

Resins: natural

Description: Details of the characterisation, classification and nomenclature of resinites is presented by Anderson et al., (1992) and Anderson and Crelling (1995). They propose use of the term “resin” only in reference to modern plant resins.

The resinites are divided into four main groups:

- Class I resinites are the most abundant forms in the geosphere and are based primarily on polymers of diterpenoid carboxylic acid (Baltic amber is a member of this group),
- Class II resinites are derived from resins based on polymers of sesquiterpenoid hydrocarbons, especially various isomers of cadinene,
- Class III resinites are natural polystyrenes,
- Class IV resinites are the least characterized, but appear to consist of largely non-polymeric materials.

Natural fossil resins are most frequently polymerised substances (polyesters) containing a large variety of compounds (Class I). Resins are the solidified products of higher plants with great resistance to chemical attack and can also withstand decomposition by microbiota. Natural resins have frequently occurred in the form of amber for at least 140 Ma (Helmuth, 1989a). The unique properties of fossil resins make them exceptional candidates as potential indicators of particular palaeoenvironments, sedimentary conditions and geochemical processes.

Due to their high durability they could serve as potential analogue material for the long-term behaviour of certain macromolecular structures. Insects and small animals have been excellently preserved within amber for millions of years (Baltic amber). Preservation of natural resins is good in less permeable rocks (e.g. clays) because of favourable geochemical conditions and temperature; in more permeable sediments the mechanical stability is worse. Resins can even survive high temperatures, for example during the earlier stages of coalification.

Amber is also preserved as archaeological artefacts, but such materials have not yet been interpreted as analogues of repository materials. The durability of such artefacts is generally good. Amber is frequently excavated and collected as a semi-precious stone (“organic gemstones”) - such historical items are also devoid of degradational features.

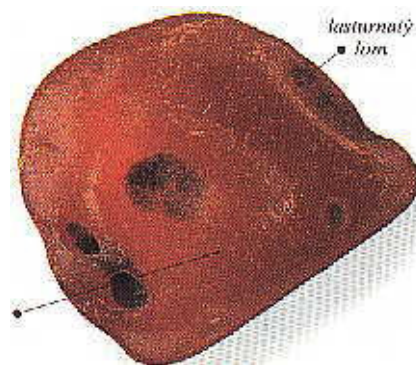


Figure 1: Example of natural amber

Relevance: Immobilized organic ion exchangers, produced in nuclear power plants, represent an important waste stream. Unfortunately, the analogy in composition between natural resins and technical resins (usually styrene-divinyl-benzene copolymer structure) is poor, and does not allow reliable transfer of results concerning natural resins to repository conditions. Radiation effects that can have important influence on the degradability of technical resins are not possible to evaluate in samples of natural resins.

Position(s) in the matrix tables: (Near-field) Waste material and demonstration of integrity, durability and low degradability.

Limitations: Comparability of the composition of natural resins and technological ion-exchange resins is low.

Quantitative information: Quantitative information has not yet been produced specifically for an analogue of any repository material.

Uncertainties: Questionable compositional and structural similarities between technical and natural resins; uncertain geochemical conditions during deposition of natural resins in comparison with disposal conditions in repositories.

Time-scale: Geological (tens of millions of years)

PA/safety case applications: None.

Communication applications: Not known.

References:

Anderson K. B. and Crelling J. C. (1995): Amber, resinite, and fossil resins.- ACS Symposium series 617, American Chemical Society

Anderson K. B., Winans R. E. and Botto R. E. (1992): The nature and fate of natural resins in the geosphere - II. Identification, classification and nomenclature of resinites.- Organic Geochemistry, 18, 6, 829-841

K.-H. Helmuth (1989): Natural analogues of bitumen and bitumenized radioactive waste.- STUK-B-VALO 58

Added value comments: None to add

Potential follow-up work: None recommended

Keywords: Organic material, waste

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