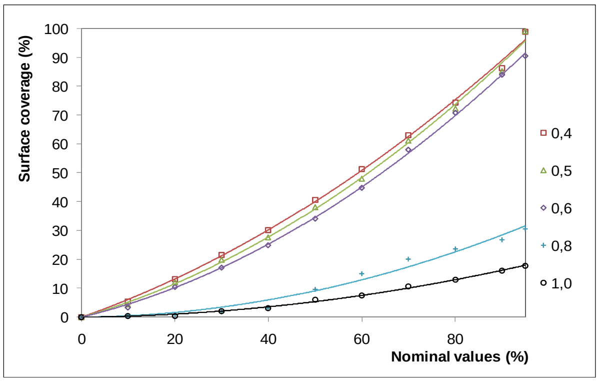

Fig. 3. Results of the measured surface coverage values

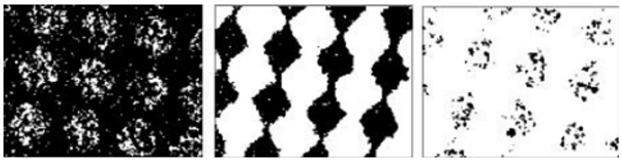
Fig. 4. Images of the 50% coverage values processed in solution with 0.2 $moldm^{-3}$, 0.5 $moldm^{-3}$ and 1.0 $moldm^{-3}$ conc

Results obtained by measuring the PP samples processed with solution of 0.4, 0.5 and 0.6 $moldm^{-3}$ conc. have been similar, as well as results on samples obtained with 0.8 and 1.5 $moldm^{-3}$ solution conc. On the other hand, one can see the significant difference between the results of the plates' coverage of 0.6 and 0.8 $moldm^{-3}$ conc.

4. CONCLUSIONS

The results obtained in this research have showed that molar concentration of alkali in a processing solution has significant influence on characteristics of image as well as non image areas of the PP samles. If the molar concentration of alkali in solution is higher, dissolving of whole photoactive coating could occur which makes the printing plate useless for exploitation. The non image areas could be of lower quality too, by processing in higher molar concentration of alkali solution. When the molar concentration of alkali in solution is to low some parts of photoactive coating remains on non image areas which disables adsorption of the fountain solution.

Obtained results indicate that chemical composition of processing solution it is essential for obtaining the PPs of high quality.

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