# 37. Tables

#### **Table 37.1. Incralac formulations based on FTIR analysis**

|  |  |  |
| --- | --- | --- |
| **Distributor** | **Base acrylic resin** | **Additives** |
| A | Paraloid® B44 | Very low amounts of substituted benzotriazole, epoxidized soybean oil |
| B | Paraloid® B44 | Substituted benzotriazole, epoxidized soybean oil |
| C | Paraloid® B44 | Substituted benzotriazole, epoxidized soybean oil |
| D | Different resin, possibly Paraloid® B48N | Substituted benzotriazole, epoxidized soybean oil |
| E | Paraloid® B44 | Substituted benzotriazole, epoxidized soybean oil |
| F | Paraloid® B44 | Substituted benzotriazole, epoxidized soybean oil |

#### **Table 37.2. FTIR assignments of key materials**

|  |  |
| --- | --- |
| Incralac® Absorption maxima (cm–1) | Assignment1 |
| 3444 | Carbonyl ester harmonic |
| 2989, 2953, 2846(sh) | *vas* CH3, *vas*CH2, *vs*CH2 in base acrylic resin (Paraloid® B44) 2 |
| 2926 | *vas* CH2 from oil, possibly ESO4 |
| 2875 | *vs* CH3 (due to presence of t–butyl methacrylate in Paraloid® B48N; found in one case, see text) 2 |
| 1732 | *v* C=O in base acrylic resin2 |
| 1604 | *v* C=C in aromatic ring of BTA3 |
| 1548 | *δ* NH |
| 1494 | *v* C=C (aryl ring) |
| 1474 | *δ* CH2 main chain in base acrylic resin2 |
| 1449 | *δ* CH3-CH2-O side chain + *δas* CH3 in base acrylic resin2 |
| 1387 | *δs* CH3 side chain in base acrylic resin2 |
| 1265 | *v* C-O in epoxy-ring in ESO5 |
| 1238, 1177, 1147 | *v* C-O-C in base acrylic resin2 |
| 1027 | *v* C-C-O in base acrylic resin2 |
| 990 | *δ* Η-C-Η, *τ* CH3 in base acrylic resin |
| 875 | *δoop* C-H in substituted aryl ring in BTA3 |
| 848 | *δ* C-C-CH3 (α-CH3 of EMA in base acrylic resin)2 |
| 824 | *δ*(CCO) in epoxy-ring in ESO5 |
| 753 | *δoop* C-C=O |
| 688 | Aromatic ring vibration in BTA3 |
| 606 | Triazole ring vibration in BTA3 |

1 Abbreviations: BTA: benzotriazole; ESO: epoxidized soybean oil; *v*: stretching vibration; *δ*: bending vibration; *s*: symmetric; *as*: anti-symmetric; *oop*: out-of-plane; *ip*: in-plane.

2 Lazzari and Chiantore 2000.

3 Brostoff 2003.

4 Ioakimoglou et al. 1999, Boyatzis et al. 2002.

5 Argitis et al. 1998.

#### **Table 37.3. Condition of coatings on objects from the National Archaeological Museum as investigated through FTIR spectroscopy**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Registry #** | **Description** | **Region and Historical Period** | **Year of Conservation** | **Pre-treatment** | | | **Application of Coating** | | | | | | Arbitrary grading | |
| **Mechanical** | **Chemical** | **Stabilization** | **Incralac solvent** | **Incralac Concentration (%)** | **Matting Agent** | **Distributor** | **SEM analysis1** | **FTIR analysis of corrosion products1** | **FTIR analysis of coating** | **Degradation grading2** |
| Χ 7934 | Jug | Greece, 5th c. BC | 1979 | Yes | No | ΒΤΑ | Toluene | ? | Yes | E or F | Cu, Al, Si, Fe, Mg, Ca, S | Calcite, silicates, copper oxides | Low levels of degradation: mainly hydrolytic and depolymerization | 4 |
| X 1974 | Statuette, Isis with Horus | Egypt, 26th-30th Dynasty (600–300 BC) | 1985 | Yes | Yes | ΒΤΑ | Toluene | ? | No | E or F | Cu, Sn, Pb, Al, Ca, Cl | Copper oxides and hydroxides, traces of organic coating, moisture | No sign of degradation | 0 |
| Χ 21039 | Mirror | ? | 1991 | Yes | No | ΒΤΑ | Toluene | ? | No | E or F | Cu, Pb, Al, Si, Fe, Ca | Copper oxides, malachite | Very low levels of degradation | 1 |
| Χ 26175 | kyathos | Greece, end of 7th – beginning of 6th c. BC | 1998 | Yes | No | ΒΤΑ | Toluene | 8–10% | Yes | A | N.A. | N.A. | Low levels of degradation: mainly hydrolytic and depolymerization; also signs of bio-degradation (formation of nitrates) | 4 |
| Χ 25604 | ring | ? | 2000 | Yes | No | No | Toluene | 8–10% | Yes | E | N.A. | N.A. | High levels of degradation: mainly hydrolytic and depolymerization; also signs of bio-degradation (formation of nitrates) | 5 |
| Χ 17166 | kringle | Greece, possibly Geometric period | 1999 | No | Yes | No | Toluene | 8–10% | Yes | E | N.A. | N.A. | Significantly high levels of degradation: mainly hydrolytic and depolymerization | 9 |
| Χ 8297 | strigil | Greece, 5th c. BC | 1997 | Yes | No | ΒΤΑ | Toluene | ? | Yes | E | Cu, Sn, Al, Ca , S, P, Si | Malachite, organic coating residue | Very low levels of degradation |  |
| Π 7317 | sword | end of 15th–beginning of 14th c. BC | 2003 | Yes | No | No | Toluene | 8–10% | No | A | Cu, Sn Al, Si, Fe, Ca, As, S, P | Malachite | Low levels of degradation | 3 |

1 Corrosion products were analyzed when detaching powder particles from the objects’ surface was feasible.

2 Arbitrary scale, based on the absorption of C=C at approx. 1646 cm–1 as a marker for oxidative degradation (see main text).

#### **Table 37.4. Condition of coatings on objects from the Epigraphic and Numismatic Museum as investigated through FTIR spectroscopy**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Group** | **Description** | **Region/ Historical Period** |  | **Pre-treatment** | | | **Application of coating** | | | | | | **Coating grading** | |
| **Year of conservation** | **Mechanical** | **Chemical** | **Stabilization** | **Coating thickness (μm)** | **Coating layers** | **Incralac solvent** | **Incralac Concentration (%)** | **Matting Agent** | **Distributor** | **FTIR results** | **degradation grading** |
| A | coin | Byzantine | 2002 | Yes | No | BTA | 1.5 | 2 | Toluene | 10–15 | Second layer, only | D | Very low levels of degradation. | 1 |
| B | coin | Greek Imperial | 1997 | Yes | No | BTA | 2 | 2 | Toluene | 10–15 | Yes | C | Low levels of degradation. | 2 |
| C | coin | Hellenistic | 1992 | Yes | Yes | No | 2 | 2 | Toluene | 10–15 | Yes | E | Significant degradation mainly due to oxidation. | 5 |
| D | coin | Ancient Greek and Greek Imperial | 1987 | Yes | No | Yes | 2 | 2 | Toluene | 10–15 | Yes | E | Low levels of degradation. | 2 |
| E | coin | Late Roman and Byzantine | 1982 | Yes | No | ? | 3 | 2 | Toluene | 10–15 | No | E | Very low levels of degradation. | 1 |