Comparative Evaluation of Ink Transfer

Scheuter, Karl R.; Rech, H.

(1967)

DOI (TUprints): https://doi.org/10.25534/tuprints-00014147

Publication type: Conference or Workshop Item

Division: 16 Department of Mechanical Engineering

16 Department of Mechanical Engineering

Original source: https://tuprints.ulb.tu-darmstadt.de/14147

9th International Conference of Printing Research Institutes

Rome 1967

Comparative Evaluation of Ink Transfer

K. R. Scheuter · H. Rech

Institut für Druckmaschinen und Druckverfahren

der Technischen Hochschule Darmstadt

Institutsdirektor: o. Prof. Dipl.-Ing. Karl R. Scheuter

Mai 1967 67/2

Comparative Evaluation of Ink Transfer

List of Contents

Comparative Evaluations of Ink Transfer

1. Model Printing Machine

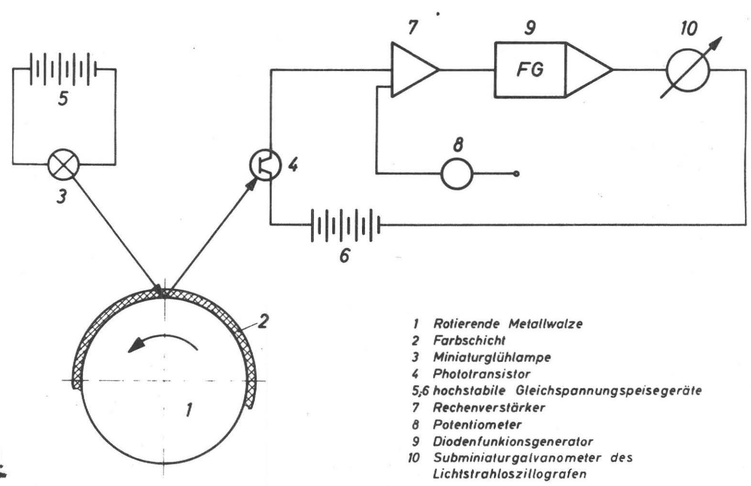
   A model printing machine with special measuring instrumentation was designed and built for the purpose of studying ink flow measurements in roller type inking units.

   The model machine is a small rotary press designed to operate either as letterpress or letterset unit. The inking unit was conceived to make possible several unit combinations.

2. Measuring Procedure

   Based on qualifying optical intensity measurements with reflective light were given preference for the determination of ink layer thickness. A schematic drawing showing this photoelectric measurement of ink layer thickness is shown in picture No.1.

Schema für die photoelektron. Farbschichtdickenmessung



Ill. 1

The rotating metal roller (1) carries ink layer (2). A miniature light bulb emits an non-monochromatic and unpolarized light which is loosing intensity in the ink layer and thence is reflected to the phototransistor (4). Both phototransistor and miniature light bulb are energized from a highly stable regulated power source for directive current.

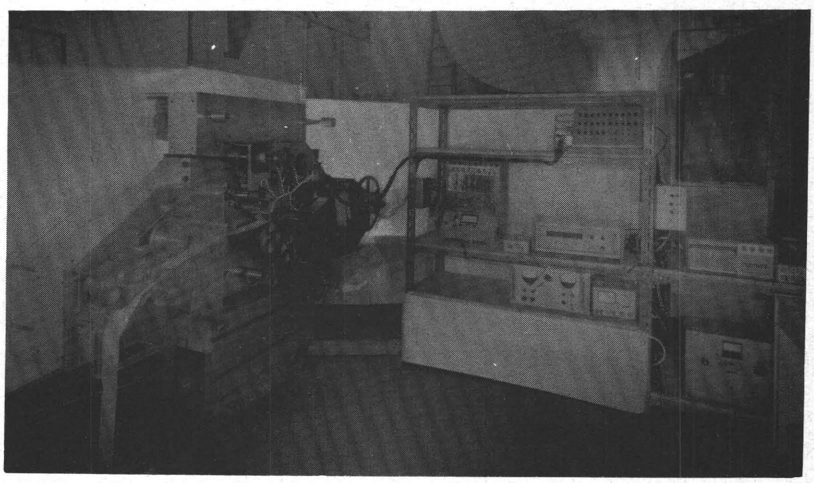
There is no linear relationship between ink layer thickness and photovoltage. These values would be difficult to visualize and evaluate if recorded only on the registration apparatus. The non-linear measuring signal provided by the phototransistor is amplified non-linearly in an electronic analogue computer with the assistance of a pre-programmed diode function generator in order to create linear correlation between electrical recording and ink layer thickness.

3. Calibration of the photo-electronical Measuring Unit (Reader-Converter)

It is difficult to find theoretical relationships for the loss of intensity as light penetrates ink layer, because no monochromatic and non-polarized light is being emitted. Furthermore ,complex relationships do exist also for monochromatic and polarized angular light. For these reasons, calibration is accomplished empirically by weighing. A special calibration roller with removable ring can be used for calibration or also a defined ink quantity which is applied to a roller system about to be calibrated and on which it is distributed thoroughly. The calibration curve obtained empirically in this way is mirrowed unto a basis and programmed into the diode function generator as amplifier reference line. Calibration and subsequent measurements are obtained under identical machine conditions.

4. Test Stand

A common instrumentation panel houses the photoelectronic measuring units (reader converters). This instrumentation panel can be displaced alongside the inking rollers and completely removed for cleaning of inking unit.



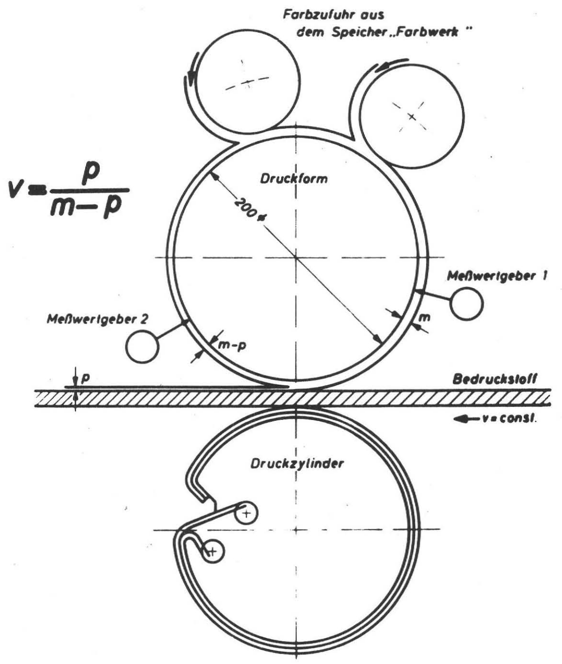
Ill. 2

Picture 2 shows the complete test stand. The machine forms an integrated unit together with the photoelectronic measuring devices (reader-converters) and the instrumentation needed to process and register values measured. With this test arrangement it is possible to determine the ink flow in the inking unit. Through ink exhaustion tests it is also possible to obtain relationships governing ink transfer from printing material.

5. Test Results

A change in ink supply m to printing form is known to cause a change in the ink transfer factor v.

For this type of measurement a set of two reader-converter units (one immediately before and one immediately after the printing zone) is necessary. See picture 3.



Ill. 3

Versuchsschema zur Ermittlung der Farbübertragungskurven

Prior to printing the reader unit No. 1 determines the thickness of ink layer m. The ink layer defined as m-p is read immediately behind the printing pressure line or nip.

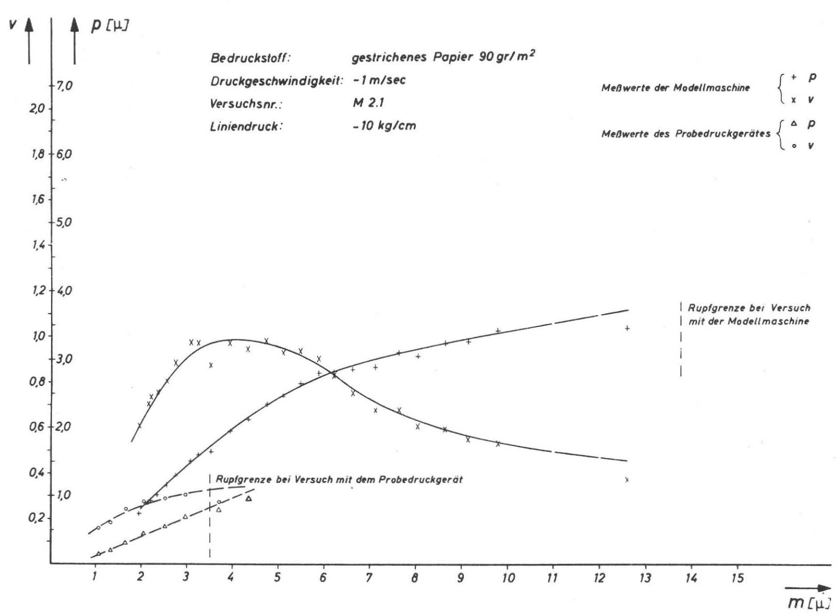
This ink transfer involves:
A freely chosen ink quantity supplied to the inking unit. This quantity is thouroghly distributed over the inking rollers yet

without engaging the printing roller which is engaged only after the start of the measuring process. The printing material draws ink from the reserve in the inking unit thus gradually causing a reduction in ink supply m.

Thickness of ink layer data m and m-p are recorded by means of a visicorder oscillograph.

In this case the ink transfer curve is computed in the dynamic state and should reflect operational conditions in a printing press at an optimum. Tests were conducted with an offset proofing ink of 25% pigment content.

The following diagrams show ink transfer curves for select range of printing materials. Comparability curves were run on the Fogra test printer. The limit of pick resistance being reached on the printing test apparatus at a considerably lower ink supply, only a fragmentary ink transfer curve could be established with this apparatus.

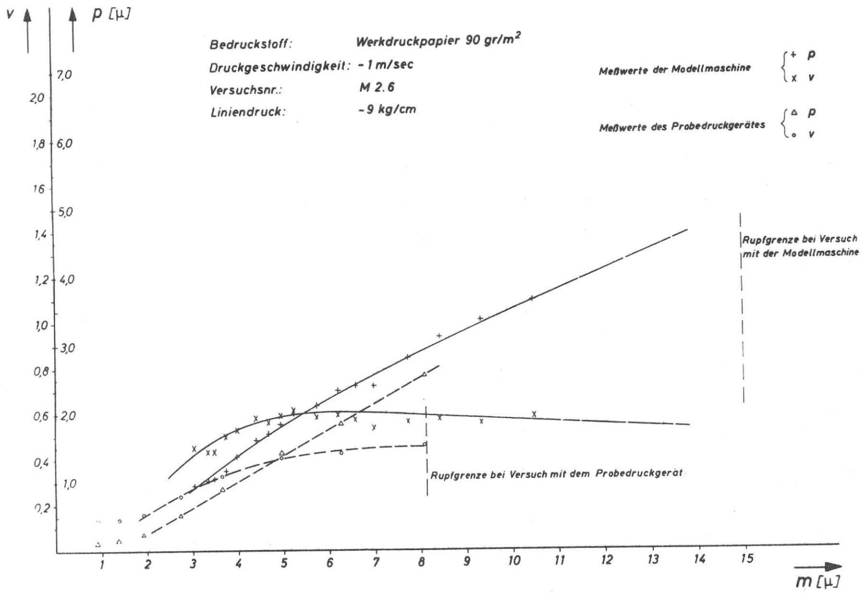


Ill. 4

Picture 4 shows ink transfer curves for machine coated paper (90 g/m^2). The limit of pick resistance in the model machine was reached at 13,7 μ for an ink supply m and at 3,5μ on the test printing apparatus. Both tests were conducted at a room climate of 20 (± 0,5)°C and a relative humidity of 60 (± 5)%. The large deviations in these curves as well as in all subsequent ones can be explained as follows:

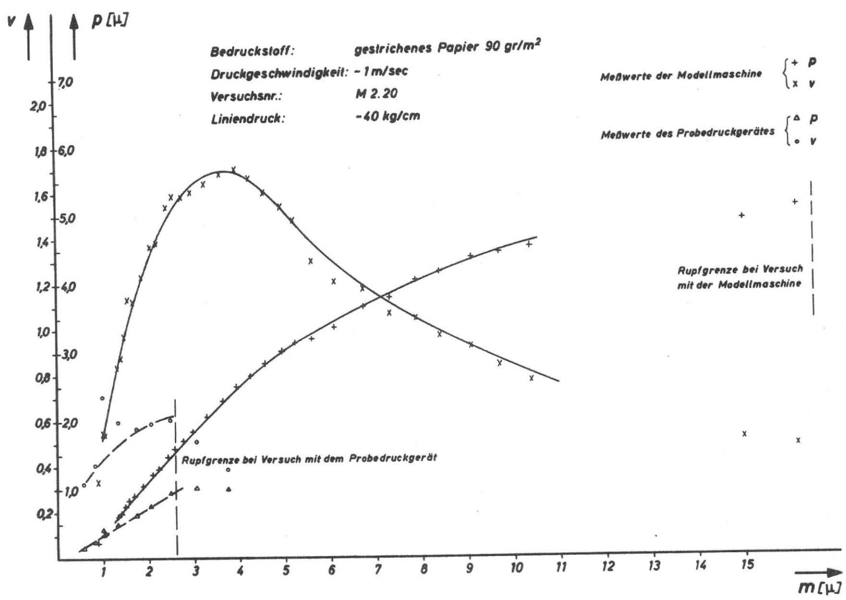
On the model machine, a warm-up period of about 2,5 hours was allowed for arriving at a temperature equilibrium in the inking unit prior to ink transfer tests. The temperature distribuations can be described in form of a saturation function. Empirically it was found that no major temperature fluctuations occured after 2,5 hours, Roller surface temperatures and consequently ink temperatures were higher than surrounding air temperatures. The rheological conditions of ink would therefore appear to differ essentially. Moreover, as the ink transfer test proceeds, the ink layer remaining on the rollers is being split repeatedly so that we can assume a break-down in the trixotropous structure of ink. With the printing test apparatus the ink distribution process is affected on a seperate unit which will show only a minimum temperature increase relative to surrounding room temperature. In this ink distribution unit the trixotropous structure of ink has been broken down but is at least partially being rebuilt at the time of weighing the printed form. The printing process proper shows different rheological conditions from those of the inking process. The printing process in its first phase is non-stationary in a printing test apparatus. By means of the weighing process integration automatically occurs over the entire area of the printing form.

Let it be noted also that ink splitting behavior and consequently splitting acceleration on the two test instruments differ.



Ill. 5

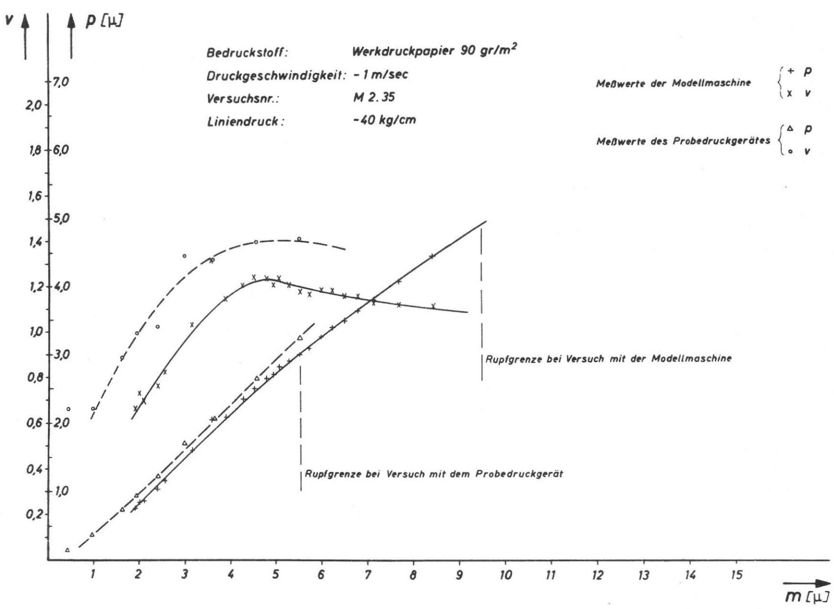
Picture 5 illustrates ink distribution curves for a low grade paper (90 g/m²). These curves too show extraordenary differences in the limit of pick resistance. Line pressure (nip) was 10kp/cm. Machine speed was 1 m/sec.



Ill. 6

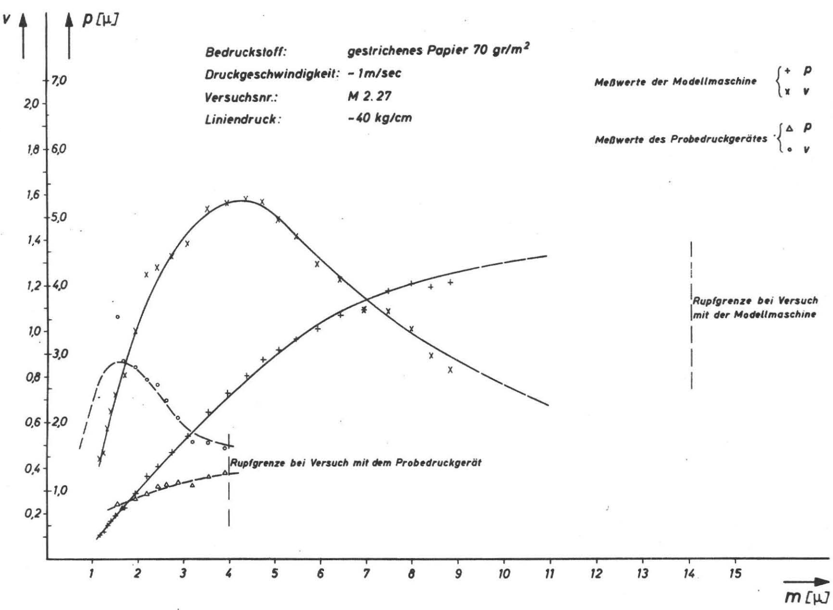
This test shows the same great differences in pick resistance limits. A line pressure of 40 kp/cm was used. Compared to values in picture 4 an increase in v-values can be observed for both instruments.

In analogy to picture 6 a similiar trend may be observed for picture 7.

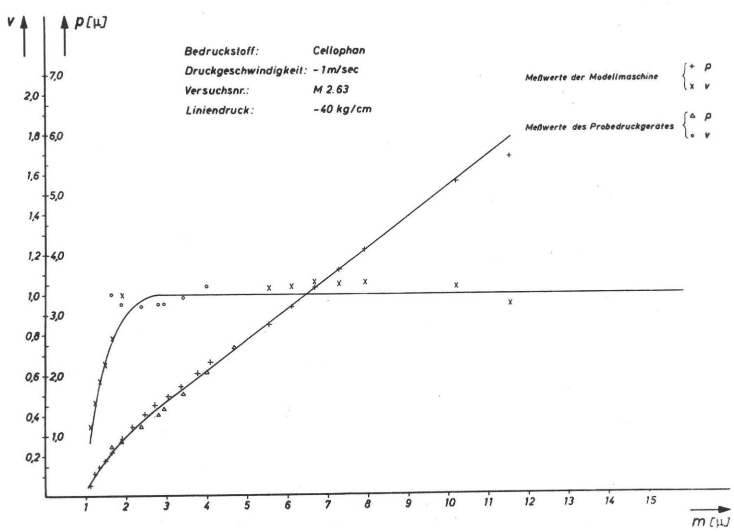


Ill. 7

The same trend may be observed in picture 8.



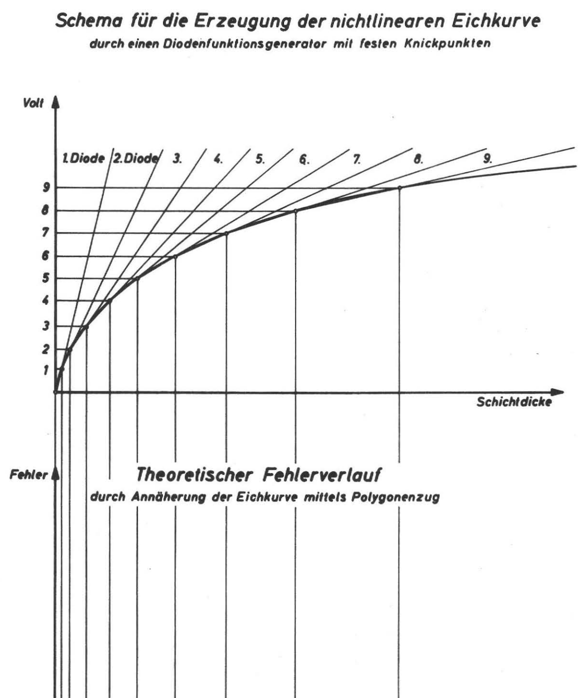
Ill. 8



Ill. 9

Picture 9 represents an ink transfer curve for cellophane. p-values obtained show good correlation in both tests. Small deviations in p-values result in large deviations of v-values, however, considering this fact, ink layer thickness p and ink distribution factor v are shown above ink supply m.

In establishing ink transfer curves with the test printing apparatus, accuracy increases with net weight, because of weighing process, or with m respectively m-p. For very thin layers accuracy decreases accordingly. Initial or starter effects in the printing process may create the illusion of very high v-values. The photoelectric measuring process (on the other hand) works accurately with no or with medium ink layer thickness because errors caused by linearization through a diode function generator remain still small. With increased thicknesses of ink layer these errors increase also. Picture 10 illustrates this.



Ill. 10

Thermally generated collector current of phototransistor behaves similarly to that generated by photons. This explains dependence on temperature of photoelectronic measuring devices. This interference factor was kept small by an appropriate warming-up run of the model machine prior to calibration and measuring activity.

6. Summary

A model machine and corresponding special instrumentation for measuring of data pertaining to the study of ink flow determination in roller type inking units was designed and built.

Optical intensity measurements by reflective light were used for determining the thickness of ink layers.

By adapting and utilizing modern electronic components it was possible to develop a reader-converter type measuring unit of very small dimensions and with a practically intertia free response. The basically non-linear characteristic of this measuring unit could be linearized by means of an electronic analogue computer so as to receive clearer and easier to evaluate measuring results.

By means of this apparatus it is possible to conduct dynamic state tests which closely reflect operational conditions (declining ink supply). Parallel tests on the Fogra printing test apparatus showed generally strong deviations. Confirming experiences made so far in measuring ink transfer by means of printing test apparatus, the tests appear to indicate that the correlation conditions governing ink transfer are of greater complexity than originally assumed.

7. References

1 Mildner, W., "Anleitung zum praktischen Gebrauch des elektronischen Analogrechners" Rhode & Schwarz - Vertriebs - GmbH., Karlsruhe

2 Giloi, W./Lauber, R., "Analogrechnen" Springer-Verlag (1963)

3 EAI, TR 10-Computer Maintenance Manual

4 EAI, Variplotter Maintenance Manual

5 Pohl, R.W., "Einführung in die Physik" Bd.III Optik und Atomphysik, Springer-Verlag (1963)

6 Carter, H./Donker, M., "Photoelektronische Bauelemente" Philips Technische Bibliothek (1964)

7 Rupp, E./Rieche, E., "Beiträge zur Bedruckbarkeit von Papier und Folien" Institut für Graphische Technik, Leipzig (1959)

8 Rupp, E./Rieche, E., "Die Farbübertragung im Ein- und Mehrfarbenhochdruck" (1963)