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Influence of surface phenomena in shape offset-printing

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Abstract
During the operation for printing the form of many different processes occur in different ways that affect the surface štamparskr form, causing a decline in its quality. The aim of this work is the observation Influence of temperature on the wettability of free surfaces. The temperature rise that occurs due to friction between the printing form, rollers and cylinders in offset printing process influences the adsorption process solution for wetting the free surface of the printing form, which is extremely affect print quality. Test results show that the increase in temperature increases the free surface energy of the printing form. The increase in the surface free energy and causes an increase in the wetting solution for wetting.
Research has shown the importance of temperature and indicate that the parameter has a large impact on the printing process, or the quality of the final product.

Keywords: printing form, the free surface, surface phenomena, energy, temperature

1. Introduction
Graphic technology can be divided into processes of preparing, printing and finishing of printed products. Each of these phases of production influence the final product. The materials are used in manufacturing printing forms are different, while the use of materials depends on the type of printing form so that it can be made of pure metal, alloy, can be made of certain polymers or even of elementary particles - electrons. Explained by the free surface energy, which causes the surface tension, adsorption and wetting. All these phenomena, especially wetting, watched by the quality of the printing form. Measure for wetting the contact angle, which is less wetting it is better, which is the basic precondition for quality print.
The aim of this work is the observation and definition of the degree of wetting liquid wetting by changing the temperature. Namely, in the process of printing of the contacting roll and the cylinder pressure, whereby a friction. Due to the friction surface temperature of the cylinder increases, respectively, in the case of basic cylinder of a printing form, raises the temperature of the printing form.

2. Surface Properties
Surface phenomena are phenomena that occur at the interface, such as solid-liquid, gaseous or liquid-solid-liquid-gaseous. They can occur on the boundary of two liquids that do not mix with each other. The surface phenomena include wetting or wetting, adsorption, spilling, capillary penetration and the like. They arise because the particles of the first phase have different properties from the second phase particles.

2.1. Surface properties of offset plate
The printing color is always a small amount of surface active substances, such as active acids and their salts, which during wetting of the printing form coming into contact with the free surface and gradually suppress the adsorbed hydrophilic layer, and for a long time and can fully and to replace it. Prolonged operation wetting can displace the hydrophobic layer with printing elements, so that the free surface begin to receive and lose by printing color printing.
Ability štampajućih and free surfaces during printing to keep their hydrophobic or hydrophilic properties is called a physical-chemical stability. On the physical and chemical stability influence surface properties and specific surface offset plate. Since the metals of the active substance, their surfaces can adsorb molecules of other materials with which they are

In contact. For example, in the air is adsorbed layer of oxygen molecules, which changes the surface properties of the metal, because with some metals and oxygen react chemically to the surface creates a metal oxide (chemisorption). Spontaneously formed oxide coatings (natural coating) are removed, if necessary chemical action on metal, easier or harder, depending on the type of metal (Zn code is easier, with Al and Cr weight). It is known that clean metal surfaces, bezprirodnih oxide coatings, hydrophobic - oleophile and does not adsorb water. Oxide coatings significantly influences the surface properties of metals. Since the coating is polar, more or less attracted to the water molecules and the oxidized metal surface hydrophilic.

However, there are exceptions. Size zinc in contact with the oil is hydrophobic, oleophillic-and the surface of copper and bronze, and at the very hydrophilic surface of chromium. Strong hydrophilic character, also show steel and aluminum with an oxide coating. The emergence oleofilnosti metal, despite the existence of polar oxide coatings, informs you good adsorption means for oleofilizaciju on the surface of the coating, causing the metal surfaces behave oleophillic. The oksidovanoj surface of copper and zinc leads to chemisorption of fatty acids and therefore copper, zinc and brass having oleophilic character.

Among all the metals zinc and copper and most easily subject to hydrophobization is used for making printing elements, while for the preparation of neštampajućih elements using permanent hydrophilic layer surface chrome, stainless steel and nickel.

3. Wetting Offset Printing

The technique of flat printing, printed surfaces (those that take on the color printing) and free surface are practically at the same level geometry (DH 0,5-5μm), but differ considerably according to their physicochemical chemical properties. Printed surfaces are constructed of a non-polar material small surface energy (resins or polymers) while the free surface made of polar materials typically high surface energy (mechanical lock- and anodically oxidized aluminum). Materials to build a free surface show good hydrophilic properties, but are not very pronounced enough oleophobic properties. In order to create the necessary oleophobicity free surfaces before applying paint on them inflict a wetting agent. The main task of wetting agents in the process of offset printing is oleofobizacija free areas on the form. The paint that is applied by means unique to the printed surface to form, together with the wetting agent, under the influence of pressure through the rubber of the offset screen is being transferred to the substrate.

The development of offset printing and changing the role of wetting in the printing system. The wetting agents are added to the surface active agents whose primary role of reducing the surface tension of wetting agents. By reducing the surface tension of the wetting agent allows for quick and uniform adsorption on the free surface. On the free surface in the printing process will therefore be less drift wetting agents which will reduce or completely eliminate most of the print quality of the negative consequences caused by the wetting agent (thinning printing inks, wetting the paper ...)

The wetting agent is added a buffer to maintain the pH of which is between pH 5 to pH 6. The primary buffer is added in order to enhance wetting of the free surfaces a wetting agent, since the isoelectric point of anodically oxidised aluminum at a pH about 5.5.

Its evaporation and wetting cooled machine parts that are heated by friction in the press. In a properly tuned machine parts temperature ranges between 30°C values - 35ºC. The wetting agent during the press is mixed with colors. Most supplements that are added to the wetting agent is added primarily for better interaction with the STAM-rusting form. After mixing these additives affect only the printing ink. In modern systems, offset printing most significant impact on the measurement parameters and visual image quality wetting agent has the right to interact with the inks.

If wetting during the printing process is not good, there may be negative consequences. One of them is flush printed surface as a result of the excessive amount of wetting the surface of the printing form. Or tonic, which occurs in case of insufficient amounts of wetting the surface of the printing form, and color acceptance on free surfaces. To wetting agent is able to fulfill all the requirements that were required, in addition to the basic ingredient, water in the wetting agent is added to the hydrophilic salts, buffers, surfactants, water-soluble gum arabic, solvents, additives for lubricating oil, emulsifying agents for the control of agents for increasing viscosity, other additives (biocides, otpjenjivanje, dyes), isopropyl alcohol - IPA, each of which has its role during the printing process.

4. Function Appendix Wetting

Looking at the role of the wetting liquid in the plane of the press might say that the answer to this question is very simple, prevent the acceptance of color on the free surfaces and to protect the printing form with printing machine downtime. In principle, the answer is correct, but in the process of printing processes taking place that affect the behavior and physical-chemical properties of the printing form, a wetting agent, paint and as a result may have a different quality prints. Therefore, the wetting agent is made up of water and additives that dynamically regulate and maintain the physical-chemical properties and thus maintain approximately equal conditions throughout the duration of a printing runs.

4.1. Proper dosing

Tebal 1: Proper dosing wetting

The desired amount	**100**		
The amount of additives	**4**	Additives	**4**
The amount of alcohol	**10**	Alcohol	**10**
Water quantity	**86**	Water	**86**
Total quantity	**100**	**Total quantity**	**100**

4.2. Nepravilno dosing

Tebal 2: Improper dosing wetting

The desired amount	**100**		
Water	**100**	Water	**87,7**
An additive concentrate	**4**	The amount of alcohol	**3,5**
IPA	**10**	IPA	**8,8**
Total quantity	**114**	**Total quantity**	**100**

4.3. Preparation wetting

Wetting agent which is here used in practice is used for moistening the offset machines. We used demineralised water that is added supplement to increase the electrical conductivity, the recommended concentration of 2%, and puffer solution at the recommended concentration of 2.5% to wetting maintain a constant pH value. To reduce the surface tension of the used surface active agents, in this case, used is an alcohol of 2-propanol at a concentration of 10%. Prepared wetting was measured pH value of pH = 04.48, electrical conductivity, κ = 01.31 mS /cm¹ and surface tension = 0.4275 mN / cm¹.

Measuring these parameters, which define the behavior of wetting agents in terms of printing is enabled standardization means a wetting agent.

4.4. Water

Chemistry untreated water is composed of a lot of dissolved minerals in the printing process can create problems. Depending on the amount of dissolved minerals are hard and soft water. In our region, the water is very hard, which means it contains a lot of different dissolved inorganic salts. One dissolution in water to its dissociated ions (Ca_2^+, Mg_2^+, Na^+, CO_3^{2-}, Cl^-). If the concentration of calcium ions (Ca_2^+), and carbonate (CO32-) is large, it may cause precipitation of calcium carbonate ($CaCO_3$), which is in the process of printing is deposited on the rollers. It may also cause an increase in pH value of a wetting agent, affects the electrical conductivity of a wetting agent. All these bad effects as a result may have a toning in the printing process. It is therefore necessary for the preparation of a wetting agent to pay attention to the water hardness, if applied too demineralization, ie to prepare wetting use demineralised water. The ideal hardness of water for the preparation of a wetting agent is 8ºdH to 12ºdH.

Tebal 3: Tvrdoća water

0 – 4 ºdH	Very soft water
4 – 8 ºdH	Soft water
8 – 18 ºdH	Medium hard water
18 – 30 ºdH	Hard water
30 > ºdH	Very hard water

4.5. Salts hydrophilic

Some inorganic salts, such as silicates $[SiO_4]^{4-}$ and phosphates $(PO_4)^3$ which is bound by adsorption on the free surface of the print form, the aluminum creates hydrophilic spojeve.U its structure and salts thereof have a strongly polar group, or a free electron pairs through which bind the water molecule, and thereby further increase the hydrophilicity of the free surface in the form of.

4.6. Buffers

Buffers are mixtures which are composed of a weak acid and its conjugated base or a weak base and its conjugate acid. Because of the hydrolysis process that occurs in these cases, the pH of the buffers reserved in a particular area regardless of the addition of substances that can change the pH value (acid or base). To narrow area convenient for contact with colors, and allows fast enough drying, prevents chemical changes in the free areas of the printing form. Buffers have a role to maintain the pH value within the tolerance limits provided for sheetfed printing ofest are between 4.7 to 5.3 pH.

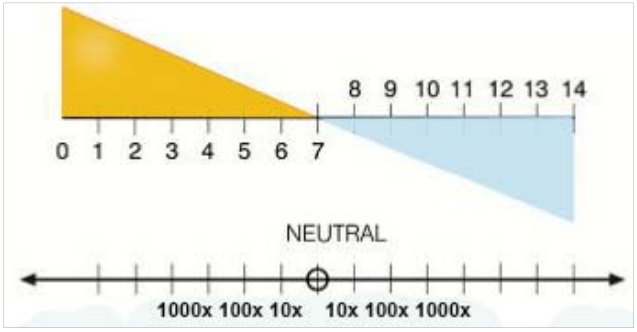

Fig 1: pH value

4.7. Measurement of pH

A wetting agent in addition to the salt and the hydrophilic substances that reduce the surface tension are added to the salts forming a buffer and stabilize the pH at a particular constant value. Similar to the surface tension, and when measuring pH little extras concentrate sharply reduce the pH value of a wetting agent. As the pH of deionized water is considerably higher compared to the operation of the buffer, this value is shown in the diagrams. From the diagram in Figure 11 it can be seen that the pH value for all three samples decreases rapidly to a concentration of about 3 vol%, and after concentration and pH drop is much smaller.

Tebal 5: Effect of pH values on the Press

	pH value		
	3 4 5 6 7		
Separation štampajućih and no printing elements	more		worse
The absorption of color and wetting	or less		worse
Drying oxidation	slowly		faster
Corrosion	more		less
The influence of the coating paper	more		less

4.6. Surface active agents

Surface active agents are substances that authorities in low concentrations have the capacity to adsorb at the interface of the system and thereby substantially alter the free surface or the surface energiju.Voda without additives surfactants has a very large surface tension, and therefore less wetted surface štamparkse free form shape. Surface active agents consist of two parts (hydrophobic and hydrophilic). As the non-polar substance having a lower surface free energy of the polar material, and therefore the surface tension. Nowadays, as a means of reducing the surface tension of water commonly used 2-propanol. The picture shows the relationship between the surface tension and 2-propanol where you can see that increasing the concentration of 2-propanol reduces the surface tension.

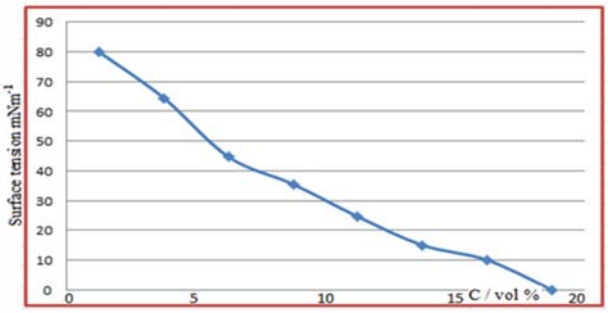

Fig 2: Dependence of surface tension and concentration of 2-propanol

As the 2-propanol is one of the pollutants that threaten the environment and harmful to health, it is necessary to find a replacement funds that will have similar properties as 2-propanol.

5. Surface Phenomena

Between particles of liquid or solid substances ruled attractive cohesive strength. Particles that are located in the interior of the stage, surrounded on all sides by the neighboring particles, so that the forces acting on any item in the account-phase interior of equal intensity in all directions, as schematically shown in Fig.1. The resultant force acting on each individual particle in the interior phase is equal to zero, which is said to be in the interior of the isotropic phase of the government forces. However, the case is different with particles at the edge of contact. Regardless of whether it is a liquid phase in contact with its vapor or solid phase in contact with the liquid or gas, the forces acting on the surface phases are not mutually balanced, because such particles are surrounded on all sides by same-sex particles. Therefore, the resultant forces acting on the particles on the surface directed toward the interior of the stage. In contrast to the interior of account-phase, characterized by isotropic forces on the border of touch two phases anisotropy government forces. The properties of a material are determined by the type of particles that make it and the forces that act on them. Since the forces near the border on the different phases of the interior phase, interfacial properties of the field will be different from the properties of both phases. The specificity of the characteristics and behavior of the phase boundary in relation to the interior of the phases depend on the characteristics of the phases which are in contact - whether it is a jednokomponentnoj multicomponent liquid or solution in contact with gaso-slender phase of metal, semiconductor or insulator in contact with the electrolyte, nonelectrolytes or gas phase.

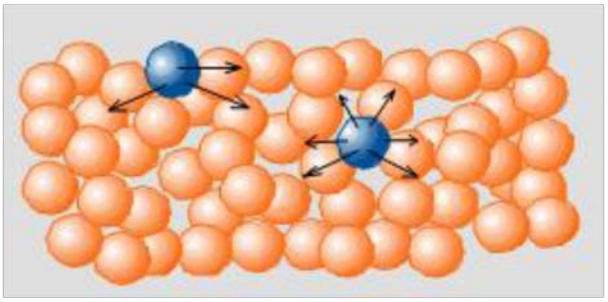

Fig 3: The forces of the molecules in the interior phase and on the surface

As a result of the surface free energy on the surface phase occurs is the surface tension. This is a force which acts parallel to the surface of a wetting agent and tends to reduce in order to achieve a state of reducing the energy content. The greater the cohesive strength of a liquid or gas, it is a surface tension greater. The decrease of the surface free energy can be achieved by creating a geometric body with the smallest surface, ie. balls or geometric object as similar balls. Surface tension is celebrated symbols, and or T. It is the force per unit length perpendicular to the surface, her unit N / m, while the unit of surface free energy J / m². They are numerically equal. Energy substances E area A is equal to:

The conductivity depends on its characteristics, but the characteristics of the materials with which it is in contact - their mutual adhezijonim forces, and on the temperature. Increasing the temperature increases the kinetic energy of the particles, they can move faster, weaken the bonds between the molecules and the surface tension decreases. Conversely, if we reduce the temperature will be less action force, and more uncompensated energy, which will increase the surface tension. Surface tension can vary depending on how and with which the same chemical substances in contact. Examples, water in contact with air has a surface tension of a certain value, while in contact with ethanol, the surface tension is equal to zero, because both of the liquids are mixed, and the boundary between the liquid disappears. Because of the uneven distribution of charge within the molecule occurs polarity of the molecules, ie one part of the molecule has a negative surplus, and the second part of the excess positive charge. Such molecules are used to orient the surface, and is said to have a polar karakter.Tečni hydrocarbons have the lowest polarity, and hence the surface tension, because their molecules have a symmetrical structure and are thereby non-polar, and among them, acting weak Van der Vaals- these attractive forces. Surface tension of solids is usually much larger than the liquid because the connection between their particles larger than the attractive forces between molecules.

6. Experimental

6.1. Wetting as a surface phenomenon

Wetting is a physical phenomenon caused by the reduction of surface tension forces. The fluid wets a solid body only if there is a reduction of surface tension. If the liquid reduces uncompensated surface forces, it is poured over the surface, trying to occupy the largest area, as this reduces its surface tension and surface tension of the solid body. Different solid surface is wetted differently the same liquid, a variety of different fluid wetted same solids. Since the surface tension of the liquid is lower than that of solids, liquids mainly to wet down the solids.

Water as a polar liquid wets the solid non-polar substances (paraffin wax, fatty surfaces). Wetting the first stage of the interactions of liquids and solids, because it is full contact between the two phases. If the solid surface simultaneously operate two liquids completely different polarity leads to selective wetting. Rugged body will be wet that liquid whose polarity is similar to a solid body. From the size of the contact angle can be concluded about the molecular nature of this matter.

Hidrofillne those substances in terms of selective wetting wet down the water better than a nonpolar liquid. These are substances whose molecules are ionic or dipolar region (eg. Salts, oxides and hydroxides of metals). In the presence of polar surface water drop on it spills or forms a sharp contact angle [Θ]. What is the value of cos Θ closer to +1, this is a solid surface better wetted with water and it is hydrophilic,

Hydrophobic substances in terms of selective wetting better than wetted nonpolar liquid water. Chemically pure metals are also non-polar, and therefore hydrophobic, but spontaneous oxidation in the air are coated with an oxide layer which then provides their hydrophilic properties.

Oleophilic materials into image selective wetting well wetted non-polar liquid (oil, printing ink). These are also hydrophobic substances.

Oleophobic substance in terms of selective wetting well wetted polar liquid. These are also the hydrophilic substance. On the air to solids wetted well with any liquid, because it leads to the reduction of surface energy. When the surface tension of the liquid is greater than in solids, the liquid does not wet.

6.2. Surface active agents

Water with no additives of surfactants has a very high surface tension, and therefore less wetted surface area available on the printing form. Surface active agents are built of large molekolula having two parts, nonpolar and polar (functional group) work. The mode of action of such substances, the addition of those in the water, because of their non-polar parts are migrating on a water surface. As the non-polar substance having a lower surface free energy, and thus the surface tension of the polar substances, reduces the free surface energy and surface tension of the solution. Therefore, it is added to a solution of a wetting agent to reduce the free surface energy, the surface tension and thereby reduce the contact angle, which is a measure of wetting. Today, as a means of reducing the surface tension of water commonly used 2-propanol.

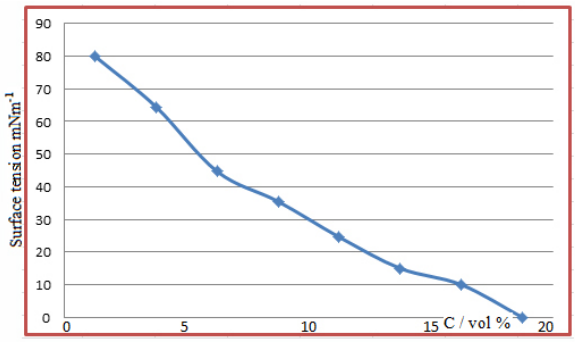

Fig 4: The dependence of surface tension on the concentration of 2-propanol

As the 2-propanol is one of the pollutants that contaminate the environment and harmful to health, it is necessary to find a replacement funds that will have similar properties and functioning as 2-propanol.

The effect of pH on the formation of electrochemical coating.

The higher the concentration of H^+ ions in the electrolyte (lower pH) leads to their reduction at the cathode and hydrogen evolution. This process reduces the current efficiency, and affects the quality of the coating, because the resulting hydrogen incorporated in the coating and makes it brittle and less solid. A higher concentration of OH- ions in the electrolyte (higher pH) in some of the electrolyte can cause the precipitation of a basic cation, precipitate as hydroxide [Cu $(OH)_2$; Ni $(OH)_2$]. The non-precious metal the pH of the electrolyte has to be below 7 for the nickel deposition electrolyte pH should be between 5.8 to 6.3. In order to maintain such a narrow range of pH values are used as buffers H_3BO_3. In addition, the electrolyte may also be added, and the organic components as gelatin, glycerol, sulfospojevi naphthalene at low concentrations, because they contribute to the structure of the coating and its compound. Such compounds are adsorbed on the cathode surface and thus block the surface and affect the formation of new crystallization centers.

6.3. The ability of the adsorption

Ability of the adsorption of the active substance increases with the increase in non-uniformity of their molecule: the longer and stronger polarity radical of functional groups, the greater the adsorption capacity.

The extension radicals decreases the solubility of surfactants in water. By increasing the hydrophilicity of (increasing the number of functional groups in the molecule) increases and solubility in water. Melting of surface-active substances in a liquid surface tension of the fluid can be reduced or increased. If molecules of added material having weaker attractive forces than those that exist in the liquid, these can be collected at the interface (liquid-to-air), and thus compensate for the free surface energy and surface tension is decreased.

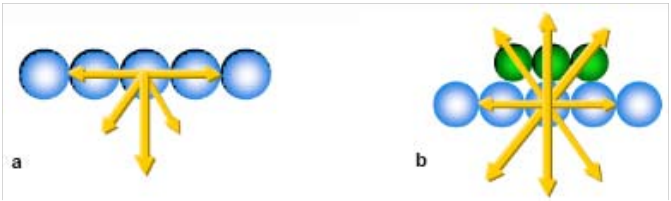

Fig 5: a) The reduction of the surface tension, b) Increasing the surface tension of

The molecule if the added material have a stronger attraction forces, they will be collected in the inside of the solution, so that a surface layer rich molecules of surfactants than the weight of the solvent. On the surface it has so little to increase the surface tension.

Surface active agents differ in the degree of surface activity. The low molecular weight compounds (alcohols, water-soluble) and the compound having average molecular weights are used for lowering the surface tension of water and aqueous solutions, or better wetting of solid surfaces.

Lowering of surface tension (the use of appropriate surface active agents) is possible with a much smaller amount of the solution to wet the large surface.

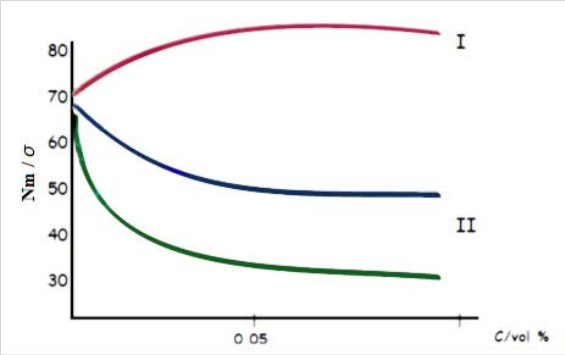

Fig 6: Surface tension

Curve I shows the increase in surface tension.
Curve II is the most common case, when there is a continuous decrease of the surface tension by increasing the concentration of surfactants in solution.
Curve III shows the sharp reduction of surface tension and is characteristic of soaps and detergents. For use in offset printing can be used all surface active agents that lower the surface tension of water, and do not change other physico-chemical properties of the solution wetting free and printed surfaces. Surface active agents that are used most powerful influence waterproofing (fatty acid soaps) or hidrofiliziranje (dextrin, starch, gum arabic).

6.4. Pron pH developer

Change in pH developer was measured with a pH meter VTV GmbH, 330 / SET. Developer Samples were prepared followed by a clean solution developer, at intervals of 12 hours, until the expiration of 84 hours.

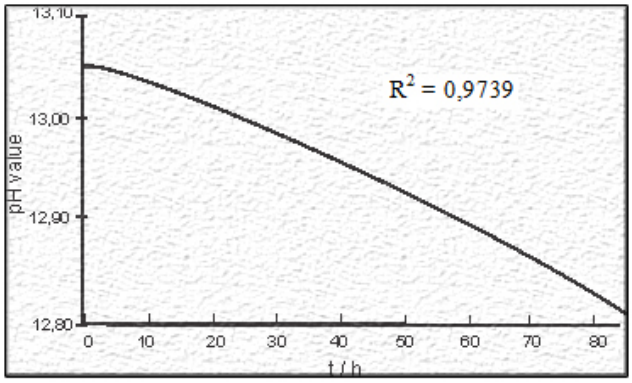

Fig 11: Diagram depending on the pH value of the developer of the time

The diagram shows that the pH value of the developer at intervals intake decreases. Home pH value was 13:05, and the final, after 84 hours, is 12.82. However, the solution retains a pronounced alkaline properties. The resulting curve is approximated by a polynomial of the second degree.
Due to the properties Amphoterism, aluminum oxide will to some extent dissolve in alkaline solution developer. With aging developer, alkalinity him then decreases, and because of that with time and the dissolution of the surface structure of alumina to be less pronounced.

7. Conclusion

The surface of the aluminum hydrofilni adsorbed layers are more stable and less stable than the hydrophobic surface of the zinc. Means that the aluminum plates Physico-chemical stability of the free area larger than the zink, a štampajućih less. Of all the metals copper is the strongest and firmest hidrofobizuje and is considered the best metal for printing the elements. Steadiest hydro fi or vertical layers are formed on the surface of chrome, stainless steel and nickel, and they may not receive a permanent hydrophobic elements, and can not be used for printing the elements.
In this study looked at the impact of developer solution on the surface properties of alumina offset printing forms. The subject of this study were of the printing form, since they are one of the most abundant form of the printing market. To test the method used SEM analysis and electrochemical impedance spectroscopy of aluminum oxide, which makes the free surface of the printing form, and measuring the pH value of the developer samples. These methods are visually and quantitatively monitored and explained the changes in the patterns that occur due to the developing process of printing forms. Tests conducted in this work show that the impact on the quality of the developer of the free surfaces, although the process of developing a standardized, significant.
Today, new technological solutions such as waterless offset or digital printing is trying to avoid the influence of wetting solution for print quality. However, it still is widely used in modern offset, which is the dominant printing technique and is therefore still subject of research to all its flaws tried to translate into an advantage.

7. References

1. Kumar, M., (1978). Standardization of development and exploitation of printing forms for offset printing, College of Printing, Zagreb.
2. Kipphan H., (2001). Handbook of Print Media, Springer, Berlin.
3. Marušić K., (2008). Electrochemical impedance spectroscopy and its application in testing of protection in satin bronze, Seminar, FKIT, Zagreb.
4. Radosevic, J., (2007). Electrochemistry, Script, KTF, Split, 2007.
5. Lasia A., (1999) Impedance Spectroscopy. Electrochemical and its Applications, Département de chimie, Université de Sherbrooke, Sherbrooke, Québec.
6. FIEBAG U., Savariar-Hauck, C., (2003). Aqueous Developer for Lithographic Printing Plates, Patent No .: US 6,649,324 B1.
7. Schmitt, U., (2005). Erfahrungen mit den digital Kontrollmitteln und der Testformen FOGRA für die Qualitätssicherung, FOGRA Symposium: Computer to Plate, Munich, 2005. 8. Bartolomé MJ, López, V., E. Escudero, G. Caruana, González JA, (2006). Changes in the specific surface area of porous aluminum oxide films during sealing, Surface Coating Technology 200 4530-4537.
8. Gojo M., Mahović Poljaček S., (2013). Basics of printing forms, Graphic Arts, Zagreb. 10. Korelić O., (1986). Kemigrafija, College of Printing, Zagreb.
9. 11. Bolanča S., (1997). The main printing techniques, Acta Graphica, Zagreb.

10. 12. Cigula T., (2011). Qualitative analysis of free surface printing forms, doctoral thesis, Faculty of Graphic Arts, Zagreb.