Beckfoot

Engineering Manufacture

Unit R109: Engineering materials, processes and production: **Lo1 – Know About Properties And Uses Of Engineering Materials**

Year 10

enjoy learn succeed

1. Materials; Metals

Ferrous Metals		These Metals Contain **IRON** (Fe).
1	**Iron**	Machine Bases, Metalworking Vices
2	**Tool Steel (Carbon Steels)**	Screwdrivers, Hammers, Saws
3	**Stainless Steel**	Sinks, Rules, Cutlery
4	**High Speed Steel**	Drill Bits, Lathe Tools

Non-ferrous Metals		Metals which **do not** contain IRON.
5	**Copper**	Plumbing & Electrical Components
6	**Aluminium**	Cooking Foil, Sauce Pans, Ladders
7	**Zinc**	Coatings On Steel Products
8	**Tin**	Coating On Food Cans
9	**Lead**	Weather Proofing For Roofs
10	**Titanium**	Jewellery, Surgical Implants.

Alloys		A mixture. of **two or more** metals.
11	**Brass**	Plumbing Accessories
12	**Bronze**	Boat Propellers

Smart Materials – materials which have properties that can be significantly changed in a **controlled fashion** by external stimuli, such as heat, moisture, electric or magnetic fields, light.

3. Materials; Ceramics

1	**Tungsten Carbide**	Cutting Tool Tips
2	**Glass**	Windows, GRP, Fibre Optics – Broadband.
3	**Ceramic Bearing Material**	Electric motors, applications under water, aerospace

4. Materials; Composites

A material made from **two or more** different materials that, when combined, are stronger than those individual materials by themselves.

1	**Glass Reinforced Plastic (GRP)**	Car / Boat Bodies, Bike frames
2	**Carbon Fibre**	Bicycle Frames, Sports equipment
3	**Concrete**	Constructional applications

5. Materials; Smart & New Materials

1	Shape-memory Alloys	Dental Braces, surgical implants, fire prevention.
2	Thermochromic Materials	Thermometers for rooms, refrigerators, aquariums, and medical use.
3	Shape-memory Plastics	Smart fabrics, intelligent medical devices and self-disassembling mobile phones
4	Quantum Tunnelling Composite (QTC)	Switches on mobile phones, pressure sensors and speed controllers
5	Nanotechnology	Sunscreen, cosmetics, food packaging, and clothing

2 Materials; Polymers

Thermoplastics		**Can** be remoulded numerous times with the application of heat.
1	**Acrylonitrile-butadiene-styrene (ABS)**	Appliance casings
2	**Polyethylene**	Pipes, Buckets, Toys
3	**High Impact Polystyrene (HIPS)**	Vacuum Forming, electronics casings
4	**Polyvinyl Chloride (PVC)**	Water Pipes, Chemical Tanks
5	**Nylon**	Curtain Rails, Hinges, Clothes
6	**Polycarbonate**	Safety Goggles, Bullet Proof Windows.
7	**Polypropylene**	Medical Equipment, Food Containers.

Thermoset Plastics		Polymers which **cannot** be remoulded once set in shape.
8	**Polyester Resin**	Used in GRP – Car/ Boat bodies
9	**Urea-formaldehyde**	Electrical fittings, Door Handles.
10	**Epoxy Resin**	Glue, Casings, Coatings.
11	**Phenol-formaldehyde**	Heat resistant saucepan handles

https://www.bpf.co.uk/plastipedia/applications/shape-memory-polymer.aspx

6. Properties Of Engineering Materials

1	**Malleability**	Is capable of being extended or shaped by beating with a hammer or by the pressure of rollers.
2	**Ductility**	The ability of a material to be drawn out into wire or thread without losing strength or breaking.
3	**Conductivity**	Measure of a material's ability to conduct an electric current.
4	**Resistivity**	A measure of the resisting power of a specified material to the flow of an electric current.
5	**Hardness**	The measure of the resistance of a material to surface indentation, abrasion, or scratching.
6	**Machinability**	A characteristic of a metal that makes it easy to drill, shape, cut, grind, etc. Materials with good machinability can be cut with relatively little power and low cost.
7	**Corrosion Resistance**	How well a metal can withstand damage caused by oxidization or other chemical reactions.
8	**Elasticity**	The ability of a metal to resume its normal shape after being stretched or compressed.
9	**Plasticity**	Is the ability of a metal to undergo permanent deformation, a non-reversible change of shape.

7. Materials Testing: Destructive Testing

Carried to find properties and behaviour of materials under different loads and conditions. The material is damaged during the test.

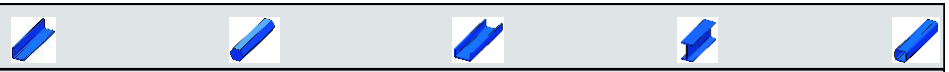
1	**Tensile Testing**	Controlled **tension** (pulling force) is applied to a sample material either as a load for proof **testing** (make sure it is strong enough) or until it fully **fails.**
2	**Hardness Testing**	This involves applying a constant load via a **rounded or pointed object**, under controlled conditions, to create an **indentation** in a metal surface. The **width** of the indentation is then measured to determine the hardness of the material.
3	**Compression Testing**	Used to establish the **compressive** force or **crush resistance** of a material and the ability of the material to recover after a specified **compressive** force is applied.
4	**Impact Testing**	Performed to determine the impact resistance or **toughness** of materials by calculating the amount of energy absorbed during **fracture** when a free falling weight is dropped into the sample material.

8. Materials Testing: Non-Destructive Testing (NDT)

A **testing** technique used by engineers to evaluate the properties of a material or product **without** causing **damage** to the original product.

1	**Conductivity Testing**	The measurement of a materials ability to **conduct** an **electric current**. When carried out over a weld or a joint it will inform you as to the quality of the weld / joint. Good conductivity indicates a good joint, poor conductivity / high resistivity could be caused by gaps or cracks within the joint or damage to the material by heat.
2	**X-ray Crack Testing**	The tyre industry use x-rays to **show up air bubbles** between rubber layers.
3	**Visual Inspection**	One **NDT** method used extensively to evaluate the condition or the quality of a weld or component. It is easily carried out, inexpensive and usually doesn't require special equipment. **Visual testing** is the primary NDT method of many quality control programmes.
4	**Ultrasonic Testing**	Used on sheet material to precisely locate faults. Aircraft industry employ this method.
5	**Dye Penetrant**	Sprayed onto a surface, and the dye/penetrant will settle in any cracks to highlight them.

https://www.bindt.org/videos/



Standard Stock Shapes - Angle, Channel, Ingot, I-Beam, Rebar, Sheet, Rod, Flat, Hex, Tube, Threaded Rod, Square Bar