



Materials & Chemistry



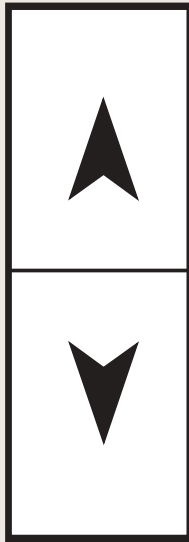
Topics

- Mechanical and thermal stress
- Corrosion
- Scale
- Pressure Tubes

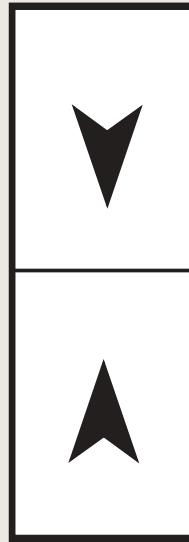
Mechanical Stress

- Definitions
 - Stress
 - Strain
 - Elastic
 - Plastic
 - Failure
 - Residual Stress
 - Hoop Stress

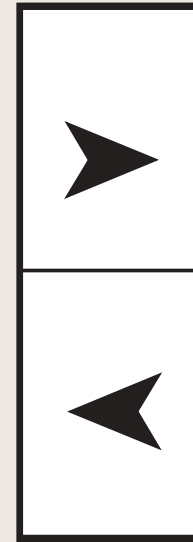
Three Types of Stress



TENSION



COMPRESSION

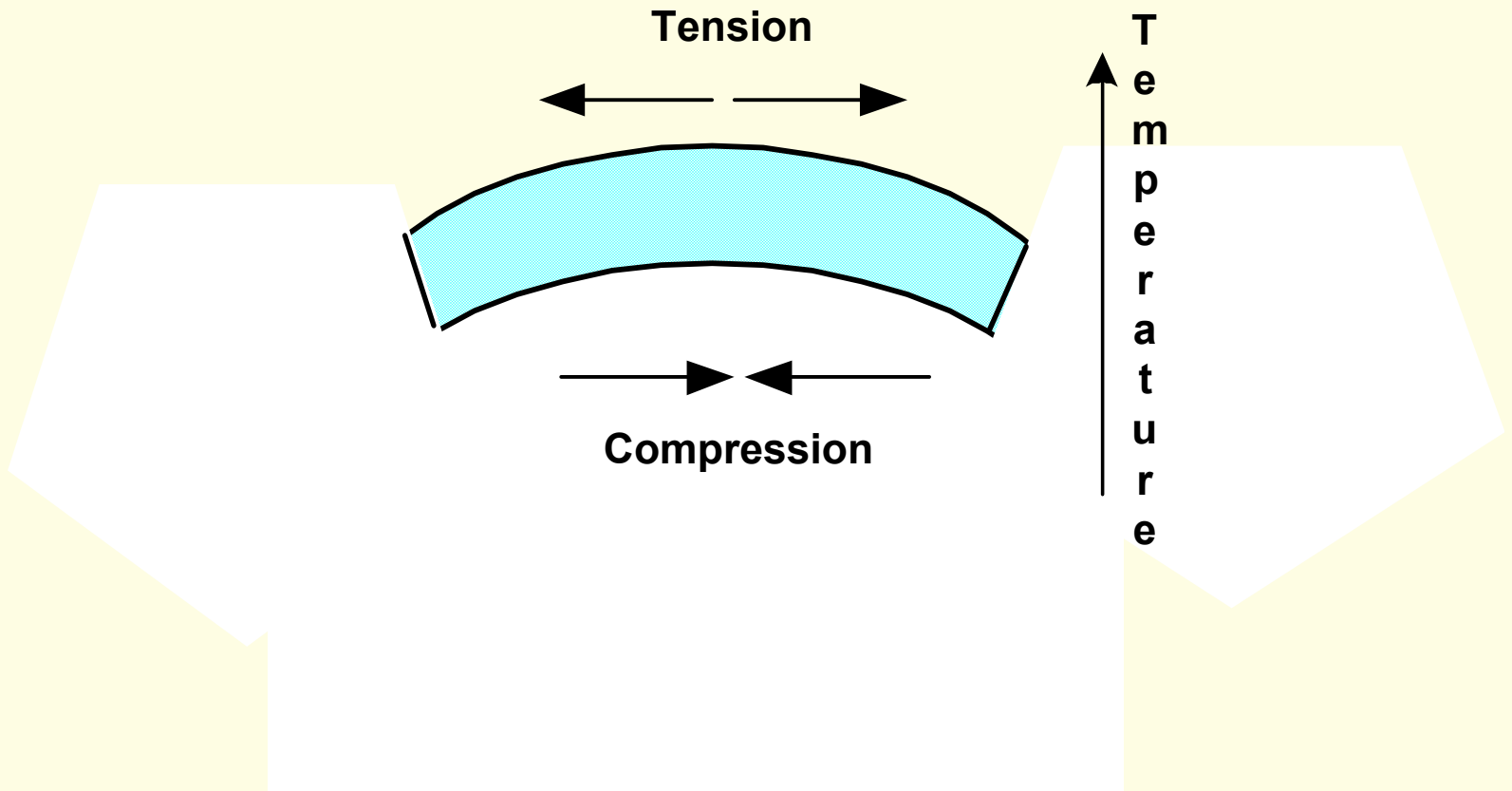


SHEAR

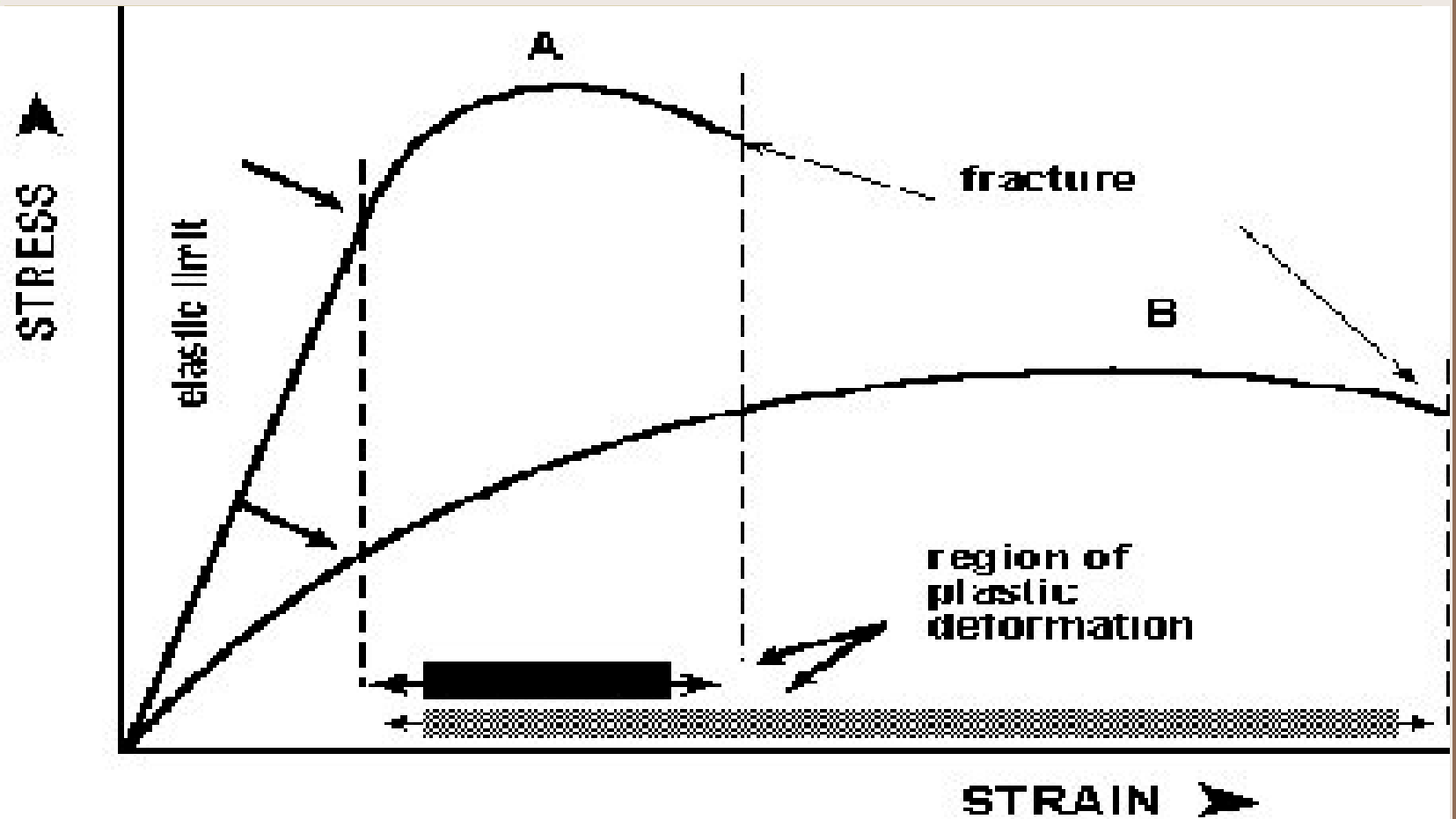
Thermal Stress

- Thermal stress
 - The result of changes in length with temperature
- Differential thermal expansion
- Thermal Shock

Differential Thermal Expansion



Strain

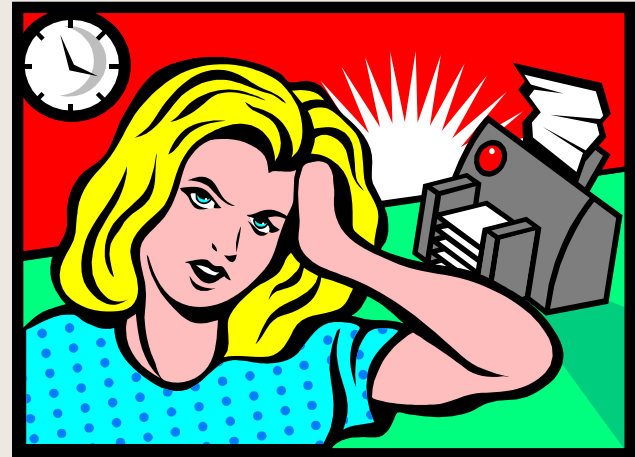


What are some of the things that put stress on material in a plant?



Things that cause stress

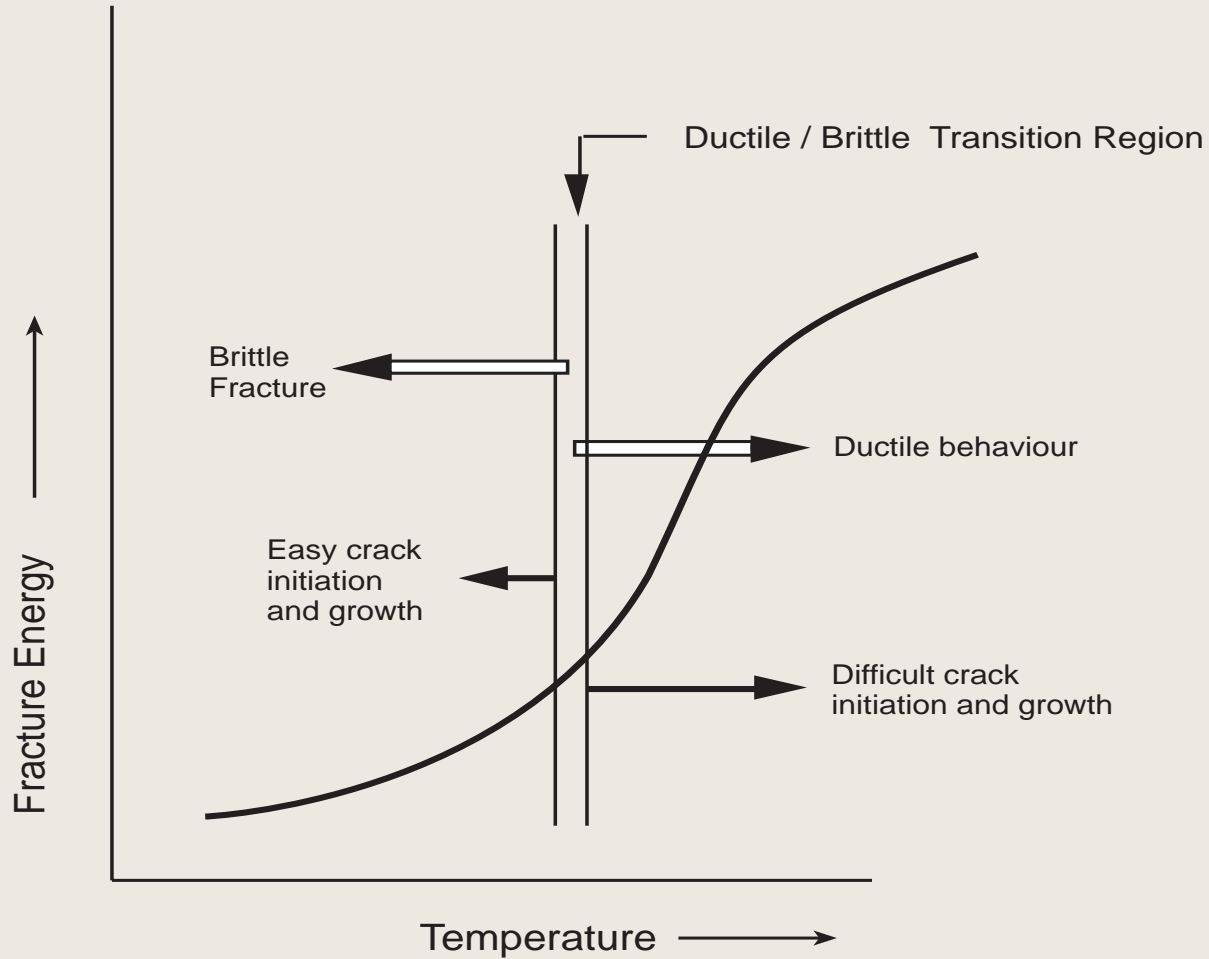
- Supervisors, Licensees
- Gravity
- Centrifugal force
- Heating and cooling
- System pressure
- Water hammer
- Sudden pressure changes



Brittle Ductile Transition

- Ductility
 - A measure of how much deformation a material can take
- Brittle
 - The opposite of ductile
- Nil-Ductility Transition
 - Some materials are brittle when cold and ductile while warm.
 - They change from one to another over a very small temperature range

Nil-ductility transition



Creep

- The permanent time-dependant deformation of a material under constant stress.
 - Turbine shaft under gravity
 - Turbine blades when running
 - Pipes when operating at pressure



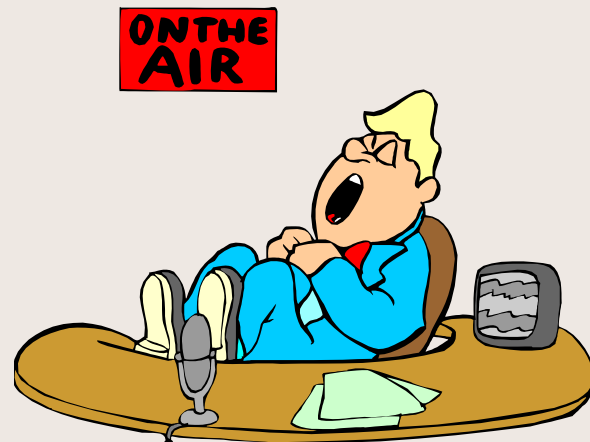
Creep Rate

- Stress $\uparrow\uparrow$
- Temperature $\uparrow\uparrow$
- Neutron Flux $\uparrow\uparrow$



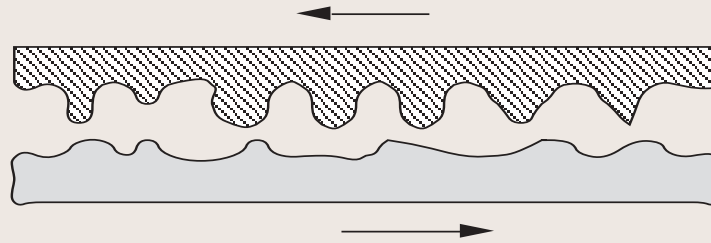
Fatigue

- Failure after repeated loads below the yield point
 - After a large number of large stress cycles
- Ultimate failure is brittle fracture

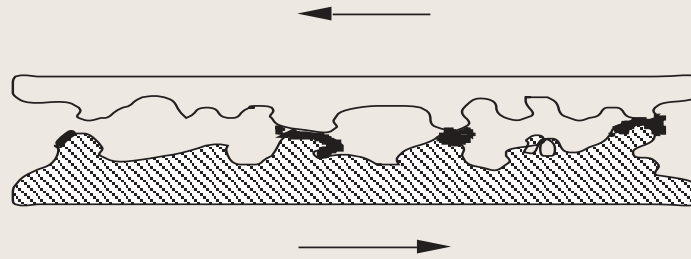


Erosion

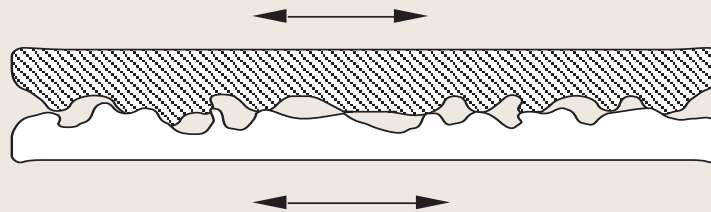
ABRASION



ADHESION



FRETTING



For You to Do

- Read the section on material properties pp. 3-15
- Answer questions p. 16 & 17