Filling losses in granite linoleum with Beva 371

Julia Kun

Introduction
At the beginning of the twentieth century, when a higher awareness for the need of hygienic living conditions arose, linoleum was increasingly applied to a wide variety of furniture and interior surfaces. For highly resistant furniture covers the so-called granite linoleum was often used. This is a patterned linoleum with a speckled top coating which may consist of different colour combinations (like a granite stone). Today, granite linoleum is not produced anymore. This leads to conservation challenges when filling losses in granite linoleum. Within the context of a study project and a seminar about putties, techniques were developed which utilise the thermoplastic material Beva 371 as a highly flexible putty to fill losses in granite linoleum.

One project involved the treatment of a kitchen table dated to the late 1900s which had large losses within its granite linoleum covering. The restoration aimed to the complete and visually harmonisation of the surface. This was achieved by introducing a neutral-coloured putty made of Beva 371 which was modified to show a similar texture and haptic properties to the original granite linoleum. The fills provided the desired integrity to the surface, while remaining distinguishable as such.

The second project demanded the complete visual reconstruction of losses in granite linoleum. In addition to the first approach chips of Beva 371 were coloured to match the original linoleum and thermoplastically formed into inlay films. By modifying the additives, the pigment composition, and the form and size of the Beva 371 chips, it is possible to create a convincing surrogate for granite linoleum.

After a brief overview on the historical development and usage of granite linoleum in furniture, particularly in German-speaking areas, this paper describes the two filling techniques step by step and reflects on their benefits and challenges.

Definition of linoleum
Linoleum is classified as a modified natural material. It belongs to the plastic precursors of the nineteenth century that aimed to imitate other materials using natural resources. The name is derived from Latin: linum, meaning flax, and oleum, meaning oil. Accordingly, it is a composite material in which a coarse-meshed jute fabric is laminated with a cover layer of a linoleum mass (figure 1). This mass consists of a mixture of linoxyn and resins;

Figure 1  Granule linoleum in cross-section (Tischgranulit (table granite), 1.4 mm thick, sample of Deutsche Linoleum-Werke (DLW), in a sample catalogue for furniture and wall linoleum).

Figure 2  Key dates of the history of linoleum and its precursors.
for example, the brittle resin kauri copal (for hardness and durability) and the soft resin colophony. It can achieve different decorative and functional properties by adding cork powder and/or wood powder, and pigments and dyes. A coating, usually made of wax, was used to protect the covering against mechanical load. Synthetic resins (e.g. acrylates) were later used for this purpose.

Launch as flooring

Linoleum was patented in 1863 and was the most successful material for interior fittings around the turn of the century. Low production costs and superior properties enabled a wide distribution: linoleum’s closed smooth surface is hydrophobic, hygienic, anti-bacterial, jointless, easy to clean, poorly flammable, elastic, noise-attenuating, warm to the feet, decorative, durable, inexpensive, economic, and recyclable. Thus, linoleum succeeded in replacing its precursors, such as oilcloth or the expensive rubber-based Kamptulikon (figure 2). In the beginning plain-coloured, natural-brown floorings were mostly produced.

In the last decades of the nineteenth century and in the beginning of the twentieth century linoleum often served as a surrogate to imitate splendid oriental carpets, elaborate parquetry, stone, or tiles. Later, linoleum increasingly found recognition as an independent material and became a material used for modern design ideas. New colours and forms (floral patterns, borders, ornaments) emerged, with the participation of major architects, designers and artists, such as Lucian Bernhard, Hans Christiansen, Carl Eeg, Albert Gessner, Josef Hoffmann, Albin Müller, Bruno Paul, Richard Riemerschmid, Henry van de Velde, and especially Peter Behrens.

From the 1920s onwards, plain-coloured linoleum, also known as Uni Walton after its inventor, became a popular material among architects such as Bruno Taut, Walter Gropius, and Ludwig Mies van der Rohe for colourful floors, stairs, walls and furniture.

The use of linoleum for furniture by the middle of the twentieth century

The first use of linoleum on furniture cannot be precisely determined. However, this innovation in furniture ran parallel to the development of the kitchen. Previously, oil cloth was used for highly stressed surfaces; now, almost only linoleum was applied. Knowledge about the emergence and spread of diseases gained in the last third of the nineteenth century led not only to changes in medicine but also to new demands for housing and kitchen equipment. Work surfaces had to be resilient and hygienic. Linoleum and rubber coverings, as well as glass plates and marble were frequently recommended. Advisors for households and welfare organisations emphasised the importance of hygiene, but the manufacturers of linoleum also advertised their products as hygienic furniture coverings (figures 3, 4). Leading designers took advantage of the excellent properties of the material (‘the rich shades,
the insensitivity (...), its washability, its hygienic properties and its low price (...). They participated in the improvement of housing and living situations by using new insights regarding hygiene and designing furniture with linoleum.

In the 1920s and 1930s, designers like Marcel Breuer, Erich Dieckmann, Walter Gropius, Paul Griesser, Franz Schuster, and Margarete Schütte-Lihotzky showed multiple application possibilities of linoleum in their furniture designs. By combining harmonious contrasting colours and cube shapes with smooth surfaces they created discreet modernist furniture. Generally, the furniture's surface was made of light woods or bright paints on wood, with the colours of the linoleum in dark tones. However, the strong, dark tones for paint and wood were also used with light linoleum for contrast, usually.

The use of the material prevailed until the 1950s/1960s, especially for kitchen furniture but also other furniture types. Since the 1990s, linoleum has been rediscovered as a material for furniture by some well-known designers.

Granite linoleum and the special type 'Tischgranit'

The fabrication of granite linoleum began in England in 1879, and in Germany in 1891. The material was used for floors, furniture, and walls (figures 5-10). Today, this linoleum type is no longer produced due to the complexity of its fabrication. Production was discontinued in the 1950s. Granite linoleum is a patterned covering in which the linoleum mass is dyed. The name and look are derived from natural granite stone, whose pattern is irregularly speckled. There were different colour combinations, with two to five similar or strongly contrasting shades. Granite linoleum was known for its durability, because the grained mass was minimally susceptible to soiling or abrasion. 'Tischgranit' (literally translated as 'table granite') was a special type of granite linoleum used for furniture. It was used as a durable and easy-to-clean surface covering for furniture and was often applied to kitchen tables, chairs, stools, cupboards and sideboards, desks, drawing tables, as well as counters and tables in the dining area.

In addition to granite linoleum there were also plain and patterned furniture linoleum (e.g. Uni Walton, Jaspé). However, granite linoleum was almost entirely used for kitchen furniture. Because of the low wear of the various types of furniture linoleum, it was usually produced in a relatively thin thickness of 1.7 mm; further fabrication thicknesses ranged from 1.4 to 2.2 mm.

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Figure 5  Granite linoleum; sample catalogue for flooring of 'Deutsche Linoleum-Werke' (DLW), 1926-1938.

Figure 6  Granite linoleum; colour scale DLW, 1931.

Figure 7  Granite linoleum for furniture; sample catalogue DLW, 1926-1938.

Figure 8  Granite linoleum for furniture & walls; sample catalogue DLW, after 1938.
Unlike floor coverings, table linoleum did not receive a water-repellent red primer of oil paint on the back during the fabrication. It was pasted directly on the furniture without protective coating.

**Fixing linoleum to a tabletop**

Fixing linoleum onto furniture (figures 11-16) is described as a simple procedure in historical sources. First, a completely smooth surface was created by filling joints and bumps in the wooden tabletop (the filler used is unknown). Then a paste made mostly from rye flour was evenly spread over the surface. The paste had to be very viscous, with little water, for better handling with a spatula. The rolled linoleum was unrolled starting from one side (with an excess length of ca. 1 cm on every edge) and was firmly pressed on the tabletop by hand. The surface was weighted with iron plates or similar aids until the paste had set, which was the case after six hours. Then, the linoleum was...
cut flush along the edges of the table with a knife. As the last step the table edges were covered with nailed wooden strips. The strips were levelled with the top edge of the linoleum. This method was also used to apply linoleum to sideboards and other kitchen furniture, such as trays. (figure 17). 

**Case study**

The treated object is a kitchen table from the late 1900s – and also a mass-produced product during the early twentieth century in Germany (figure 18). The tabletop’s granite linoleum shows a pattern of mint green and black speckles of different sizes evenly distributed in a petrol-coloured ground (figures 19, 20). The linoleum covering mass is filled with wood powder, which was identified in a cross section (figures 21, 22). The wood fibres are also perceptible to the naked eye.

Two major types of losses defined the linoleum’s condition: losses of the linoleum covering mass where the ground texture was exposed, and the complete absence of the linoleum (figure 23). Most losses emerged from the edges of the tabletop. A particularly large loss area was about 40 cm wide over the total tabletop width of 69 cm. The conservation proposal involved the consolidation and cleaning of the linoleum and the comple-
tion of losses by applying a neutral filling mass which fitted visually with the heterogenic granite linoleum. Retouching should be avoided.

**Fill mass with solvent-free Beva 371**

Various binders and fillers with different concentrations were tested in advance, including some already utilised within conservation science and practice. The binders were determined according to the results of Ellerman 1999, Kühn 2004, Stockhorst 2007 and Tauss 2007. Acrylates and PVACs such as Vinnapas EP 17 (or Airflex EP 17), Plextol D 498 or B 500 and Lascaux 498 H are recommended. It should be noted that the focus in these theses was on floorings: the fill masses had to show a very high elasticity and resistance to tension and pressure loads. In this case study, however, the visual appearance was a key decision criterion. For the preliminary tests, Vinnapas EP 17, Vinnapas XD 05, Plextol B 500 were utilised.

For the first time, the thermoplastic deformable material Beva 371 (ethylene vinyl acetate copolymer, cyclohexanone resin, phthalate ester of hydroabietyl alcohol, and paraffin wax) was tested. The material was chosen with regard to the good experiences with Beva 371 fillings gained so far in conservation practice. Because of its good workability with heat and solvents, and a number of further good properties (see below for benefits and challenges), Beva 371 allows a versatile application.

The pure binder is obtained by evaporating the solvents (at 50 °C, ca. 5-7 days) from the commercially available Beva 371 solution (figure 24). The solvent component (toluol, white spirit) within the solution is not desired for the putties, as it leads to a loss of mass or shrinking in the filling during drying. Moreover, during cleaning tests on the granite linoleum a white surface haze was formed on the linoleum with 100-140 °C petroleum spirit. Even if the use of aliphatic and aromatic hydrocarbons was possible with aged linoleum the limits of solvent use were shown here.
The fillers were also selected according to the results of the aforementioned authors, who recommend cork powder (medium and fine grains, Ø 1.0 mm and 0.2-0.5 mm) and scrap powder (figures 25, 26). The latter is a linoleum powder produced by the Deutsche Linoleumwerke (DLW Flooring GmbH). For more than 100 years, linoleum manufacturers have recycled their own linoleum waste generated during fabrication. The waste is sorted by colour, crushed, ground, and then reintroduced into the production process. Linoleum powder is available in different shades. In this case, a light brown powder (‘nature’) was utilised. In addition to these filler materials microballoons (phenolic resin spheres) were also tested.

With regard to mechanic workability (cutting, sanding) good results could be achieved with almost all putties, except the acrylate and PVACs in combination with microballoons. The acrylate and the PVACs in combination with linoleum powder and cork powder mostly showed poor shrinkage behaviour and adhesion. Beva 371 was stable with all fillers, as expected. The microballoons were finally excluded because a subsequent retouching would have been necessary.

The best result used a recipe consisting of Beva 371 (1.0 g), fine cork powder (Ø 0.2-0.5 mm; 0.7 g), and linoleum powder (0.3 g). The high flexibility of Beva 371 in combination with the fillers could be utilised to develop fills with very similar optical properties to the original material. The fillers had a positive effect on the appearance of the fill mass. The cork powder yielded a slightly rough surface similar to the linoleum of the kitchen table while the linoleum powder produced a lightly heterogenic appearance because of its differently-coloured particles.

### Pigment mixture

In the following step a standard formula was determined for the petrol-coloured basic tone of the linoleum. Different films made of pure Beva 371 and pigments were produced and compared to the original (figure 27). For this purpose the Beva 371 was heated to temperatures between 100 and 120 °C in a melting pot and pigments were added. Relatively small amounts of pigments can be used to colour the viscous mass. The adjusted pigment mixture was added to the brown fill mass (figure 28). As the colour of the original was not homogeneous due to ageing and use, the filling material was adjusted with further small pigment additives to visually match different losses (table 1).

### Filling technique

The self-produced Beva 371 putty films were utilised for the fills. The coloured putty was pressed into a film between a preheated PMMA sheet and a hot plate (both at ca. 100 °C). Two siliconised Hostaphan films were used as separating layers. The putty films were fixed into the losses with a heated spatula and processed further using mechanical action and with solvents.)

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**Table 1**: Empirically determined recipes of a neutral filling.

<table>
<thead>
<tr>
<th>neutral filling (for petrol coloured granite linoleum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>uncoloured fill mass:</td>
</tr>
<tr>
<td>solvent-free Beva 371 (1.0 g) :</td>
</tr>
<tr>
<td>linoleum powder (0.7 g)/cork powder (0.3 g)</td>
</tr>
<tr>
<td>1:1 parts by weight</td>
</tr>
<tr>
<td>mixing components in melting pot (ca. 100–120 °C) with a glass rod or a spatula</td>
</tr>
<tr>
<td>pigment mixture:</td>
</tr>
<tr>
<td>0.4 g chromium oxide hydrate green</td>
</tr>
<tr>
<td>0.1 g Cassel brown</td>
</tr>
<tr>
<td>0.04 g bone black</td>
</tr>
<tr>
<td>0.02 g titanium white</td>
</tr>
<tr>
<td>0.01 g Indian yellow</td>
</tr>
<tr>
<td>grinding mixture with mortar and pestle</td>
</tr>
<tr>
<td>(determining the standard formula for the pigment mixture by making films of Beva and pigments which are compared to the original)</td>
</tr>
<tr>
<td>coloured fill mass:</td>
</tr>
<tr>
<td>0.5 g uncoloured fill mass: 0.1 g pigment mixture</td>
</tr>
<tr>
<td>mixing components in melting pot</td>
</tr>
<tr>
<td>pigment additives:</td>
</tr>
<tr>
<td>little amounts of:</td>
</tr>
<tr>
<td>(for visually matching of the respective loss)</td>
</tr>
<tr>
<td>chromium oxide hydrate green</td>
</tr>
<tr>
<td>Cassel brown</td>
</tr>
<tr>
<td>bone black</td>
</tr>
<tr>
<td>titanium white</td>
</tr>
<tr>
<td>Indian yellow</td>
</tr>
<tr>
<td>adding additives to heated coloured fill mass in melting pot</td>
</tr>
</tbody>
</table>
Figure 29  Loss before treatment.

Figure 30  Fixing a small piece of film and scraping the glossy surface.

Figure 31  Brighter tone after scraping.

Figure 32  Deepening the surface with Shellsol T.

Figure 33  Colour after treatment (dried condition).

Figure 34  1. Layer unfixed in loss.

Figure 35  2. Layer fixed in loss with heating spatula at 90-100 °C.

Figure 36  1. Layer unfixed in loss.

Figure 37  2. Layer fixed in loss with heating spatula; also possible: warming the film and pressing in loss with a preheated PMMA sheet

Figure 38  Colour of filling after levelling with scalpel
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Testing the colour

Before a putty film was inserted into a loss it was examined for its colour match (figures 29-33). A small piece of film was spot-fixed into the loss with a heated spatula (at ca. 80 °C) and a separation layer of a siliconised Hostaphan film. The film was then scraped with a scalpel to uncover its fillers and to matt the very glossy surface. This resulted in a lightening of colour, which had to be deepened again to better match its surroundings.

The fastest and most gentle technique for adjusting the colour besides reheating was the use of solvents, especially Shellsol T, which was applied with a cotton swab. Using this technique, the overall colour, texture, and gloss of the putty were now appropriate for the fills, with minor tweaks applied for different fills. Finally, the test putty could be peeled off after quickly heating it with a heated spatula or a hot-air fan.

Filling a small loss

After colour matching the fill was ready for its implementation (figures 34-39). The putty film was roughly cut to the shape of the loss and pressed into the void with a heated spatula (at 90-100 °C). A hot-air fan can help to soften thicker Beva 371 films, allowing for easier further processing. Additionally, thick films can be preheated on a heating plate before introducing them into the loss.

Due to the high filler content and the resulting increased hardness of the filling the putty had to be processed at higher temperatures in comparison to pure Beva 371 or Beva 371 with a little amount of pigments. In this case, temperatures of 90 to 100 °C were necessary to achieve the desired ductility, compared to temperatures of 65 to 80 °C for pure Beva 371.

Near the edges of the losses this intervention had to be carried out very carefully in order not to expose the linoleum to increased temperatures and thus accelerate the ageing process. A preliminary test on an aged green granite linoleum piece (from a counter of a merchant shop at the turn of the nineteenth century) showed that it tended to yellow at temperatures above 120 °C.

Because of the thickness of the original linoleum covering mass the putty was inserted in two or three layers to ensure sufficient adhesion to the substrate. After pressing the putty into the loss a thin Beva 371 film was laid on the surrounding original area and the filling. Excess material was levelled with a scalpel, or a cranked chisel for larger areas. After adjusting the brightness with Shellsol T the fill mass was very well integrated into the original surface.

The putties were deliberately coloured slightly lighter than the original to allow later fine-tuning of colour both in the editing state and once the putty is aged. In some cases a discreet retouching was implemented with highly diluted watercolours. The paint was applied with a glazing technique and also dabbed with a soft cotton cloth.
Filling a large loss
The largest loss in the linoleum posed a particular challenge due to its size (figures 40-42). It required finding a neutral basic tone for the divergent colours of the surrounding linoleum, which ranged from lighter to darker blue, with the yellowish and brownish tones of degraded areas. Due to the size of the loss the putty film could only be filled in step by step. The effort to insert the whole fill in one attempt was not successful, as this required a large amount of scattered heat that might stress the original material. Mechanically finishing the surface with a cranked chisel (20 mm wide) was also difficult because of the size of the fill. A smooth surface could only be realised by additional sanding using sandpaper of 180 and 400 grit.

Protective coating
Historical literature states that linoleum should be preserved by rubbing in a wafer-thin layer of polish made of wax and turpentine oil with a brush and a soft cloth. This not only protects the linoleum against mechanical wear but also preserves its neat appearance. In the case of the table only minimal residue of a waxy coating has been found (figure 43). After completion of the treatment the linoleum surface should be provided with a protective coating to protect the porous linoleum covering mass against moisture penetration through hairline cracks in the linoleum (figure 44). The aesthetic aspects of the coating should also be considered. The coating should support the colour transition between the left and right linoleum halves of the tabletop. Moreover, linoleum surfaces usually show a certain gloss during their useful life, depending on the taste of its owner, the thickness of the coating layer, and the subsequent processing. The microcrystalline wax Cosmoloid H80 dissolved in Shellsol T has been successfully applied in recent conservation practice; it was used here in a 10% concentration. The application was carried out in an even thin layer with a fine cotton cloth, followed by rubbing without pressure with a dry cotton cloth. It should be noted that the coating produced little noticeable change in the degree of gloss. Nevertheless, the coating had the positive effect of optically harmonising the entire surface and its colour changes (figures 45, 46).

Condition after the restoration
The neutral fill resulted in the desired harmonisation of the linoleum surface and produced an
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The overall impression of integrity (figure 47). The viewer’s eye is no longer distracted from the bright, contrasting colours of the jute fabric, and one can experience the tabletop with its linoleum as a whole. The additions remain identifiable as such and are also clearly visible under UV light.

**Example for a material-imitating filling technique**

The second example presents the results of Nicole Nitschmann, also student at the Cologne Institute of Conservation Sciences. Here, a material-imitating technique for granite linoleum was carried out on a test sheet in a seminar about putties (figures 48, 49). This example was a first attempt. Nitschmann utilised the Beva 371 film as a top layer of laminate on a ground layer consisting of Degalan PQ 611 and cork powder.

The material-imitating granite linoleum laminate consisted of three different Beva 371-pigment blends: one for the background colour and two for the lighter and darker speckles (table 2). Using a grater, coarse speckles were produced. Scrap and cork powder were also included in the Beva 371 masses.

A film with the background colour was placed on a heating plate at ca. 90 °C, separated by a siliconised Hostaphan film. The speckles were then sprinkled into the softened film. Structures and texture could be modified with a wooden stick or a similar tool. Subsequently, the film had to be pressed again with a PMMA sheet. After inserting and welding the Beva 371 laminate into the loss its colour was deepened by applying Shellsol T. The gloss could be reduced by sanding or with a chisel.

At a typical viewing distance the filling is hardly noticeable. At a closer distance the putty is apparent as such. This technique certainly leaves room for improvement, but the result can be assessed as good.

**Benefits and challenges**

Finally, the advantages and disadvantages of solvent-free Beva 371 as filling should be compared. Beva 371 shows a relatively good chemical stability during ageing and does not lose its flexibility, tensile, and bond strength. However, it does show a tendency to yellow. The material is reversible because of its low melting point of 65 °C and its

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### Table 2  Empirically determined recipes of a material-imitating fill.

<table>
<thead>
<tr>
<th>Material-imitating fill for brown-coloured granite linoleum</th>
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<tbody>
<tr>
<td><strong>basic tone</strong></td>
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<tr>
<td>The material-imitating granite</td>
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<td></td>
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<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td><strong>bright speckles</strong></td>
</tr>
<tr>
<td>Beva-pigment mixture:</td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td><strong>dark speckles</strong></td>
</tr>
<tr>
<td>Beva-pigment mixture:</td>
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non-polar properties, which allow removal of the film by heat and removal of residues with petroleum spirit. However, its polarity and solubility tend to shift to more polar agents during ageing. It has good adhesion to many materials and does not show any migration into absorbent materials. It is also very advantageous that it does not require drying time and no colour changes arise after application. The use of heat, non-polar solvents, and various tools allow for good processing and workability. Beva 371 can be mixed well with seemingly all fillers and can be retouched. However, its wettability and ability to be coated strongly depend on the binder-filler ratio and the character of the fillers.

The material allows for great freedom in modifications to achieve compelling visual results. The high flexibility can be used to replicate the optical and structural properties of the original materials. For example, imitations of craquelure or bark-like skin can be moulded with the aid of silicone mats.

Looking at the disadvantages, one has to stress that it takes some training to discover and master the material and its properties. Above all, colour adjustments can take a long time due to the slow mixing process of the highly viscous material and the aggregates.

Furthermore, the filling material is technically difficult to implement in the case of very large losses. In these cases the levelling of the surface can take a lot of time, or one has to put a lot of effort into preparing technical aids.

The yellowing of Beva 371, mainly due to light ageing, seems to be a further problem. Beva 371 was included in the Canadian Conservation Institute (CCI) testing program and its yellowing was studied. It was found that visible discoloration (degree of yellowing = 0.10) was perceived at about 6 months of light ageing (700-800 lux, 1905W/lm) and at about 10 years of dark ageing. Extrapolation of the curves suggests that strong discoloration (degree of yellowing = 0.25) might occur within 80 to 120 years. These results are for a 0.1 mm thick film.

Nevertheless, the application of the material must also be considered with regard to the designated use of the furniture. This case study presents an object that is stored under museum conditions, which mostly excludes the causes for strong yellowing. Furthermore, the filling colour was adjusted to a slightly brighter tone to allow for future interventions like a glazed retouching when the colour may change.
There are efforts to improve the material formula of Beva 371 by replacing its critical tackifier with a more photo-chemically stable one. Despite this, it would be desirable to enlarge the potential selection of binders for linoleum fillings. Other thermoplastic deformable materials also show potential. Acrylates and PVAc have already been tested in this case study, and further experiences can be gathered.

Acknowledgements
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Notes
1 Hausen 1957, p. 51.
2 Krätz 1985, pp. 13, 15.
3 Ziegler 2000, p. 41.
4 Bodenbender 1931, pp. 455, 459.
5 Especially for light tones of a linoleum covering mass, typical for granite and also inlaid linoleum (Bodenbender 1931, p. 47).
6 Fritz 1924, p. 7.
7 Ellerman 2000, p. 64. Ellerman 1999 p. 92.
8 Despite the elastic properties heavy objects might leave imprints in the linoleum and cause irreversible damage. In such cases (for flooring), it was recommended to use appropriate furniture accessories made of glass, rubber and the like (Bodenbender 1931, pp. 408-409).
9 Hellmann 2000, pp. 48-49.
36 Bodenbender 1931, p. 416.
35 Bodenbender 1931, p. 416.
34 Platz 1933, p. 22.
33 Bodenbender 1931, p. 416.
32 Bodenbender 1931, pp. 22, 93.
31 Bodenbender 1931, pp. 22, 416.
30 Bodenbender 1931, p. 417.
29 Bodenbender 1931, p. 22.
28 Bodenbender 1931, p. 416.
27 Bodenbender 1931, p. 416.
26 Bodenbender 1931, p. 416.
25 Bodenbender 1931, pp. 22, 93.
24 Paste of rye flour for fixing linoleum to furniture. A recipe is not known, but a recipe for 25 m2 flooring was found in historical literature: mixture of 6-7 lbs rye flour and 1 lbs Venetian turpentine, and, if required, a few drops of carboxylic acid (to prevent mould formation) and a little water (Bodenbender 1931, p. 395).
23 Bodenbender 1931, p. 417.
20 The linoleum powder was obtained with the kind support of Mr. Marco Dowidat-Eskes (R&D Project Manager - Linoleum/Design at DLW Flooring GmbH) via the manufacturer DLW Flooring GmbH.
19 But the polish should be only occasionally applied on linoleum (Bodenbender 1931, p. 428).

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• Josef Hausen, Wir bauen eine neue Welt. Das Buch der Kunststoff- und Chemiefasern, 1957
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- Gustav Adolf Platz, Wohnräume der Gegenwart, 1933
- Sabine Weißler, Design in Deutschland 1933 – 45.
- Ästhetik und Organisation des Deutschen Werkbundes im >Dritten Reich<, 1990

Photo credits
- 1, 18-49: Julia Kun
- 6, 11-17: Bodenbänder 1931, table 2, pp. 390, 418-419

Suppliers
- Beva 371 heat-sealing adhesive – Gustav Berger’s Original Formula, 40% solution; Cork powder (fine, Ø 0.2-0.5 mm); Cosmoloid H80; Pigments (chromium oxide hydrate green, Cassel brown, bone black, titanium white, Indian yellow); Shellisol T; Watercolours: Kremer Pigmente
- Hostaphan® NT 36: Deffner & Johann
- Linoleum powder (‘Scrapmehl’); previously
- Armstrong DLW GmbH, Delmenhorst, Germany (now DLW flooring GmbH)