



CHEM-C2420 Materials Performance

Examination on 8th August 2019

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(Tämän kurssin opetuskieli on englanti. Siten kysymykset ovat englanniksi, mutta luonnollisesti myös suomeksi saa vastata. Undervisningsspråk i denna kurs är engelska. Därför är frågorna på engelska, men naturligtvis kan man svara på svenska)

Total marks: 50

Question papers must be returned.

Question 1 (8 marks)

- What are the major differences between thermoplastics, elastomers and thermosets considering polymer structure?
- How are these differences reflected in the material properties such as melting temperature, stiffness and brittleness?
- How do engineering thermoplastics differ from so called standard thermoplastics and high performance thermoplastics?

Question 2 (8 marks)

What is a polymer composite? What kind of components can be involved in it and what kind of purposes do they serve? Give advantages and disadvantages of polymer composites compared to neat polymer materials.

Question 3 (5 marks)

Describe the life cycle of your team's product in the Polymer project (or optionally select some other polymer product). Mention the most important effects to health and environment during the product life cycle.

Question 4 (5 marks)

Explain the concept of "forms of corrosion". How can you identify different forms of corrosion? Do the different forms of corrosion have same theoretical background? How you can use the information in materials selection and equipment design?

Question 5 (6 marks)

Creep

A) Creep (in metals):

The creep rate $d\epsilon/dt$ is given by: $d\epsilon/dt = A\sigma^n e^{(-Q/RT)}$. Explain shortly what are the terms σ , n and $e^{(-Q/RT)}$ and how they are tied to / how they affect the creep phenomenon.

B) Over time, wood "creeps", in other words it undergoes further slow deformation under a static load. Creep of wood (and other natural fibre –based materials) is accelerated by moisture. **Why do moisture and temperature affect creep of wood?** Connection to basic structure/components of wood? Short answers, please.

Question 6 (9 marks)

Think about the following claims about metals and metal properties. Are they right or wrong and explain shortly why (correct answer 0,5 points - acceptable explanation 0,5 points):

1. Factors that should be considered in designing laboratory tests to assess the mechanical characteristics of materials for service use are the nature of the applied load, load duration, and environmental conditions.
2. Yield and tensile strengths and ductility are sensitive to any prior deformation, the presence of impurities, and/or any heat treatment.
3. Hardness is a measure of a material's resistance to localized plastic deformation
4. The ease with which a material is capable of plastic deformation is a function of dislocation mobility.
5. Repetitive plastic deformation results in strain hardening (also known as work hardening) due to decreased grain size.
6. For a cold-worked metal that experiences annealing, as temperature increases (at constant heat-treating time), tensile strength decreases and ductility increases.
7. Most precipitation-hardened alloys are limited in their maximum service temperatures.
8. For hot-working operations, large deformations are possible, and they may be successively repeated.
9. Cold working produces an increase in strength with the attendant decrease in ductility.

Homework - Question 7 (9 marks)

Homework – Add the handwritten article summary to the exam papers.

Note! Write your name + student number to the paper.

Homework was (article copies available at exam):

Read Sections 7.2 and 7.3 of the article by R. Sam Williams - Chapter in "Handbook of wood chemistry and wood composites". Boca Raton : CRC Press, 2005 -http://www.fpl.fs.fed.us/documents/pdf2005/fpl_2005_williams001.pdf

In your own words summarise the chemical changes the wood undergoes after exposure to uv light

Write no more than about one third to half of a page!

(it is sometimes more difficult to write concise text)