

## Acidic books in libraries. How to count them?

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### Summary

*The acidity of over 11 thousand books from the years 1938–2001 was tested with a pH-pen at the Jagiellonian Library, Cracow, Poland. A characteristic curve was obtained, with a breakthrough in paper acidity in the years 1994–1996. The total amount of acidic books in the studied library has stabilised at 1.5 million volumes, which makes up 83% of the whole collection. A parallel survey carried out at two smaller libraries in Cracow showed a very similar pattern of change in the acidity of books. On the basis of these findings, the authors postulate that a statistically significant analysis of the acidity of paper in a library holding the status of a national library (and thus having every title printed in a given country) could be used for the estimation of the number of acidic books in any other library in the country.*

Paper has been the main information carrier for 2000 years. Unfortunately, for almost 150 years it has been produced by methods which have not allowed it to last. New paper-making technology introduced in 1850 involved formation of paper in an acidic environment. Cellulose in paper produced with this technique is prone to acidic degradation. The mechanical properties of paper deteriorate to the point in which pages of books or documents become brittle and therefore cease to exist. Libraries and archives find themselves in a situation where they are unable to carry out their role in preserving human heritage in its original format. Various methods of mass-scale paper deacidification are available on the market nowadays. Poland is faced with the problem of organising the deacidification of its endangered collections. To calculate the scale (and cost) of such an operation, an estimate is needed of how many books in Poland are acidic and should be deacidified.

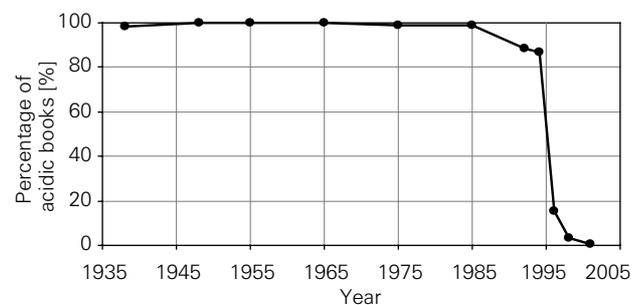
The survey was carried out at the Jagiellonian Library in Cracow, which is the main library of the Jagiellonian University. With its collection of about 4.7 million objects, it is the biggest library in southern Poland. The Jagiellonian Library collects at least two copies of every printed book, magazine or newspaper in Poland. The core of the book collection, located at the main building (apart from 47 branch libraries at the university departments), consists of nearly 2 million volumes.

The acidity of books was tested with a pen filled with a water solution of chlorophenol red<sup>1</sup>. This indicator

changes colour, from yellow for pH under 6.5 to lavender for pH values over 7, and thus is well-suited to differentiate acidic paper from that which is neutral or alkaline (MCCRADY, 1995).

Since no statistics have been published recently on the acidity of paper produced by Polish manufacturers, the first question was whether new books coming to the Jagiellonian Library, or any other library in Poland, were acid-free. A sample of 2500 titles was tested from a total of 54 thousand new acquisitions for the year 2001, only 18 of which were printed on acidic paper. This result shows that even without regulations forcing paper mills in Poland to produce acid-free paper, the era of poor quality, unstable paper in Poland has ended. The acidity test was continued with samples of 1000 titles from selected years, going back to 1955. For the years 1948 and 1938, the number of tested titles was smaller (300 and 374, respectively). Volumes were chosen randomly, but only one copy of a given title was taken for testing. Obtained results are presented in Figure 1.

The percentage of books printed on acidic paper is nearly 100% for the years from 1938 to 1985, drops dramatically in the mid-nineties to 3.5% in the year



**Figure 1.** The percentage of acidic books at the Jagiellonian Library.

<sup>1</sup> pH-pens used in this study were produced at the Faculty of Chemistry, Jagiellonian University, in a large number and were distributed free of charge among librarians, archivists and others interested in acidic-paper problems in Poland. At the same time a web page devoted to this topic was launched at the Jagiellonian Library web site and its address was printed on the pH-pen grip, so anyone interested could easily find not only instructions on how to use the pen, but also complete information regarding the problem of paper acidity, ranging from the history of papermaking to methods of paper mass deacidification. Since the pH-pens are not in common use in Poland, this home-made product was warmly welcomed by the community of conservators and has helped to promote the problem of deteriorating collections of libraries and archives.

1998, and finally to only 0.7% in 2001. These findings correspond with changes in the Polish paper industry. In the years 1995 and 1996, major paper mills were privatised, and shifted to modern, more economical acid-free technology.

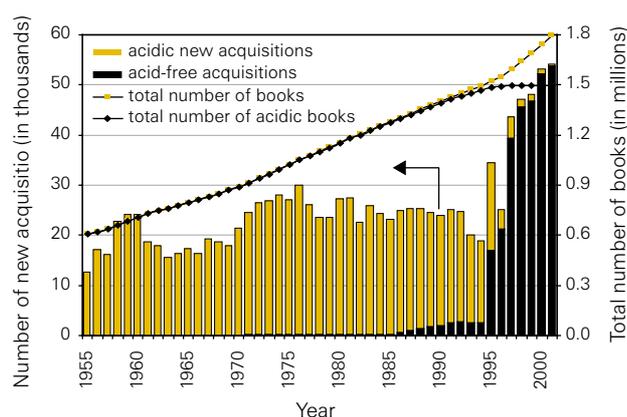
By applying a linear interpolation, missing percentage values were calculated for the years for which acidity was not tested. This interpolation is expected to give accurate results, since where the time span between the test years was large (10 years), the measured percentage was nearly constant, and for the period of rapid changes in acidity the pH of books was tested every second year. In this way, the amount of work necessary for the evaluation of the whole collection was reduced considerably.

Knowing the number of books which came to the Jagiellonian Library from its records, and the percentage of acidic books in this set (measured or estimated as explained above), it is possible to calculate the number of acidic books for a given year, and by summing up these values, for the whole collection. Bars in Figure 2 represent the number of new acquisitions for a given year, the black part of a bar corresponding to the percentage of books whose paper is not acidic. Both lines drawn in Figure 2 show cumulative numbers – the total number of books in the Jagiellonian Library grew steadily to 1.8 million in the year 2001 (dark squares), but the number of acidic books stabilised in 1996 to the value of 1.5 million volumes (white squares).

The conclusion drawn from this evaluation is partly optimistic – although the large part of the library holdings is acidic (about 83% of books from the main collection), the number of books endangered by the acid catalysed degradation has stopped growing.

As was said, the Jagiellonian Library has the status of a national library and collects at least two copies of every material printed in Poland (in the case of books, this rule is strictly followed). Thus, the book collection of any other library in Poland could be considered a sub-set (smaller or equal in the number of owned titles) of the holdings of the Jagiellonian Library. If this assumption holds true, the characteristic curve of paper acidity presented in Figure 1 should apply to all other Polish libraries. This postulated universal nature (universal, of course, on a national scale<sup>2</sup>) of the obtained curve was tested in other Cracow libraries. Two libraries were chosen – a small departmental library at the Faculty of Chemistry of the Jagiellonian University (Chem. Lib. – 30 000 volumes) and the main library in the University of Mining and Metalurgy

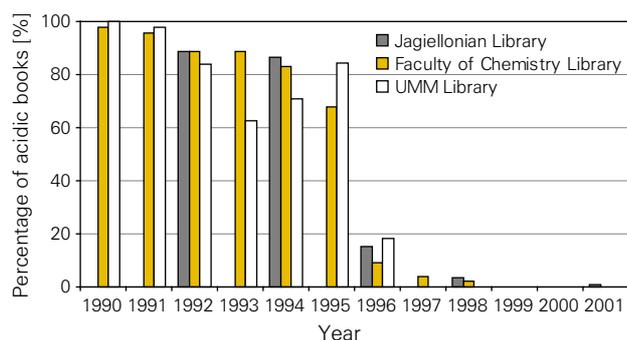
<sup>2</sup> In other countries the situation is different. For example, in Switzerland a similar change in paper acidity was observed during the years 1985–90 (BLÜHER 2002). In the USA 91% of about 5000 books tested at the Penn State Library (KELLERMANN 1999) and printed between 1990–1992 were acid-free.



**Figure 2.** The number of books at the Jagiellonian Library for years 1955–2001.

(UMM Lib. – 400 000 volumes). In this study, the acidity of books was checked for every year from 1990 to 2001, which was a period of rapid change according to the results obtained for the Jagiellonian Library. The number of tested titles of Polish origin was 553 for the Chem. Library, and 508 for UMM Library. The results from all the libraries in question are summarized in Table 1 and Figure 3.

The general trend for all the libraries was the same, from nearly 100% acidic books at the beginning of the last decade of the twentieth century, to zero, or almost zero by the year 2001. One could attribute the observed discrepancies in the measured values to differences in the fractions of acidic books between the libraries studied. In such a case, our assumption that all libraries in Poland should follow the pattern of the Jagiellonian Library would fail. But because standard errors for fractions estimated with small samples are high<sup>3</sup>, our hypothesis cannot be rejected on this ground.



**Figure 3.** The percentage of acidic books at three libraries of Cracow.

<sup>3</sup> For example, for the year 1994 the percentage of acidic books at the Jagiellonian Library is  $86.6\% \pm 2.2\%$ , at the UMM Library  $83.0\% \pm 15.9\%$  and at the Chem. Library  $70.8\% \pm 20.0\%$ . The standard of error was calculated at a level of 0.05 significance, according to the equation:  $SE = 1.96 \times [p \times (1-p)/n]^{1/2}$ , where  $p$  denotes the fraction of acidic books, and  $n$  size of the sample (KENDALL, 1966)

**Table 1. Results of acidity measurements for the years 1990–2001 from three Cracow libraries: the Jagiellonian Library (Jag. Lib.), the Library of the Faculty of Chemistry of the Jagiellonian University (Chem. Lib.) and the Main Library of the University of Mining and Metallurgy (UMM).**

	Number of tested books			Percentage of acidic books [%]		
	Jag. Lib.	Chem. Lib.	UMM	Jag. Lib.	Chem. Lib.	UMM
1990	–	46	49	–	97,8	100,0
1991	–	45	50	–	95,6	98,0
1992	1000	44	50	88,7	88,6	84,0
1993	–	44	48	–	88,6	62,5
1994	1000	47	48	86,6	83,0	70,8
1995	–	50	51	–	68,0	84,3
1996	1000	44	49	15,4	9,1	18,4
1997	–	50	55	–	4,0	0,0
1998	1000	49	20	3,5	2,0	0,0
1999	–	49	17	–	0,0	0,0
2000	–	48	22	–	0,0	0,0
2001	2500	37	49	0,73	0,0	0,0

## Conclusions

By using a very simple and inexpensive test, essential information about the condition of books at one of the main libraries in Poland was obtained. The characteristic pattern of changes in book acidity over the studied years was observed. With the use of a drawn curve, the total amount of acidic books was calculated, which adds up to 1.5 million volumes. Since 1998, this number has practically stopped growing. A parallel study carried out in two smaller libraries has proved that the obtained results can be extended to other Polish libraries, and the total number of acidic books waiting for rescue by a mass deacidification treatment can now be easily evaluated.

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