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## **Migration of Dyes in Archaeological Textiles**

Many well preserved archaeological textiles have been recovered due to the preservative effects of waterlogged or wet soil, but the textiles have lost their original colours and are preserved in different shades of brown and tan. Dyestuff identifications are necessary in order to visualise the original splendour of these textiles. During the past 40 years, knowledge of the identification of dyes in textiles has improved greatly. Though the focus has been on oxidised dyes in historical textiles, many dyes in archaeological textiles have been identified. Still there is little knowledge of how the dyes are affected by the anoxic conditions in the wet soil.

An experiment was conducted to investigate how textiles react during burial in waterlogged soil. Wool and silk fabrics were dyed with several different kinds of natural dyestuffs and mordants. Some of the dyed samples had small samples of natural white fabric sewn on top to investigate if dyes are able to migrate from one textile to another. The aim of the project is to document and analyse the changes that occur during burial in soil in wet conditions, and investigate how different factors like mordants, dyestuffs and natural pigmentation affect the rates of deterioration. The result of the experiments will help us to interpret what the archaeological brown rags may have looked like when they were in use. Furthermore, it can also improve the knowledge on the kind of textiles that can be found in a waterlogged archaeological excavation.

Identical sets of samples of these textiles were buried in slightly acidic peat to imitate textiles from bog-finds. Each set was placed in a large box in waterlogged peat (in exactly the same position in each box), and covered with a lid to ensure an oxygenfree atmosphere. Boxes with soil and textiles were kept in a greenhouse with subtropical climate at constant temperature and high humidity.

The textiles were excavated after 8, 16 and 24 months. Some were rinsed carefully with a soft jet from the water hose before freeze-drying; some were slightly rinsed with only a light spray, and some were freeze-dried without any additional rinsing after excavation.

Methods used for the determination of the degree of deterioration include colour changes documented by measures with a spectrophotometer, specification of colours using the CIELAB colour systems; observation of fabric surfaces in a stereo microscope; colour and pigmentation in transmitted light microscopy; quantitative and qualitative element analysis using SEM-EDX and IPC-MS; and the testing of dyestuff remains with HPLC.

**Results:** The experiments showed that much dye was lost during the aqueous rinsing. The colors were, in general, brighter and better preserved in textiles only freeze-dried after 24 months of burial than in aqueous-rinsed textiles after 8 months of burial, thus indicating that before aqueous rinsing drying should be kept at a minimum.

Some of the dyes were identified in samples not dyed with this dyestuff. This was primary the red dyes madder and cochénille. These dyes were able to migrate not only to samples directly in contact with the dyed fabric, but also to textiles in the surroundings.

These results must be taken to account when making interpretations of dye analyses of archaeological textiles in the future.

**Bibliography**

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