Cursus chemie voor restauratoren

door Dr. Rene Peschar

Inhoud

Veel restauratoren hebben tijdens hun opleiding kennis opgedaan over chemie. Het bijhouden en uitbreiden van deze kennis is over het algemeen geen sinecure.

Deze cursus is samengesteld uit onderdelen van de modules chemie uit het minor- en masterprogramma van de opleiding Conservering en restauratie aan de Universiteit van Amsterdam.

De cursus bestaat uit tien bijeenkomsten, en heeft het karakter van theorie-overdracht. Er zijn daarom geen praktijkopdrachten of practica. De cursus zal worden gegeven in het Nederlands; het cursusmateriaal en de literatuur zijn in het Engels.

Na iedere bijeenkomst zal worden aangegeven welke literatuur kan worden doorgenomen. Tijdens de volgende bijeenkomst zal de docent ingaan op eventuele vragen.

De cursus wordt gegeven in dagdelen van 3 uur in een van de locaties van de UvA.

Docent

Rene Peschar (1956) studeerde scheikunde en is gepromoveerd op het gebied van kristallografie en röntgendiffractie, beiden aan de Universiteit van Amsterdam (UvA). Na een aantal jaren gewerkt te hebben als assistent-professor en uiteindelijk groepsleider op dit gebied aan de UvA Faculteit der Exacte Wetenschappen trad hij in 2012 als wetenschappelijk docent toe tot de afdeling Conservering en Restauratie van Cultureel Erfgoed (Faculteit der Geesteswetenschappen, UvA).

Hij heeft een brede onderzoeksinteresse, met name processen die eigenschappen van materialen wijzigen, en is coauteur van meer dan 80 wetenschappelijke 'peer-reviewed' artikelen.

Sinds de start van de opleiding in 2005 heeft hij lessen chemie gegeven aan studenten van het UvA minorprogramma Conservering en Restauratie, en sinds 2012 ook aan studenten van de UvA Master Conservering en Restauratie van Cultureel Erfgoed.

Programma

Bijeenkomst 1:

Functional groups, intermolecular interactions

Organic materials can contain various types of functional groups, and these can be found in art objects (e.g. binding media used in coatings applied to canvas, paper, textile, wood), in the solvents that are used to clean or treat art objects with, and in polymers that are used as adhesives and/or consolidants. Functional groups are responsible for intermolecular interactions, mutual solubility of materials, and reactions. An overview will be given of the most important functional groups (double bonds, alcohol, ether, epoxy, aldehyde, ketone, carboxylic acid, ester, amine, amide, amino acid, and urethane), reactions of functional groups (radical-chain addition, condensation, hydrolysis, and oxidation) and intermolecular forces (London dispersion forces, dipole-dipole interactions and hydrogen bonding).

Bijeenkomst 2:

Properties of liquids and solvents

The many properties of solvents and other types of fluids, e.g. boiling point, volatility, viscosity, surface tension, capillary action, mutual solubility, depend on (similarity in) intermolecular interactions. The solvent properties and solubility will be discussed in relation to the frequently used solubility models, including the Hildebrand parameter, Hansen solubility parameters and the Teas fractional solubility parameters.

Bijeenkomst 3:

Polymers and polymerization

Polymers are long chains of atoms in which large amounts of the same 'repeat unit' are linked. The two principal polymerization mechanisms will be discussed: addition (radical-chain) polymerization and condensation polymerization in which esters and/or amides bonds are created and water evolves The properties of polymers (e.g. glass transition temperature) and behavior (thermosetting or thermoplastic) are determined by a variety of parameters, e.g. average molecular weight, degree of polymerization, stereoisomerism, and built-up of the chains (linear, side-chains, cross-links, networks) that influence interchain interactions and, eventually, the packing of chains into amorphous (less dense) or crystalline (more dense) regions, and the polymer stress-strain behavior.
An overview will be given of the types of natural and synthetic polymers that can be encountered the field of conservation and restoration as adhesive, consolidant or construction material.

Bijeenkomst 4:

Natural organic compounds: proteins, lipids, resins, polysaccharides

Proteins are biological polymers characterized by sequences of amide (=peptide) bonded amino acids. Proteins originate largely from animals, e.g. hair, skin, bone, feathers, wool, silk, and have been used in art objects for various purposes, e.g. as binding medium (egg white, tempera), gelatin-based glue or as (chemically processed) products (leather, parchment). Composition and characteristics of proteins will be discussed in relation to their susceptibility to degradation.
Lipids encompass classes of largely hydrophobic organic molecules. An important class of lipids, characterized by long (aliphatic) carbon chains, includes oils and fats (triglycerides), free fatty acids (long-chain carboxylic acids), waxes (long-chain esters) and paraffin waxes (long-chain alkanes). Another class of lipids are the resins, water-insoluble compounds that are exuded by many plants and trees. Resins comprise the terpenoids, built-up from cyclized isoprene units, that have been used frequently as varnish (dammar, mastic, shellac). The chemistry of the lipids (degradation, oxidation) and degradation products (soaps) will be discussed.
Polysaccharides (carbohydrates, sugars) in the form of cellulose and starch are main constituents of wood and plant fibers, respectively. Also, other natural polysaccharides (e.g. plant gums) and

synthetic, cellulose-derived polysaccharides, like cellulose nitrate and cellulose acetate, will be discussed in relation to their tendency to degrade.

Bijeenkomst 5:

Aqueous solutions. Acids, bases

Acids and bases. The concepts of acidity (pH) and alkalinity (= basicity) will be explained, with a focus on the principal organic acids that occur on art objects (e.g. varnishes, resins, adhesives) , either naturally or in the course of time because of oxidative degradation processes. A proper understanding of acids and bases is also needed when liquid aqueous media are used, e.g. for cleaning or removal of a surface layer (e.g. varnish, retouche).

Bijeenkomst 6:

Emulsions, surfactants, gels

Surfactants are molecules that contain both a (very) hydrophilic part and a hydrophobic (lipophilic) part. Surfactants are typically used to stabilize emulsions (see below). Various types of surfactant used in C&R will be discussed, as well the parameters to characterize them (e.g. HLB number, CMC critical micelle concentration).

Emulsions are mixtures of two liquids that cannot be mixed, because of their different intermolecular interactions esp. oil and water, unless a third component, a surfactant, is added that can interact with both oil and water. The two types of emulsions, water-in-oil and oil-in-water will be discussed, and how they can be applied in C&R practice.

A gel is a solid material in which a liquid is dispersed. The solid form ensures a limited and controlled release of the liquid, e.g. an aqueous cleaning medium. The various types of gelling agents used in C&R (synthetic and natural polymers) and their specific conditions (e.g. pH, heat,) will be discussed.

Bijeenkomst 7:

Aqueous solutions. Polyprotic acids, buffers

Many chemicals used in modern cleaning and removal systems, as discussed during meetings 8-9, are based on polyprotic acids. The activity of these materials is pH-dependent and requires the pH to be constant (buffered conditions). The concept of buffers will be explained, especially in relation to some of the most frequently used polyprotic- acids (EDTA, citric acid) that advantageously form a self-buffered system at an appropriate chosen pH.

Bijeenkomst 8:

Aqueous solutions. Conductivity. Solubility. Chelation

In addition to the presence of H^+ ions (as expressed by the pH), it is important to consider the ion concentration of an aqueous solution that is in contact with a surface, e.g. for cleaning or removal purposes. The concepts of hypertone, hypotone and isotone solutions and experimental observation of ion conductivity will be discussed.

Inorganic materials will be discussed, with a focus on metal-ion containing inorganic compounds (salts) that are poorly soluble or insoluble in water.

Removal of metal ions from salts (e.g. efflorescence) on a substrate can be achieved by a cleaning system (aqueous or gel) that contains a chelating agent. Chelating agents contain at least two, but ideally more, atoms or groups of atoms that can bind a metal ion. The chelating agents used in C&R are based on the polyprotic acids discussed in meeting 7, and operate within limited buffered pH ranges.

Bijeenkomst 9:

Cleaning media. Solvent-surfactant gels. Resin and bile soap gels. Hydrolytic enzymes

Richard Wolbers developed solvent-surfactant gels that are based on special alkaline surfactants (Ethomene C25 and C12) that can neutralize acidic polyacryl polymers (Carbopol, Pemulen), a process that (in presence of a solvent) leads to a solvent-surfactant gel. The chemistry behind these materials will be explained, and the conditions under which they can be used successfully as well as their risks.

Resin and bile soaps, developed by e.g. the National Gallery London, contain an 'affinity' surfactant, a chemical group that resembles a (part of a) natural resin (e.g. mastic, dammar, shellac) so enabling an improved contact with a resinous surface layer. The specific conditions (pH dependence, buffer, gelling agent) of their use will be discussed.

Hydrolytic enzymes are biomolecules that together with 'cofactors' (e.g. metal ions, catalysts) promote hydrolytic reactions so breaking down long-chain natural and synthetic polymers that contain water-sensitive functional groups (esters, amides, glycosides) into smaller, more soluble fragments.

Bijeenkomst 10:

Miscellaneous subjects and requests

Some subjects discussed during the earlier meetings will be discussed in more detail. Also participants may suggest subjects to be discussed during this last meeting.

Data

De workshop wordt gegeven op 7, 14, 21, 28 februari, 7, 14, 21, 28 maart, en 4 en 11 april 2018.
Tijd: 9:00 tot 12:00 uur.

Locatie

De cursus wordt gegeven in een van de locaties van de Universiteit in Amsterdam. De locatie is goed te bereiken met het OV.

Prijs

De cursusprijs bedraagt € 355,00 De workshop is vrijgesteld van BTW. U dient zelf te zorgen voor koffie/thee.

Doelgroep

Restauratoren die beschikken over basiskennis chemie en die behoefte hebben aan een opfrissing en uitbreiding van hun chemie kennis.

Aantal deelnemers

De cursus gaat door bij minimaal 10 deelnemers. Gezien de aard van de cursus is het aantal deelnemers niet gemaximeerd.

Aanmelden

U kunt zich aanmelden door ons voor **10 januari 2018** per e-mail of post een ondertekend inschrijfformulier toe te sturen (adressen staan op het registratieformulier). Na aanmelding ontvangt u verdere informatie over o.a. de betaling. Na ontvangst van de betaling staat u definitief ingeschreven.

Nadere informatie

Voor verdere informatie kunt u contact opnemen met Angèle Goossens (coördinator permanente educatie), via e-mail pe-CenR@uva.nl.