

Original article

Non-destructive methods for chemical, optical, colorimetric and typographic characterisation of a reprint

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Abstract

The quality of production (e.g. paper, typesetting, reproduction of illustrations, printing and bookbinding) of a book (reprint) is very important. The quality of a 1978 reprint of a book from 1921 was studied using standard and non-destructive testing methods such as microscopic and spectroscopic techniques. Chemical, physical and colorimetric properties of the papers, colour differences of the prints and typographic tonal density were analysed. Results showed that the reprint is not an identical copy of the original. Some of the differences in the reprint compared with the original (e.g. typographic tonal density) could easily have been avoided while others (e.g. structural and optical properties of paper, colour prints) are unavoidable, mainly because of the influence of internal and external factors on ageing. Ageing influences the properties of paper and colour print: optical and colour properties deteriorate and colour fades. It is concluded that precise and systematic evaluation of the properties of an old book should be carried out before a reprint is prepared. The results of the research, using non-destructive methods such as microscopy, spectroscopy and image analysis, are useful for characterising the properties of paper and printing ink, typography and reproduction of illustrations.

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1. Introduction

The quality of production of a book is very important, the main parameters being the quality of the paper and printing inks, printing technique, typesetting, reproduction of illustrations, and bookbinding. In order to achieve excellent reproduction and proper print quality in a reprinted book or facsimile, it is important to have complete knowledge of paper characteristics and printing ink properties, and proper typesetting.

Recently, non-destructive methods for the characterisation of archival or museum documents have also been used, especially microscopic and spectroscopic techniques and image analysis [1–5].

For over 500 years, letterpress was the dominant technology for book printing. When phototypesetting and lithographic printing became widespread in the 1970s, the printed book turned into a low-cost mass medium. Efficient production and the availability of inexpensive paper were the reasons for the breakthrough of books as mass media. In letterpress, the printing elements (type, lines, dots) are raised. When the printing plate is inked, the ink adheres to the raised (printing) parts and is transferred (under pressure) onto the printing substrate. The ink transfer

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mechanism and the drying of the ink on the substrate principally determine the structure and components of a printing ink. In letterpress printing, viscous inks composed of organic and inorganic pigments and binders (vehicles) are used [6,7]. In lithography, the printing and non-printing elements are on the same planographic level, but have different chemical and physical surface properties. In offset, the printing elements are oleophilic, whereas the non-printing elements are oleophobic. During printing, the non-printing elements are usually made oleophilic (ink repellent) by wetting, so that the ink is taken up only from the printing areas. In offset printing, pasty inks consisting of organic and inorganic pigments and binders are used [6,7].

A reprint is a second or subsequent printing of a book, with no changes other than minor corrections [8]. In preparing a reprint, when the original is not complete (e.g. a page is missing or damaged), we have to examine as many copies as possible of the original to be sure how the original really looked. After the Second World War, many reprints were made because of the number of libraries destroyed during the war. A facsimile is a reprint of an out-of-print book that is an identical reproduction of the original [8]. For example, if a page is missing in the original, it must be the same in the facsimile.

Under the influence of internal factors (paper composition and technology, printing inks and adhesives) and external factors (light, heat and humidity), the appearance of colour print can change and fade [9–13]. Thus, a good reprint is hard to make after 50 or 100 years, especially if the original was not of good quality.

2. Experimental

The study compared an original edition of a collection of poems, first published in 1921 (Book 1) and the reprint of that book from 1978 (Book 2). The sale of Book 1 was prohibited because of bad production quality. In 1978, the same collection of poems was published. The publishing house wanted to publish a book identical (though without mistakes) to that published, but not sold, in 1921. These books were chosen for the study because they are illustrative of the difficulty of producing a well executed reprint from a low-quality original.

Visual assessment of both books revealed major differences between them. The original (Book 1) was printed using the letterpress technique, and the reprint (Book 2) used offset printing [7]. Of course, this is not the reason that different green colour of inks and papers were used (Fig. 1). The aim of the research was to define standard and unconventional non-destructive methods for characterisation of paper and print properties of an original book in order to produce the best quality reprint.

2.1. Materials and methods

The differences between the original and reprint were studied by analysis of chemical, physical and colorimetric

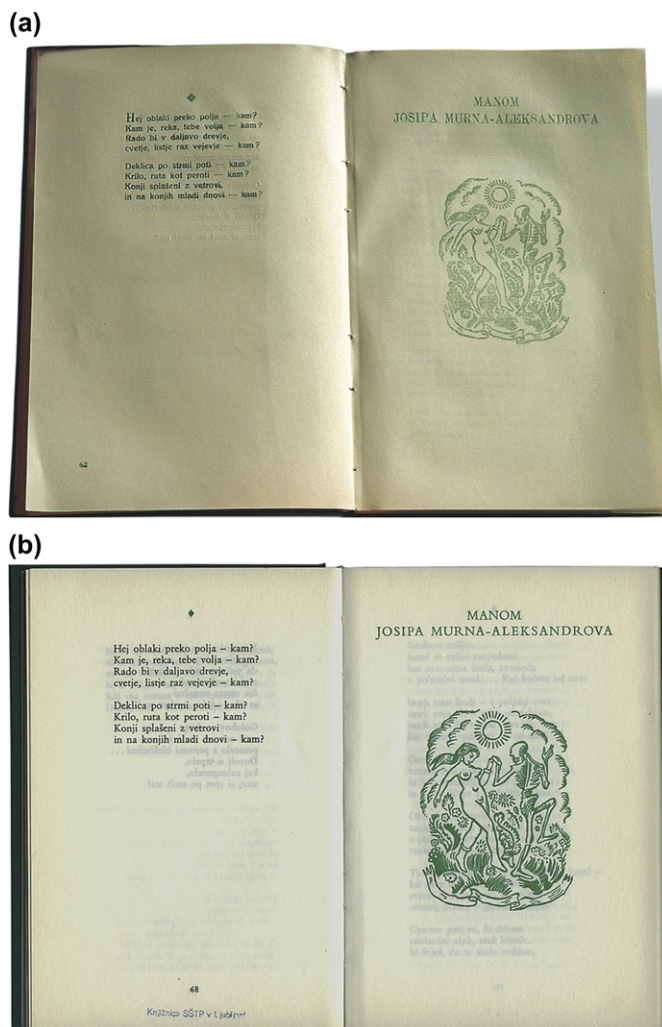


Fig. 1. Visual assessment of (a) the original (Book 1) and (b) the reprint (Book 2).

properties of the paper and print, along with typographic properties, using standard methods as well as unconventional microscopic and spectroscopic techniques.

2.1.1. Paper properties

The analysis of the basic physical and chemical paper properties of the original (Book 1) and the reprint (Book 2) comprised: grammage, thickness, specific volume, surface pH, qualitative identification of lignin in cellulose fibres and starch in the paper, FTIR–ATR spectroscopy, brightness, opacity and colour properties.

Grammage is defined as the weight (in grams) of a square metre of paper, measured according to the ISO 536 [14] standard.

Paper thickness is expressed in micrometres, measured according to the ISO 534 [15] standard.

Specific volume or density is expressed in gram per cubic centimetre and defined as the ratio of the weight of one square metre of paper to the thickness of the paper. Specific volume is the reciprocal of the apparent density: the volume of one gram

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