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MODELLING AND RESEARCH OF THE INK SPLITTING FACTOR INFLUENCE ON THE WORK OF THE OFFSET INK PRINTING SYSTEM

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A mathematical model of the offset ink printing system has been developed, which describes the operation modes of all its components. A simulator of the serial-parallel structure ink printing system has been constructed, which reproduces the technological process of imprints replication. The simulation and research of the influence of the ink splitting factor at the contact places of the rollers and cylinders on the process of its transfer to the paper with different values of the form filling coefficients by the printing elements have been carried out. As a result of model experiments, a significant influence of the ink splitting factor value at the contact places of the rollers and cylinders on the ink thickness at the output of the ink printing system has been established. It has been found that this effect in the replication of imprints with different form filling coefficients by the printing elements has an S-shaped dependence. The high sensitivity of the offset ink printing system to the change of the ink splitting factors is established, which increases with the decrease in the density of the image elements on the surface of the imprints. A significant difference in the influence of the ink splitting factors on the dynamics of the ink printing system when replicating imprints with different fill density of their image elements is revealed.

Keywords: *mathematical model, ink printing system, offset machine, printing plate, ink splitting factor, ink fountain device, oscillator cylinder, signal graph, simulator.*

Problem statement. Offset ink printing system is a system consisting of an ordered set of metal cylinders and elastic rollers interconnected. In it, there are processes of supplying, rolling, and circulation of direct and reverse ink flows, the formation of a uniform thin ink flow with technologically defined properties. And also there is rolling this ink flow to the surface of the printing plate and transfer it through the blanket cylinder to the paper [1]. The physical processes that take place in ink printing systems are quite complex. Being in the distributing system the ink must be continuously transmitted from one system's element to another, well wetting the surfaces of the rollers and contact cylinders at the same time. Structural-mechanical ink properties are the basic technological properties that determine its deformation behavior in the ink printing system during printing, as well as the conditions of the interaction of ink with paper. Structural-mechanical properties mean rheological, cohesive, and adhesive properties of ink [2]. The printing process can only be realized if the adhesion of the ink to the paper and the printing elements of the form are greater than its cohesion. The ink properties that determine its behavior in the ink printing system will affect the accuracy of printed image reproduction. Therefore, the research of the effect ink splitting in the contact places of the ink printing system elements on the imprint's ink film thickness, and, accordingly, the quality of printing is an urgent task.

Analysis of recent research and publications. Ink rolling at the ink printing system, i.e. its distribution and transfer is accompanied by cyclic overlaying at the entrance to the contact places of the rollers and cylinders and splitting at the exit from them. During repeated ink overlaying and splitting, provided a sufficient number of rollers, with a discrete supply from the ink portions coming in the form of impulses to the first roller, continuous ink thin flow is formed. At the contact places, the ink flows are subject to high stresses and shear rates. In the process of splitting the ink undergoes quite complex physical, mechanical, and rheological phenomena. Under these conditions, the ink structure and its cohesion are changes, which determine the ink splitting factor at the contact places of the rollers and cylinders.

Of particular interest is the scientific work [3], which proposed a model of ink transfer between two cylindrical surfaces. The results of temperature researches in the contact zone of two rotating rollers are presented based on which it is established that the ink temperature at the outlet of the contact zone is higher than at the inlet. However, no information is available on the effect of temperature changes on the value of ink splitting. Publication [4] is concerned with the process research of ink transfer between the blanket cylinder and the substrate on which the imprints are deposited. Based on the analysis of ink tack models and theories describing the ink distribution process, it is concluded that the best way to measure tack is the work required to ink splitting between two moving surfaces, referred to the unit area. Due to the differences in the designs of the ink printing systems and the choice of different values that were measured, it was not possible to determine the value of the ink splitting factor between the two moving surfaces. In [5], a model of ink transferring was developed based on the Reynolds equation. A mathematical description of the relationship between such parameters as the pressure and ink thickness in the contact zones between the ink printing system elements is offered. As a result, the simulation is installed directly proportional to the ink thickness in the contact zone of the rollers with their equivalent radius. However, there is no information on the splitting parameters of ink micro-flows in the contact zones of the ink printing system elements. A publication [6] proposes a system for visualizing the process of ink transferring for offset printing. The ink splitting was investigated in the contact zone of the blanket cylinder with the rubber cloth and paper attached to it. Based on the obtained data, it is established that with increasing print speed the length of the stretched ink thread and the height of its breakpoint increases. There is no information on the research of the ink splitting in other contact places of the ink printing system elements. In [7], the results of experimental research on the nature of the ink flow temperature distribution on the surface of the form rollers and its effect on the quality of the imprinting are presented. It is found that the temperature of the ink film increases from the middle of the rollers to their edges. And this causes a corresponding growth in the magnitude of the tonal increase in the imprints.

The analysis of publications shows that the majority of scientific works are devoted to the study of the process of ink transfers to the printed material. No information on the specific magnitude of the ink splitting factor during its transportation from the ink fountain device to the blanket cylinder is available. However, it should be noted that [8] presents the results of experimental studies, based on which it is established that the ink splitting factor at the exit from the contact places of the rollers and cylinders are in the range from 0.45 to 0.57. Such an ambiguous result may be explained by the errors of the measurement method and the measuring means or by the insignificant influence of the ink splitting factor on its transmission in the ink printing system. To test these hypotheses, it is necessary to conduct researching the effect of the ink splitting factor at the contact places of the ink printing system elements on the accuracy of imprints reproduction.

The purpose of the article is the research effect of ink splitting in the contact places of the ink printing system elements on the ink layer thickness of imprints.

Presentment of the main research material. To consider this task, we use an ink printing system of a serial-parallel structure, in which the ink by the vibrator roller is fed by impulses from the ink fountain roller to the first roller of the ink distributing subsystem. The ink thickness in each supplying zone is regulated by the respective regulators. The ink flow coming into a certain zone of the first distributing roller's surface is moved to the contact place with the second roller. The ink flows at the contact places of the ink printing system elements are summed up, and at the exit of them are split, i.e. divided into two flows. And the action of the oscillator cylinders leads to a shift of the direct and reverse ink flows even in the axial direction. In the distributing process, ink is applied by form rollers on the printing plate from the surface of which the blanket cylinder is transferred to the printed material. The circulation process of direct and reverse ink flows by the surfaces of the ink printing system rollers and cylinders clearly shows the signal graph presented in Fig.1.

The input vertices of the graph simulate the ink supply thickness, and the output vertices of the graph imitate the ink thickness that is transmitted during printing on paper. All other vertices of the signal graph correspond to the ink flows thickness at the contact places of the multi-zone ink printing system elements. The arcs of the graph are the transfer operators of direct ink flows (arrows pointing downwards) and reverse flows — (arrows pointing upwards) within the respective zone on the surface of the rollers and cylinders. The segments connecting the adjacent ink transfer zones reflect the movement of the direct and reverse ink flows in an axial direction.

In developing the mathematical model, the following assumptions are made: the surfaces of the ink printing system elements are conditionally divided into zones of ink transfer in a direction perpendicular to the axis of the rollers and cylinders, i.e. from the entrance of the ink printing system to the exit; the number of zones corresponds to the number of ink supply regulating elements; the widths of the zones are equal; the oscillation period of ink fountain device's vibrator roller corresponds to the time of one revolution of the blanket cylinder; the linear velocities of the ink printing system elements in the circular direction are the same and constant; the diameters of the rollers and cylinders are different; the magnitude of the ink splitting factors at the contact places of the rollers and cylinders may vary; by the variables, we accept the ink flows thickness on the surfaces of the ink printing system elements, the thickness of the ink flows supply at the inlet and selection at the output and the thickness of the ink flows at the contact places of the ink printing system elements.

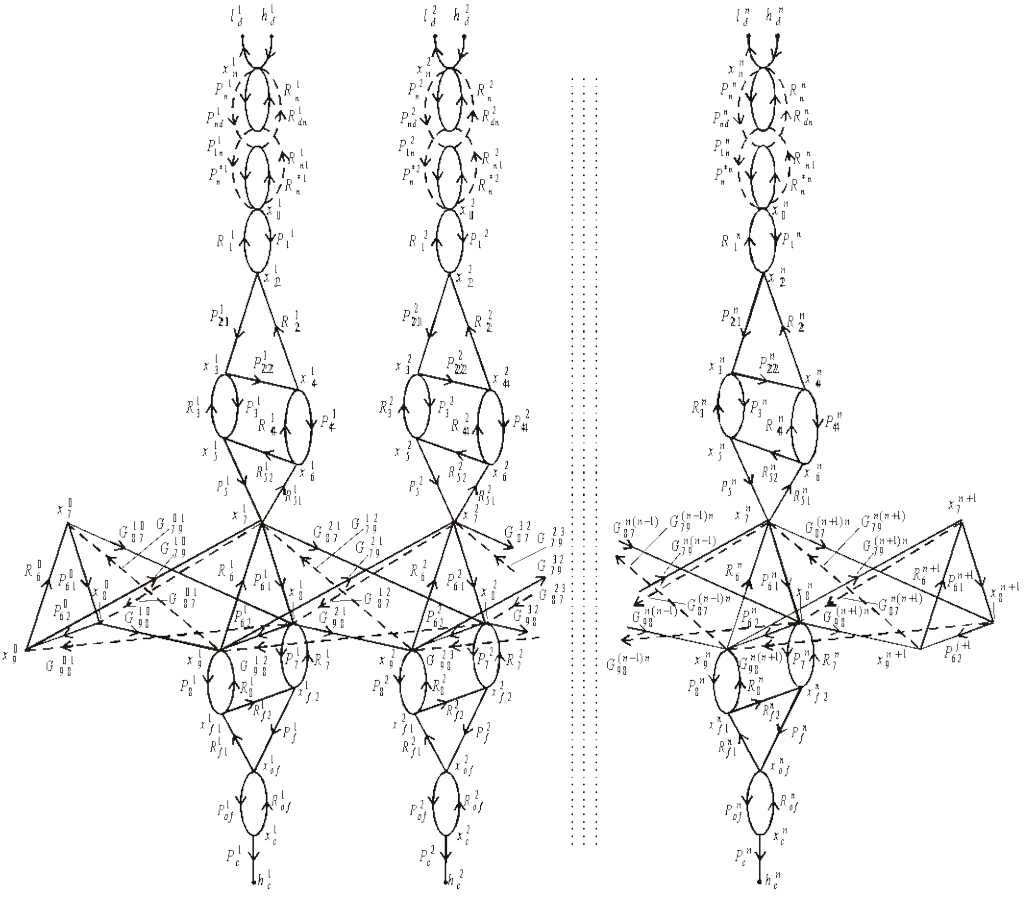


Fig. 1. Signal graph of a multi-zone ink printing system of a serial-parallel structure

The accepted assumptions are used to construct a mathematical model. Based on the works [9–11] and a structural scheme (Fig. 1), we perform a mathematical description of j-th zone a multi-zone ink printing system in the operator form:

$$x_n^j(z) = P_d^j(z)h_d^j(z) + R_n^j(z)x_{nd}^j(z) + R_n^{*j}(z)R_{dn}^j(z)x_1^j(z); \qquad l_d^j(z) = R_d^j(z)x_n^j(z);$$

$$x_{nd}^j(z) = P_n^j(z)x_n^j(z) + R_{n1}^j(z)x_{n1}^j(z);$$

$$x_{n1}^j(z) = P_{nd}^j(z)x_n^j(z) + R_n^{*j}(z)x_1^j(z);$$

$$x_1^j(z) = P_n^j(z)P_{1n}^j(z)x_n^j(z) + P_n^{*j}(z)x_{n1}^j(z) + R_1^j(z)x_2^j(z);$$

$$x_2^j(z) = P_1^j(z)x_1^j(z) + R_2^j(z)x_4^j(z);$$

$$x_3^j(z) = P_{21}^j(z)x_2^j(z) + R_3^j(z)x_{52}^j(z);$$

$$\begin{aligned}
&x_4^j(z) = P_{22}^j(z)x_3^j(z) + R_4^j(z)x_{51}^j(z);\\
&x_{52}^j(z) = P_3^j(z)x_3^j(z) + R_{52}^j(z)x_{51}^j(z);\\
&x_{51}^j(z) = P_4^j(z)x_4^j(z) + R_{51}^j(z)x_6^j(z);\\
&x_6^j(z) = P_5^j(z)x_{52}^j(z) + R_6^j(z)x_8^j(z) + G_{68}^{j(j-1)}x_8^{j-1} + G_{68}^{j(j+1)}x_8^{j+1};\\
&x_7^j(z) = P_{61}^j(z)x_6^j(z) + R_7^j(z)x_{f2}^j(z) + G_{76}^{j(j-1)}x_6^{j-1} + G_{76}^{j(j+1)}x_6^{j+1};\\
&x_8^j(z) = P_{62}^j(z)x_7^j(z) + R_8^j(z)x_{f1}^j(z) + G_{87}^{j(j-1)}x_7^{j-1} + G_{87}^{j(j+1)}x_7^{j+1};\\
&x_{f1}^j(z) = P_8^j(z)x_8^j(z) + R_{f1}^j(z)x_{of}^j(z);\\
&x_{f2}^j(z) = P_7^j(z)x_7^j(z) + R_{f2}^j(z)x_{f1}^j(z);\\
&x_{of}^j(z) = P_f^j(z)x_{f2}^j(z) + R_{of}^j(z)x_c^j(z);\\
&x_c^j(z) = P_{of}^j(z)x_{of}^j(z); \qquad h_c^j(z) = P_c^j(z)x_c^j(z),
\end{aligned} \tag{1}$$

where $x^j_n(z)$, $x^j_{nd}(z)$, $x^j_1(z)$, $x^j_{n1}(z)$ is z–image of the ink flows thickness at the contact places of the vibrator roller with the ink fountain roller and the first distributing roller; $P^j_d(z)$, $R^j_d(z)$ is transfer operators of direct and reverse ink flows by an ink fountain roller; j is number of ink supply zones; $P^j_n(z)$, $R^j_n(z)$ is operators of ink transfer by the surface of the vibrator roller at the moment of contact with the ink fountain roller; $P^{*j}_n(z)$, $R^{*j}_n(z)$ is operators of ink transfer by the surface of the vibrator roller at the moment of contact with the distributor roller; $P^j_{nd}(z)$, $P^j_{1n}(z)$ is operators of ink transfer by a vibrator roller from the ink fountain roller to the distributor roller; $R^j_{dn}(z)$, $R^j_{n1}(z)$ is operators of ink transfer by a vibrator roller from the distributor roller to the ink fountain roller; $h^j_d(z)$ is thickness of the ink zonal supply; $l^j_d(z)$ is z–image the thickness of the reverse ink flows to the ink fountain; $x^j_{\mathrm{i}}(z)$, $x^j_f(z)$, $x^j_{of}(z)$, $x^j_c(z)$ is z–image of the ink flows thickness at the contact places of the ink printing system elements; i is number of contact places between the ink printing system elements; $P^j_i(z)$, $R^j_i(z)$ is transfer operators of direct and reverse ink flows by rollers of the ink distributing subsystem; $G^{j(j-1)}_{(i+1)i}(z)$, $G^{j(j+1)}_{(i+1)i}(z)$ is transfer operators of direct ink flows by an oscillator cylinder in the axial direction; $G^{j(j-1)}_{i(i+1)}(z)$, $G^{j(j+1)}_{i(i+1)}(z)$ is transfer operators of reverse ink flows by an oscillator cylinder in the axial direction; $P^j_f(z)$, $R^j_f(z)$, $P^j_{of}(z)$, $R^j_{of}(z)$ is transfer operators of direct and reverse ink flows by plate and blanket cylinders; $P^j_c(z)$ is operator of ink transferring paint to substrate; $h^j_c(z)$ is z–image of the ink thickness in the j-th zone of the imprint.

The ink splitting factor α_i at the exit from the contact places of the ink printing system elements are part of the respective transferring operators of direct and reverse ink flows in a circular direction:

$$\begin{aligned}
&P_i^j(z) = \alpha_i z^{-p_i};\\
&R_i^j(z) = (1-\alpha_i)z^{-r_i};\\
&R_7^j(z) = (1-\alpha_{f2}F^j(z)z^{-r_{f2}})z^{-r_7};\\
&R_8^j(z) = (1-\alpha_{f1}F^j(z))z^{-r_8};\\
&P_f^j(z) = \alpha_{f2}F^j(z)z^{-r_{f2}}z^{-p_f};\\
&R_{f1}^j(z) = (1-\alpha_{of})z^{-r_{f1}};\\
&R_{f2}^j(z) = \alpha_{f1}F^j(z)z^{-r_{f2}};\\
&P_{of}^j(z) = \alpha_{of}z^{-p_{of}};\\
&R_{of}^j(z) = (1-\beta)z^{-r_{of}}.
\end{aligned} \tag{2}$$

The proposed mathematical model makes it possible to describe the process of ink distributing and transfer in the ink printing system with any number of ink supply zones. Also, the model can be set the density of the zonal form filling with printing elements in the j-th zones of the printing form. The developed mathematical model is convenient for writing code for simulation modeling.

Based on the mathematical model (1, 2), we build a simulator of a multi-zone ink printing system in the Matlab-Simulink software environment. For each transfer operator of direct and reverse ink flows from the Simulink library, the appropriate block is selected and configured depending on the functional need. The geometric dimensions of the ink printing system rollers and cylinders are set through the corresponding transport delays p_i, r_i, p_f, r_f, p_{of}, r_{of}. The ink splitting factors at contact places of the ink printing system elements are set in blocks that reproduce the ink transfer operators. Assume that the coefficient of the ink transfer to the printed material is $\beta = 0.7$. The density of the form zonal filling with printing elements can vary widely from 0 to 100%. Therefore, when investigating the effect of ink splitting factors on the accuracy of imprints, we consider this factor. The possibility of generating printing elements in the j-th zone of the printing plate is given by blocks displaying operators of ink transfer by a printing form $F^j(z)$.

The research process of the ink splitting factor effect on the ink thickness transmitted to the imprints is implemented as follows:

- we introduce a certain density of form filling by printing elements and determine from the condition of balance ink selection and its supply the value of the input task h_d at the value of the ink splitting factor $\alpha=0.5$;
- at a steady input task we change the magnitude of the ink splitting factors α_i and perform a series of model experiments;
- we fix at the output of the ink printing system on the steady mode of operation the value of the ink thickness on the imprint h_c;
- we repeat a series of simulation experiments for different values of form filling with printing elements k_z.

Fragments of simulation results and effect research of ink splitting factor α_i on the process of ink transfer in the ink printing system of a serial-parallel structure with different values of the form filling coefficients by printing elements are presented in Table 1. According to Table 1 the graphical dependencies of the ink thickness on the imprints from the ink splitting factors at the contact places of the ink printing system elements were constructed (Fig. 2).

From the analysis of the data obtained as a result of simulation modeling, it follows that the change of the ink splitting factor at the contact places of the rollers and cylinders leads to a corresponding change in the ink thickness of the imprints (table 1). With the increase of the ink splitting factor value α is observed the stabilization of the ink thickness that transferred to the paper occurs at $\alpha = 0.6$ (Fig. 2). The ink thickness on the surface of the imprints thus increases, depending on the density of form filling by printing elements from 10% to 60% relative to the technologically required thickness. With the reduction of the ink splitting factor α to 0.4, the ink thickness on the surface of the imprints decreases at $k_z = 1.0$ by 56.5%, and at $k_z = 0.1$ – 88.5%. With the reduction of the ink splitting factor at the contact places of the ink printing system elements to 0.3, ink at the output of the ink printing system virtually ceases to be transmitted on the printed material. It should be noted that even a slight deviation of the ink splitting factor leads to the substandard of printed imprints. So when printing imprints with k_z=1.0 at the deviation from α = 0.5 by -3% or more than +8% we get the ink thickness on the surface of the imprints, which goes beyond the permissible norms set by ISO. And when printing imprints with the density of form filling with printing elements, which corresponds to k_z = 0.1 to ensure the standard of the imprints, the deviation range α should be even smaller and be within ±1%. Besides, it should be noted that the ink splitting factor at the contact places of the rollers and cylinders also has an impact on the time of the ink printing system transient process.

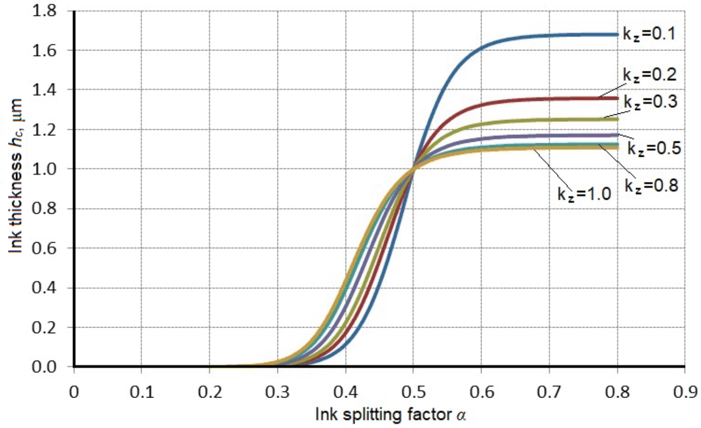
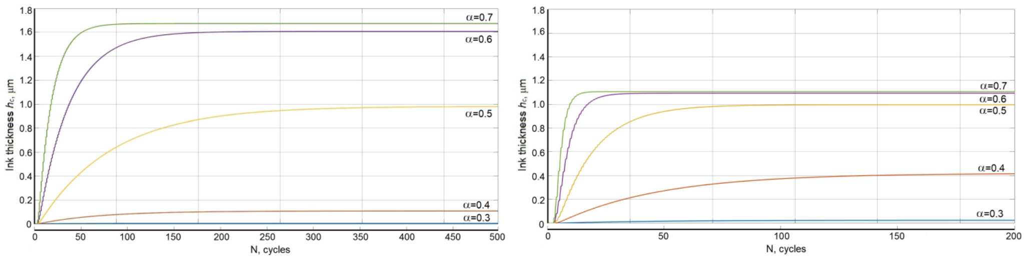


Fig. 2. Graphical dependences of ink thickness on the imprints from α_i at various k_z

In the course of the work, the effect researching of the ink splitting factor α_i on the transient process of the serial-parallel structure ink printing system for different form filling coefficients was carried out. Fig. 3 visually reflects the dynamics of the change in the ink thickness from the ink splitting factors α_i for the two options of form filling with printing elements k_z=0.1 and k_z=1.0.



a) b)

Fig. 3. Transient processes of forming the ink thickness on the imprints at different ink splitting factors: a – k_z=0.1; b – k_z=1.0

Table 1

The simulation results of the influence on the ink splitting factors on the ink thickness of the imprints

α_i	h_c, µm					
	k_z=0.1	k_z=0.2	k_z=0.3	k_z=0.5	k_z=0.8	k_z=1.0
	h_d=11.43 µm	h_d=18.47 µm	h_d=25.5 µm	h_d=39.84 µm	h_d=61.23 µm	h_d=75.47 µm
0.20	0.000063	0.000094	0.000134	0.000225	0.000334	0.000410
0.22	0.000161	0.000247	0.000350	0.000580	0.000863	0.001060
0.24	0.000390	0.000605	0.000857	0.001401	0.002090	0.002550
0.26	0.000897	0.001408	0.001989	0.003206	0.004791	0.005810
0.28	0.001980	0.003129	0.004402	0.007010	0.010470	0.012850
0.30	0.004200	0.006681	0.009350	0.014710	0.021870	0.026700
0.32	0.008640	0.013760	0.019130	0.029680	0.043740	0.052950
0.34	0.017260	0.027410	0.037740	0.057530	0.083410	0.099740
0.36	0.033510	0.052740	0.071670	0.106600	0.150400	0.176600
0.38	0.063190	0.097730	0.130100	0.186600	0.252900	0.290000
0.40	0.115300	0.172900	0.223500	0.304800	0.391000	0.435100
0.42	0.201900	0.288700	0.357900	0.457500	0.550200	0.593100
0.44	0.335500	0.448100	0.526600	0.625700	0.705600	0.739200
0.46	0.521700	0.638500	0.707300	0.782800	0.836000	0.856800
0.48	0.749600	0.832000	0.871300	0.909600	0.933300	0.942100
0.50	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
0.52	1.207000	1.126000	1.091000	1.063000	1.044000	1.038000
0.54	1.375000	1.212000	1.151000	1.102000	1.073000	1.063000
0.56	1.492000	1.268000	1.189000	1.128000	1.091000	1.078000
0.58	1.566000	1.303000	1.213000	1.143000	1.103000	1.089000
0.60	1.612000	1.324000	1.227000	1.153000	1.110000	1.096000
0.62	1.640000	1.337000	1.236000	1.160000	1.115000	1.100000
0.64	1.656000	1.345000	1.242000	1.164000	1.119000	1.103000
0.66	1.666000	1.350000	1.245000	1.166000	1.121000	1.105000
0.68	1.672000	1.353000	1.248000	1.168000	1.122000	1.107000
0.70	1.675000	1.355000	1.249000	1.169000	1.123000	1.108000
0.72	1.678000	1.356000	1.250000	1.170000	1.124000	1.108000
0.74	1.679000	1.357000	1.251000	1.171000	1.125000	1.109000
0.76	1.680000	1.357000	1.251000	1.171000	1.125000	1.109000
0.78	1.680000	1.358000	1.252000	1.171000	1.125000	1.109000
0.80	1.680000	1.358000	1.252000	1.172000	1.125000	1.109000

The duration of the ink printing system output to the operating mode during the printing of imprints with $k_z = 1.0$, provided that the ink splitting factor $\alpha = 0.5$ is 110 working cycles (Fig. 3b). When increasing α to 0.6, the duration of the ink printing system output to steady mode is reduced to 40 cycles. In the case when $\alpha = 0.4$, the duration of the ink printing system output into the operating mode increases to 195 cycles. A similar effect on the transient time of the ink printing system is observed in the printing of imprints with $k_z = 0.1$ (Fig. 3a). So the duration of the ink printing system output on the steady mode at $\alpha = 0.5$ is 500 cycles. With the increase of α to 0.6, the duration of the ink printing system output to the operating mode decreases to 190 cycles. And with ink splitting factor $\alpha = 0.4$, the transition time is 265 cycles. In this case, both increasing and decreasing the ink splitting factor α significantly reduces the duration of the ink printing system output to the operating mode.

Conclusions. The article proposes a method to research the effect of the ink splitting factors at the contact places of the rollers and cylinders on the process of ink transporting from the ink fountain roller to the imprints to obtain information for improving the accuracy of the offset printing machines adjustment. It was developed a mathematical model of the serial-parallel structure ink printing system, which describes the process of ink splitting and transfer taking into account the circular motion of rollers and axial movement of the oscillation cylinder. The mathematical model reflects the discrete mode operation of the ink fountain device and makes it possible to change the value of the total and zonal ink supply. Based on the mathematical model, a simulator of an ink printing system was developed, which simulates the functioning of the ink printing system concerning the mode operation of all its elements.

As a result of the model experiments and analysis of the obtained data, it was established a significant influence of the ink splitting factor value at the contact places of the rollers and cylinders on the ink thickness that transmitted by the ink printing system to the paper or other material. It is revealed that this influence at the replication of imprints with different form filling coefficients by the printing elements has an S-shaped dependence. The high sensitivity of the offset ink printing system to the change in the ink splitting factor α_i was found, which increased with the decrease of the image elements density on the surface of the imprints. The effect of the coefficients α_i on the duration of the ink printing system transient process in the imprints replication with different densities of image elements is investigated. It is established that the increase of the ink splitting factors at the contact places of the rollers and cylinders when printing imprints with the maximum density of the image elements leads to a decrease in the duration of the ink printing system output to the operating mode. And the reduction of the coefficients α_i greatly increases the time of the transient process. It is found that when replicating imprints with a lower density of filling by printing elements, both increasing and decreasing the ink splitting factors α_i only leads to a decrease in the duration of ink printing system output to the steady mode.

Therefore, further research is needed to identify and mathematically describe the factors of influence on the ink splitting factors value at the contact places of the ink printing system elements, on correction and stabilization of these factors value, which should improve the accuracy of pre-adjustment of the ink printing systems, and, consequently, the quality of printing products.

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МОДЕЛЮВАННЯ ТА ДОСЛІДЖЕННЯ ВПЛИВУ КОЕФІЦІЄНТІВ РОЗЩЕПЛЕННЯ ФАРБИ НА РОБОТУ ФАРБОДРУКАРСЬКОЇ СИСТЕМИ ОФСЕТНОГО ДРУКУ

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Метою роботи є моделювання і дослідження впливу параметрів розщеплення фарби у зонах контакту валиків і циліндрів на процес передачі фарби у фарбодрукарській системі офсетної машини та отримання інформації для підвищення точності її налагодження. Розроблено математичну модель фарбодрукарської системи офсетного друку, яка описує режими роботи всіх її компонентів. Побудовано симулятор фарбодрукарської системи послідовно-паралельної структури, який відтворює технологічний процес тиражування фарбовідбитків. Проведено імітаційне моделювання та дослідження впливу коефіцієнтів розщеплення фарби в місцях контакту валиків і циліндрів на процес її передачі на папір при різних величинах коефіцієнтів заповнення форми друкувальними елементами. В процесі виконання роботи було проведено дослідження впливу коефіцієнтів розщеплення фарби на час перехідного процесу фарбодрукарської системи послідовно-паралельної структури для різних коефіцієнтів заповнення форми. В результаті серії модельних експериментів встановлено суттєвий вплив величини коефіцієнтів розщеплення фарби в місцях контакту валиків і циліндрів на товщину фарби на виході фарбодрукарської системи. Виявлено, що цей вплив при тиражуванні відбитків з різною щільністю елементів зображення має S-подібну залежність. Встановлено високу чутливість фарбодрукарської системи офсетного друку до зміни коефіцієнтів розщеплення фарби, яка зростає із зменшенням щільності *елементів зображення на поверхні відбитків. Виявлено суттєву відмінність у впливі коефіцієнтів розщеплення фарби в місцях контакту валиків і циліндрів на динаміку фарбодрукарської системи при тиражуванні відбитків з різною щільністю заповнення їх елементами зображення.*

Ключові слова: *математична модель, фарбодрукарська система, офсетна машина, друкарська форма, коефіцієнт розщеплення фарби, фарбоживильний пристрій, розтиральний циліндр, сигнальний граф, симулятор.*

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