

Course Documents

Overview

Welcome! This course consists of several lectures by professionals in the field of Adhesives, Sealants and Adhesion Science tailored to those issues that may be of interest to the adhesive community. A .pdf file of the lecture notes have also been supplied for your reference. The notes can be accessed through the "Course Material" button on the right. This course is comprised of the following lectures:

INTRODUCTION

Short Course Overview

Introduction to Web Short Course (DAD Intro)

This lecture will introduce the new on-line web-based learning course and introduce the Center for Adhesive and Sealant Science (CASS) and the Adhesive and Sealant Council (ASC).

Introduction to Polymers

A Simple Scheme for Adhesion, and Five Adhesive Mechanisms (TCW #1)

Why adhesives stick to substrates can be broken down into five, non-independent, possibilities and these are explained. Since most modern adhesives are synthetic polymers, the parameters that govern their application as adhesives are briefly outlined here.

Introduction to Mechanical Properties

Introduction to Mechanical Properties: Mechanics Principles (JL #1)

This course will discuss the details associated with general or fundamental mechanics and Materials and how they might relate to adhesion and/or adhesion mechanics. Part 1 of this lecture will discuss the mechanics side, introducing some general principles of stress and strain.

Introduction to Mechanical Properties: Material Behavior (JL #2)

This course will discuss the details associated with materials including stress strain behavior, understanding the difference between energy and strength criteria, looking at yield and polymers, and failure criteria.

Introduction to Surfaces

Principles and Applications of Surface Chemistry in Adhesion (JPW #1a)

This course will discuss the principles of surface chemistry such as surface tension, capillarity, adsorption, and wetting and how these principles relate directly to adhesive bonding.

POLYMER FUNDAMENTALS

Mechanisms of Adhesion and Polymer Parameters

The Basic Polymer Parameters (TCW #2)

In much more detail, the factors of chemical structure, molecular weight, stereochemistry, chain architecture, and solid state structure are explained as they apply to adhesion science.

Mechanical and Thermal Properties

Simple Mechanical Tests of Bulk Adhesives (TCW #3)

Independent of an adhesive joint, we can measure the behavior of bulk adhesives and learn much about those applications for which they will be suitable. These test are described and interpreted for glassy, elastomeric and semicrystalline systems.

DMA and Relaxations in Polymeric Adhesives (TCW #4)

Much of adhesive joint performance can be analyzed in terms of energy management and dissipation. So, for bulk polymers we use dynamic mechanical tests to estimate this feature. Interpretation of these experiments is illustrated for a variety of systems.

More DMA, Creep and Stress Relaxation of Bulk Adhesives (TCW #5)

Further interpretation of the dynamic mechanical test is provided to aid in the design of new adhesives with enhanced performance.

Thermal Properties of Adhesives (TCW #6)

In order to correlate structure of an adhesive with its eventual behavior in a joint, the thermal response is critical. A differential scanning calorimeter is the instrument of choice here to provide everything from glass transitions to optimum cooling rates for a hot melt adhesive.

Polymer Rheology

Adhesive and Sealant Rheology - Part I (RMD #2a)

Waterborne adhesives are complex colloidal mixtures. This lecture reviews some basic issues in colloid chemistry that relate to the control of colloid stability and the subsequent effects that colloid stability has on the flow behavior, i.e. colloid rheology. The relation of colloid stability and rheology to the formulation of waterborne adhesives is also discussed.

Adhesive and Sealant Rheology - Part II (RMD #2b)

All adhesives and sealants that are processed as fluids exhibit complex flow behaviors. This lecture reviews basic features of complex fluids that are common to melts, solutions, and suspensions that comprise many adhesives and sealants. Several rheological functions are defined and explained such as viscosity and the loss and storage moduli. Some of the most useful instrumental methods for measuring these functions are then reviewed. Finally, some important structure-rheology relationships for melts, solutions, and suspensions are discussed with a focus on how these can be used in processing adhesives and sealants.

Accelerated Characterization

Accelerated Testing of Adhesive Systems - Part I (TCW #7)

The principles of accelerated testing of polymers, adhesive joints, and the use of time-temperature superposition are developed. Other variables are considered for accelerated testing as well. The reliability of these techniques are presented.

Accelerated Testing of Adhesive Systems - Part II (TCW #8)

The principles of accelerated testing of polymers, adhesive joints, and the use of time-temperature superposition are developed. Other variables are considered for accelerated testing as well. The reliability of these techniques are presented.

SURFACE FUNDAMENTALS

Liquid Surfaces, Spreading, and Wetting

Surface Chemistry in Adhesion - Liquid Surfaces - Part I (JPW #1b)

This course will discuss the principles of surface chemistry such as surface tension, capillarity, adsorption, and wetting and how these principles relate directly to adhesive bonding.

Surface Chemistry in Adhesion - Liquid Surfaces - Part II (JPW #1c)

This course will discuss the principles of surface chemistry such as surface tension, capillarity, adsorption, and wetting and how these principles relate directly to adhesive bonding

Solid Surfaces

Surface Chemistry in Adhesion - Solid Surfaces (JPW #2)

This course will discuss the principles of surface chemistry such as surface tension, capillarity, adsorption, and wetting and how these principles relate directly to adhesive bonding.

Solid Surfaces as related to Adhesion (JGD #5)

The topics covered in this introductory lecture on solids emphasizes fundamental ideas regarding gas adsorption on

solids, the determination of surface area, the nature of adsorption on porous solids, and the measurement of acid-base characteristics of solids using inverse gas chromatography.

Surface Preparation

Surface Preparation and Surface Chemistry - Metals (JGD #1)

This lecture covers material related to the chemical composition and properties of metals as related to adhesion. The topics covered include surface chemistry before and after treatment; surface treatment methods and approaches, including mechanical, physical, chemical and electrochemical processes; characterization of surface treated metals; and durability and the role of surface treatment.

Surface Preparation and Surface Chemistry Polymers and Composites (JGD #2)

This lecture focuses on the manner in which polymer surfaces can be modified to enhance adhesive bonding. Methods to alter low energy surfaces are presented. Among the methods discussed are abrasion, chemical derivatization, plasma and plasma polymerization, and plasma spraying. The effect of surface chemistry on adhesive strength and durability is discussed.

Application of Surface Science to Adhesion

Surface Chemistry in Adhesion - Applications to Adhesion (JPW #3a)

Polymer/Metal Adhesion - Part I (JPW #3b)

Polymer/Metal Adhesion - Part II (JPW #3c)

These courses will discuss the principles of surface chemistry such as surface tension, capillarity, adsorption, and wetting and how these principles relate directly to adhesive bonding.

Troubleshooting with Surface Analysis

Surface Analysis as Applied to Adhesion - Trouble Shooting (JGD #3)

In this presentation some common methods to characterize surfaces are discussed. The approach is to describe the fundamental principles of the methods and cite examples where the method(s) is (are) used to characterize adherends, adhesives, and debonded adhesively-bonded specimens. Among the methods discussed are x-ray photoelectron spectroscopy (XPS), Auger electron spectroscopy (AES), scanning electron microscopy (SEM), ion scattering spectroscopy (ISS), infrared spectroscopy (IR), and atomic force microscopy (AFM).

UNDERSTANDING ADHESIVE TESTING

Testing Bonded Joints

Introduction to Mechanics of Bonded Joints (DAD #1)

This section reviews several key issues related to the topics that follow. Among them are the concept.

Stresses in Adhesive Joints (DAD #2)

Stress distributions in several important joint families (lap shear, butt joints, and cleavage specimens) are discussed. Insights from the shear lag and beam on elastic foundation models are seen to be very useful in understanding stresses in many practical joints.

Applications of Fracture Mechanics to Adhesive Bonds (DAD #3)

A review of fracture mechanics and its applicability to adhesive bonds is given. This alternate approach to characterizing and designing adhesive bonds is of fundamental importance for both structural importance for both structural and non-structural adhesives.

Test Methods for Adhesion (DAD #5)

This section reviews some of the important joint geometries for characterizing both strength and fracture energies of adhesive. This lecture includes an examination of peel tests of various configurations.

Durability and Design

Durability of Adhesive Bonds (DAD #6)

Durability issues associated with fatigue, viscoelasticity and time dependence, and moisture are discussed from a mechanics perspective. Techniques for predicting durability are also mentioned.

Design of Adhesive Joints (DAD #7)

Durability issues associated with fatigue, viscoelasticity and time dependence, and moisture are discussed from a mechanics perspective. Techniques for predicting durability are also mentioned.

Design of Experiment

Synthesis and Characterization of Adhesives Using Statistical Methods (TEL #2)

This lecture highlights in an introductory fashion the power of statistical design of experiments as related to a peel test and the synthesis of a novel composition for a block copolymer. The lecture introduces simple statistical terms and methods for data presentation.

SYSTEM SPECIFIC OVERVIEW

Sealant Overview

Sealants - An Overview (JGD #6a) – course materials is for 6a, b, & c

Sealants - An Overview (JGD #6b)

Sealants - An Overview (JGD #6c)

The focus in this introductory program concerns the uses and chemistry of sealants. Common uses and the performance of sealants are discussed. The chemical preparation of sealants is presented and the applications, advantages, and performance characteristics for using selected sealant types is presented.

Waterborne Overview

Waterborne Adhesives - Colloid Stability and Rheology, Part I and II (RMD #1)

Waterborne Adhesives - Colloid Stability and Rheology, Part III (RMD #1)

Waterborne adhesives are complex colloidal mixtures. This lecture reviews some basic issues in colloid chemistry that relate to the control of colloid stability and the subsequent effects that colloid stability has on the flow behavior, i.e. colloid rheology. The relation of colloid stability and rheology to the formulation of waterborne adhesives is also discussed.

PSA Overview

An Introduction to Pressure Sensitive Adhesives (JGD #4)

In this talk some of the fundamental ideas, application requirements, and test methods for pressure sensitive adhesives are discussed. Applications for PSAs are illustrated and the characteristics and the role of viscoelasticity in PSAs are presented.

An Overview of Pressure Sensitive Adhesive Compositions (TEL #1)

This lecture focused on the nature of the chemical compositions and other components that are routinely found in various PSA formulations. The lecture focuses on synthetic strategies and reasons for limitations and advantages of various compositions. A discussion on the relationship of chemical structure with the modulus versus temperature relationship is presented.

Mechanical Behavior of Pressure Sensitive Adhesives (JJL #3)

This course will discuss pressure sensitive adhesives and where they fit into the various classes of adhesives and adhesive bonding. It will also discuss the ideal of debonding and its purposes both with wetting and removal. Why do PSA's stick and look at the probe tack test and how it relates to the Dahlquist criteria. Finally, it will discuss removal.

Bonding to Wood

Wood Anatomy (CEF #1)

Aspects of Wood Adhesion (CEF #2)

Introduction to wood, wood anatomy, basic wood chemistry, wood mechanical properties, wood surface properties, and testing of bonded wood assemblies, all as related to adhesive bonding.

Bioadhesion

Bioadhesion and Biosealants Applications for Fixation, Wound Closure and Disease, Part I (BJL #1a)

Bioadhesion and Biosealants Applications for Fixation, Wound Closure and Disease, Part II (BJL #1b)

Bioadhesion and Biosealants Applications for Fixation, Wound Closure and Disease Part III (BJL #1c)

These lectures will relate to bioadhesion and biosealants, application fixation, wound closure and disease evolution. The first lecture will discuss natural tissue fixation, a conventional way of bonding to skin. The second lecture will discuss aspect of wound closure, and the third will focus on disease progression and how the natural adhesion processes play a role in the evolution of certain types of diseases.