



The Kappa number

Key figure from pulp testing





EN ISO 9706 ISO 16245

KLUG's expertise

Research for preservation packaging solutions

KLUG-CONSERVATION, with over 150 years of experience, has the know-how to produce premium-quality products made from ageing-resistant paper and board, ensuring maximum permanence and durability for long-term preservation of assets in archives, museums and libraries. Close collaboration with our customers and intense cooperation with the paper industry, research institutes, universities and academies allows us to continually improve our existing products as well as develop new ones. This is essential for maintaining a consistently high quality standard, as well as keeping up-to-date with the latest developments in the conservation field. We would like to share this knowledge with you in the form of our "Technical Knowledge Folders". Should you have any further questions, please refer to our website, our printed publications or contact us personally.


Michael Kühner


Peter Lang

Lignin content and Kappa number

Oxidisable substances in paper – including lignin remaining in mechanical pulp, or residual lignin in chemical pulp – have an impact on the rate of yellowing as well as the material stability of archived goods. Determination of the Kappa number is a method used to estimate the lignin content of pulp. In simple terms: the higher the proportion of cellulose, the lower the lignin content and hence the lower the Kappa number.

Resistance to oxidation

Material used for long-term conservation must meet the technical specifications of the standards EN ISO 9706 and ISO 16245-Type A. Reference is made to "resistance to oxidation" in point 5.4 of EN ISO 9706: Paper is required to have a Kappa number below 5.0, measured as described in ISO 302, with the modifications stated in Appendix A of this international standard.

The Kappa number is a characteristic figure obtained from pulp testing. It is used to determine the residual lignin content in mechanically or chemically treated fibre pulp. Lignin content is an important parameter for technical control of pulping and subsequent bleaching processes.



It also plays a role in assessment of the stability of the degree of whiteness of fully bleached pulp in the course of natural ageing.

The determination of the Kappa number can be used to estimate residual lignin in chemical pulp and semi-chemical pulp. This involves measurement of the consumption of potassium permanganate (0.1 M KMnO_4 solution) during oxidation of pulp samples in an acidic environment (SI Analytics 2017). The resulting value can be used as an indirect measure for assessing residual lignin in a "pure pulp". (M = molar mass)
(0.1 M KMnO_4 = 15,8 g/1 L water)

Determination of Kappa number

Kappa number determination is a standardised process, which is described in ISO 302:2015. Easily oxidisable double bonds as well as aromatic, phenolic structures of lignin components still in the cellulose react under the testing conditions specified in the standard. Care should be taken in the interpretation of data since KMnO_4 can oxidise not only lignin but also resins as well as hexeneuronic acids formed from hemicelluloses during pulping.

Significant concentrations of the latter can be found in deciduous kraft pulp, which may falsely indicate an elevated residual lignin content for the pulp (Li and Gellerstedt 1997).

Kappa limit < 5

ISO 302:2015 is explicitly intended for determination of Kappa numbers of chemical pulp or semi-chemical pulp. The test procedure – as described in ISO 302 – should be used for standard-compliant tests investigating the resistance to ageing of paper materials (EN ISO 9706 1910, Appendix A). The Kappa number can then also be determined on the respective end product in accordance with ISO 302. Ageing-resistant paper materials must have a Kappa number below 5 – according to EN ISO 9706:2010, or ISO 16245:2012 – here for type A enclosing material. A whole Kappa number corresponds to a pulp lignin content of approximately 0.12% (w/w).



Significance

Determination of Kappa numbers of end products and their interpretation is not unproblematic, since the measured Kappa numbers include all oxidisable substances as well as any additives and dyes in the sample material. This means that Kappa numbers determined for paper materials cannot be considered to be a direct measure of the residual lignin content of the material, but an indicator of all the bonds in the material that are oxidised under the testing conditions. For this reason, point 5.4 of EN ISO 9706:2010 only refers to a measurement of the resistance to oxidation of the tested specimen in this regard.

Optimal protection

KLUG-CONSERVATION uses pulp made of 100% bleached cellulose with no recycling or ligneous fibre, for which Kappa numbers between 1 and 2 are determined according to ISO 302:2015.

References

EN ISO 9706:2010. Information and documentation – Paper for documents - Requirements for permanence.

ISO 16245:2012. Information and documentation – Boxes, file covers and other enclosures, made from cellulosic materials, for storage of paper and parchment documents. In: Preservation in libraries and archives, 6th edition (T. Allscher, A. Haberditzl and DIN, authors/publishers), Berlin, Beuth (2019), pp. 229-243 & 377-388.

ISO 302:2015. Pulps – Determination of Kappa number. Geneva: International Organization of Standardization.

J. Li, G. Gellerstedt (1997). Hexeneuronic acid groups in pulp xylan. Carbohydrate Research 302, pp. 213-218.

SI Analytics (2017) Die Bestimmung der Kappa-Zahl in Zellstoff. (Kappa number determination in pulp)
<https://www.youtube.com/watch?v=VNXmQTFsILU>

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