CHAPTER 1

THE IMPORTANCE OF ENGINEERING MATERIALS

OVERVIEW

This chapter is intended to stimulate interest on the part of students in engineering materials. It also contains most of the information that material users will need to know about inspecting materials for incipient failures (cracks) or manufacturing defects (NDE). Our reason for putting NDE information in the introduction is that it applies to all materials. It is important and yet most curricula cannot afford a complete lecture on just this topic.

CHAPTER GOALS

Upon completion of this chapter, the student should:

- ✓ have an interest in learning about the materials used to make things
- ✓ have an understanding of the importance of using the "right" material for an application
- ✓ have an understanding of the reasons why products fail
- ✓ have an understanding of NDE and how to apply it

LECTURE OUTLINE

- **WHAT IS MATERIALS ENGINEERING**
    - Definition
    - Historical development of Engineering Materials
    - How materials were key to the evolution of civilization

- **THE LANGUAGE OF MATERIALS**
    - Role of the pure sciences (Figure 1-1)
    - The Periodic Table of Elements (Back cover)
    - Glossary in this text

- **THE ROLE OF MATERIALS IN PRODUCT SUCCESS**
    - Reasons why things fail
    - Products that fail by design (Figure 1-3)
    - Categories of material properties (Figure 1-3)
    - What is "Service Life"

- **INSPECTION TO PREVENT FAILURES**
  - Reasons for inspection (Figure 1-4)
  - What is NDT/NDE
  - Common NDT techniques (Table 1-1)
  - What role should NDT play in engineering?

- **ENGINEERING MATERIALS AS THEY APPLY TO YOUR WORLD**
  - Engineering materials in the home
  - Engineering materials at work
  - Engineering material at play
  - Why engineering materials is important

- **A MATERIALS REPERTOIRE**
  - What repertoire?
  - Reasons for a repertoire
  - Repertoire management (for life)

Answers to Questions

1. Engineering materials are used to make "durable goods," tools, and structures. The items that they are used for have an expected service life as opposed to materials that are disposed of after use.

2.

Engineering Material	Made Possible
carbon steel shapes	incredible bridges, hi-rise structures
tempered glass	eliminated wires in safety glass
ceramic insulators	spark plugs, high voltage power transmitters
PCV plastic	siding on outside of houses
tungsten	incandescent lights
polycarbonate plastic	helmets from plastic rather than leather
silicon single crystals	computer chips
etc.	etc.

3. (b) protons (goal – understand the scope of physics)

4. (c) gases (goal – understand the scope of chemistry)

5. (f) all of the above (goal – understand scope of materials engineering)

6. (f) all of the above (goal – understand a defined service life)

7.	Acceptable answers	Materials ramifications
	any hand tool (hammer, screw driver, etc.)	significant alloy and heat treating technology is required to make them work
	underground piping (water, sewer, etc.)	corrosion control expertise required
	wood table (heirloom quality)	wood finishes require sophisticated coating technology
	nuclear power plant	materials need ability to resist corrosion and degradation from radioactivity
	etc.	etc.

8. (f) thermal conductivity (goal – know that it can be measured without altering the material)

9. (f) strength (goal – know the difference between strength and stiffness)

10. (g) composition (goal – know what a chemical property is)

11. (f) all of the above (goal – know where NDT/NDE is used)

12. (c) resonant frequency (goal – know that it is part of acoustic emission but not an NDE process per se)

13. (c) electromagnetic radiation range (goal – understanding where things are in the range of electromagnetic radiation – from visible light to x-rays)

14. (B) surface (goal – know that dye penetrate is for surface defects, magnetic particle is for surface + slight subsurface and x-ray for internal)

15. (c) 2% of 10 mm = 0.2 mm (goal – know the 2% rule)

16. (e) no limit (goal – understanding of how penetrating UT is)

17. (c) works on steels (goal – understand that it only applies to ferromagnetic materials)

18. (b) blind flat-bottom hole (goal – understanding that this is how the device is set up to find certain size defects)