KLUG CONSERVATION

Technical Knowledge folder no. 6

Polypropylene

A material for long-term archiving?

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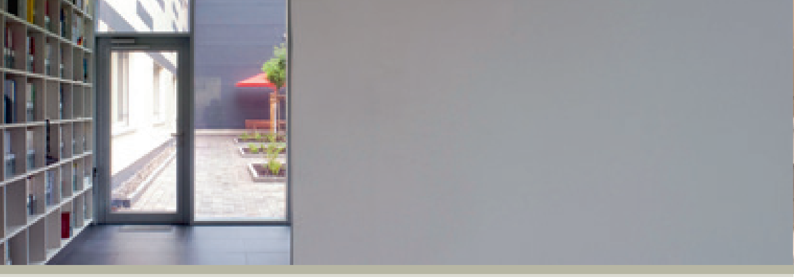
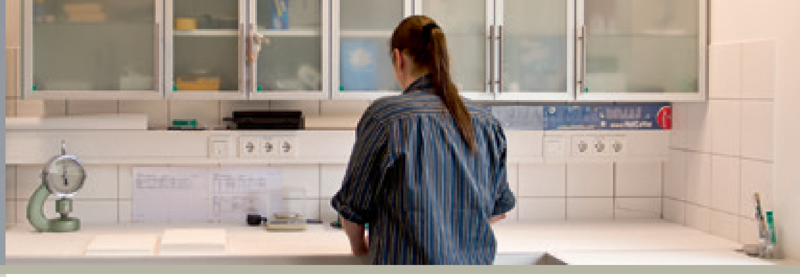
MATERIALS

KLUG's expertise

Research and development for preservation solutions

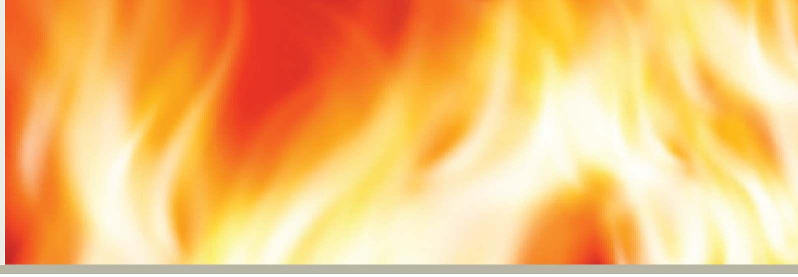
KLUG-CONSERVATION, with over 140 years of experience, has the know-how to produce premium-quality products made from ageing-resistant paper and board, ensuring maximum permanence and durability for long-term preservation of assets in archives, museums and libraries. Close collaboration with our customers and intense cooperation with the paper industry, development and 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 latest developments in the 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 (www.klug-conservation.com), our printed publications or contact us personally.

Michael Kühner　　Peter Lang

Storage containers

"Storage containers (boxes) are the most simple but effective tools to improve the preservation of library and archive collections in the long term. Boxes are truly a further development of typical protective containers that were in use until the recent past, such as chests, cabinets and drawers. When it comes to the interior and exterior packaging in use today – for example boxes or file folders – the shape and materials used are important factors for the safety and permanence of the encased objects".

In reference to this excerpt from the recommendations for packaging archives records (Verpackungen für Archivgut - Empfehlungen der ARK, 2010) we would like to address the recent discussion concerning the use of protective enclosures made of polypropylene (PP) multi-wall sheets for library and archive holdings.

Prof. Dr. Gerhard Banik

About the use of polypropylene boxes

The following summarizes an interview recently held with Prof. Dr. Gerhard Banik, who was Professor and Director of the Studiengang Konservierung und Restaurierung von Graphik, Archiv- und Bibliotheksgut at the Staatliche Akademie der Bildenden Künste in Stuttgart (from 1990 until 2008), about his opinion on the use of polypropylene boxes.

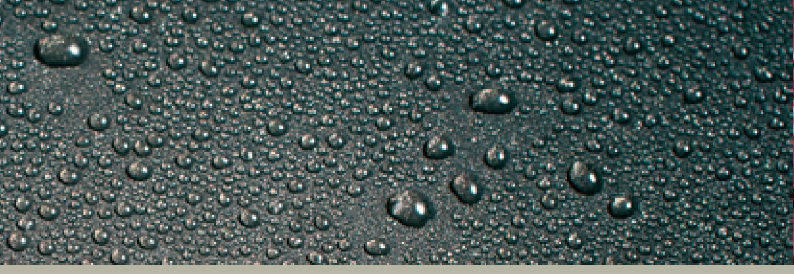
Polypropylene multi-wall sheets – a suitable enclosure material for the long-term storage of library and archives materials?

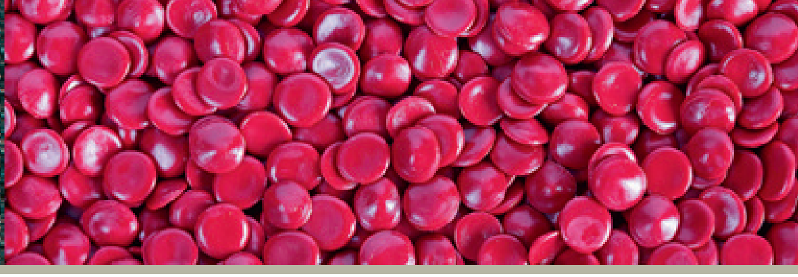
Polypropylene (PP) features a number of positive properties making its application as a base material for archival storage boxes beneficial. Among the series of polyolefin synthetics, it exhibits the best mechanical properties, excellent permanence and it does not generate harmful volatile compounds during ageing. However, PP exhibits some material properties that may limit its use as construction material for protective enclosures in libraries and archives.

Firstly, PP is hydrophobic and thus unable to establish any interaction with the moisture bound to the paper-based material it is encasing. Secondly, its strong susceptibility to build up an electrostatic charge and the resulting binding capacity of the material's surface for dust and other kinds of loose particles works as a strong disadvantage. Furthermore, storage containers made of polypropylene multi-wall sheets do not contain any alkaline fillers that according to EN ISO 9706:2010 are compulsory components of storage containers made of board. Hence, PP must not be regarded as protective enclosure for cellulose based documents against the destructive impact of acidic pollutants.

Are there standards or reccomendations pertaining to the application of polypropylene multi-wall sheets in archivies or libraries?

Currently there are no recommendations or standards listed pertaining to the use of storage containers made of PP multi-wall sheets. It has become common practice amongst vendors to make references to the standards ISO 16245 and EN ISO 9706 that specify requirements for paper permanence to give the impression that PP achieves the named requirements. It is however obviously misleading to make references to either of these standards in connection with PP as both "specify [chemical and physical] *requirements of boxes and file covers made of cellulosic materials to be used for long term storage of documents on paper and parchment" (ISO 16245:2009).*





Are storage containers made of PP-multi-wall sheets more fire-resistant in comparison to those made of corrugated or solid boards?

Some suppliers claim that boxes made of PP are more fire-resistant compared to those made of board. Such a statement is misleading, because the primary danger is posed by the softening or melting of PP as a result of the impact of heat. The melting temperature depends on the type of PP. It ranges between 127-165 °C. Within this temperature range no material strength is left. The objects stored inside the containers will be destroyed irreversibly through coating or complete penetration with the melted PP.

Is protection of PP-multi-wall sheet boxes towards penetration of liquid water superior to those made of boards?

It remains questionable to what extent the claimed liquid water impermeability of storage containers made of polypropylene multi-wall sheets may be regarded as beneficial. ISO 16245:2009 permits a water absorption capacity up to max. 25 g/m². This number derives from the assumption that in case of moderate water leaks any liquid entry at first will be imbibed by the corrugated or solid board material of the protective enclosure, so that liquid water does not penetrate into the interior. This assumption has been convincingly proved by the water leakage through the roof of the newly-built storage facility of the Albertina Museum in June 2009. Boxes made of corrugated acid free board protected their contents as the liquid entry was imbibed by the boards and no liquid water had penetrated through. However, the high RH caused by the water entry into the building enforced water vapour to migrate into the interior of the boxes; frequently resulting in an increase of up to 75 % RH (Singer 2009). With water-repellent PP storage containers, a similar outcome could be expected, only if the material were to be hermetically sealed so that no liquid water could penetrate through any crevice. Any liquid water entry through a gap would be imbibed by objects, resulting in significant water damage. In contrast to board PP is unable to absorb water vapour. One may suppose that micropores applied to the polypropylene multi-wall sheets enable »some exchange« of the air encased in the box with the external atmosphere. This does not mean that possible vapour pressure gradients due to external temperature fluctuations in the small air space encased by a PP-box are sufficiently under control. Any migration of water vapour from inside a PP-box to the outside space depends on the respective vapour pressure gradient. The equalization of humidity between the two separated spaces takes place via the slow process of diffusion of water molecules through the micropores in the PP depending on their permeability. An increase in temperature causes paper inside the box to release the water it had previously absorbed. It evaporates from an encased paper stack to the air space inside *the box where it accumulates, given the container is fairly well sealed. The relative humidity in the air space inside a PP box therefore must increase and in extreme case liquid water may condense. The four physical principles governing water and water vapour movements in small fairly well sealed spaces, such as storage containers or picture frames are complex. They have been summarized byTim Padfield et al. (2002) as follows:*

1. The RH in a small space is controlled by the absorbent material within it

The ratio of the weight of absorbent material to the weight of air within the enclosure is generally so high that it is the water content of the material that controls the water vapour concentration of the air, in contrast to in the world outside the enclosure, where the moisture content of the air controls the water content of absorbent material.

2. The RH depends mainly on the water content of the material

The RH close to absorbent material depends on the water content of the material, with little dependence on temperature. There is only a slight decrease in RH at a given water content in cellulose when the temperature drops (Urquhart and Williams 1924).

3. Water vapour concentration tends to uniformity

Water vapour tends to diffuse throughout the spaces within an enclosure to give a uniform concentration, rather than a uniform RH. A temperature gradient will therefore automatically generate a RH gradient, because the RH is the ratio of the water vapour concentration at that point to the maximum possible concentration at the temperature of that point. This maximum concentration diminishes steeply with falling temperature; so if the actual concentration is uniform, the RH must be higher in the cooler parts.

4. Water moves in absorbent material to equalize the water content

When a temperature gradient builds up, the water vapour concentration in the air spaces around absorbent material will change, even though it will tend towards uniformity throughout the enclosure. This is because absorbent material does not absorb water in proportion to the increasing RH around it. If the temperature gradient is so large that the RH becomes very high at the cold side, the material will absorb so strongly that the water vapour concentration will be reduced everywhere within the enclosure. If the RH reaches 100 % at the cold side, water will be removed by condensation and the water vapour concentration in the air space will be controlled by the temperature of this cold surface. An extreme temperature gradient will therefore cause dehydration of the picture, while dew appears on the glass or on the back plate [of a frame].

References

Bestandserhaltungsausschuss der Archivreferentenkonferenz (ARK, 2010). Verpackungen für Archivgut – Empfehlungen der ARK. http://www.landesarchiv-http://www.landesarchiv-bw.de/web/51982 (accessed 28.04.2015).

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. Geneva: International Organization for Standardization (ISO), p.1.

Martienssen, W. and Warlimont, H. (eds, 2005): Springer handbook of condensed matter and materials data. Heidelberg: Springer, p. 488.

Padfield, T., Berg, H., Dahlstrøm, N. and Rischel, A.-G. (2002): How to protect glazed pictures from climatic insult. In: ICOM-CC Preprints to the 13th Triennial Meeting (R. Vontobel, ed.), London: James & James, pp. 80-85.

Quye, A. and Williamson, C. (1999): Plastics – collecting and conserving. Edinburgh: National Museums of Scotland.

Schönbohm, D., Glück, D., Kühner, M. and Banik, G. (2010). Protective enclosures for art on paper, archives and library materials. Restaurator 31, pp. 196-125.

Singer, H. (2009): Evacuating the high bay racking system at the Albertina Museum in Vienna after a water entry in June 2009. Restaurator 31, pp. 265–285.

Urquhart, A. R. and Williams, A. M. (1924): Absorption isotherm of cotton. J. Textile Inst., pp. 559–572.

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