Resistance to ageing of selected books of children’s literature

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Resistance to ageing was studied for a number of selected items of children’s literature. Print rub-off tests were performed for 3 bases used in printing of children’s books, namely plastic sheets, white uncoated (offset) paper, and varnished prints. Three children’s books used in the experimental works were: a “bathing book” printed by flexographic technique on plastic sheets, a book printed on uncoated white paper, and a book printed on double-sided varnish-coated cardboard. Rub-off resistance tests were performed on Ink Rub Tester under identical rub rate (85 cycles/min). The resistance was evaluated by spectrophotometric and densitometric method and by visual observations. About 6000 rub-off cycles were performed for each of the books tested.

Keywords and phrases: rub-off resistance, resistance to destruction processes, colour coordinates, partial main optical density, production of children’s books.

Introduction

Books intended for the youngest readers do not comprise usually many pages, and especially much text, but they contain, as a rule, many coloured illustrations that must be printed with proper inks. They must be environment friendly, resistant to rub-off, to humidity and fading, and must not contain toxic components. Children, and babies in particular, like to take all in their mouth, thus leaving humidity on paper and ink, they like also to tread on books and drag them on the floor. For these reasons the inks intended for printing children's books should be as safe as possible for babies, resistant to destruction conforming to their untypical intended use.

Hence, this paper presents the results of studies on resistance to ageing processes connected with print rub-off. The tests were carried out with books printed in two most widespread printing techniques: offset used mainly in printing on absorbing bases and flexography used usually in printing on non-absorbing materials.

Experimental

Resistance to ageing was studied for three children’s books produced from different materials and printed by two technologies, namely:

* a plastic sheet book printed by flexographic technique, called “bath book”,
* a book printed by offset technique on white uncoated paper, and
* a book made of two-side varnished cardboard printed by offset technique.

The rub-off tests were performed for selected fragments of illustrations included in the books, all printed in red. The tests were carried out by means of Ink Rub Tester shown in Fig. 1, conforming to the standards ASTM D5264 [1] and TAPPI T830 [2]. The device has been intended for testing i.e. the rub-off paints, printing inks, corrugated board, card boards, and other packaging materials. It may be used for performing various test, such as dry or wet rub off. The tests can be carried out with three different speeds of 42, 85 or 100 cycles/min, with the use of two pulleys weighing 2 or 4 pounds (0.91 or 1.81 kg) [3]. The number of cycles passed corresponds to the number of pulls or frictions performed with the given sample, with the use of the test pulley, on an arc of length 2.25 inch (roughly 57 mm), the sample being mounted either on the top of the test pulley or on its bottom. Maximum programmable number of test cycles in a single measurement series was 999.
The samples to be subjected to rub-off tests were prepared appropriately. They were cut to dimensions 76 × 152 mm and placed on a rubber support on the test table. The role of rubbing material was played by a sheet of white uncoated paper dimensions 51 × 152 mm mounted on the testing pulley, prepared previously on the small table attached to the measuring device. The pulley with rubbing material was mounted in the Ink Rub Tester by means of a fastener. The samples were tested in dry form with the use of a pulley weighing 4 lb ≈ 1.81 kg. The rate of rubbing was identical for all the samples (85 cycles/min).

The resistance of prints to rub-off was evaluated by spectrophotometric and densitometric measurements in a Spectrolino GetagMacbeth device and visually following every assigned number of rub cycles. The quantities measured were: colour coordinates (L*, a*, b*), colour saturation (C*ab), angular measure of shade (h°ab), and partial main optical densities of process inks influencing significantly the colour of the fields tested, namely magenta and yellow inks (D_m and D_y).

The following measuring conditions were applied:
- absolut,
- illuminant D50,
- 2° colorimetric observer,

![Fig. 1. Ink Rub Tester [3].](image)

![Fig. 2. Changes of CIELAB coordinates: a) L* — colour lightness, b) chromatic coordinate a*, c) chromatic coordinate b* of the prints tested due to rub-off process.](image)

![Fig. 3. Changes in: a) saturation — C*ab and b) shade of colour — h°ab of the prints tested due to rub-off process.](image)
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Results and discussion

Figures 2-4 present the changes in colour coordinates \((L^*, a^*, b^*)\), colour saturation \((C_{ab}^*)\) and colour shade \((h^*_{ab})\) for the three bases tested. Figure I was used for denoting the initial state (prior to the ageing tests — number of ageing test = 0), and figure II denotes the final state (after roughly 6 000 rub-off cycles). Book 1 was the book made of plastic sheets, book 2 was made of uncoated paper, and book 3 was made of varnish-coated cardboard.

The diagrams presented above enable to state that the children’s publications subjected to the tests were resistant to print rub-off. The lowest resistance was observed in the case of book printed on uncoated white paper, in which the print was by no means protected against destruction processes. In this case some changes were observed in chromatic coordinate \(b^*\) of CIELAB colour space and in colour shade \((h^*_{ab})\).

Conclusions

The books intended for children should be characterized by as high as possible protection of print. Use of plastics as printing base guarantees a high resistance to ageing processes and resistance to humidity, which is of particular importance in the case of babies. Improving processes such as e.g. varnishing of print improve markedly the stability of illustrations. Plastic materials such as plastic or rubber films are nowadays often applied in production of children’s books. Such means improve the attractiveness of the product and have a favourable effect on its stability. The publications intended for the youngest readers, if printed on uncoated paper, are not sufficiently resistant to destruction processes. They are, however, much cheaper and thus often encountered. In spite of all, some publishers care of the quality and the stability of such products, taking into accounts the way of their using, which affects, however, their price.

References

