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Applied Chemistry & Environmental Scince

Unit-1 Water and its application's

Unit 2 Engineering materials and testing

Unit 3 Lubricants

Unit 4 Instrumental Techniques in materials characteristics

Unit-5 Environmental Scince

→ **Unit 2 Eng. materials and testing**

Q. What do mean by tailoring of properties ?

Ans- Modification in the properties to fulfill users need in best possible way.

Keywords :- Tailoring, R & D → Research and Development,

Genotype, Phenotype

⇓ ⇓

Structure (genes) — Physical appearance & behaviour.

(i) Macro
(ii) Micro (100 - 2000 × ppm)
(iii) Crystal
(iv) Atomic

SEM, TEM = 10^6 x magnification

microscopes

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Q. "

⇒ " Structure ⟷ properties ⟷ uses "

→ How this relation helps the engineers in the field of engineering ?

→ what material can / can't do for me ?

∘ Genotype governs the fenotype

* Tailoring → modification in the properties of materials according to the required needs of users.

→ Tailoring leads to Research and Development

most common metal use → "C - steel"

→ C - Steel = Iron + C

eg C - steel + Cr, Ni → Stainless steel

* Classification of eng. materials :

(1) on the basis of (uses)

eg : Structural material → wood, Plastic, Metal, Cement

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→ but this is not correct as all these eg. are highly different & can't be categorised in a group.

Imp * • on the basis of properties & scientific

Category : 1 Metals and Alloys

(a) Definition : Alloys are tailored metals

(b) v properties : all properties are typical to metal
Typical Malleable & Ductile, good conductor of heat, lustrous, tough & strong. & alloys.

(c) ferrous metal & non-ferrous metals

Iron

eg forms of iron
- purest form - wrought iron
- steel { 99% → Kar Iron & less than 0.25% carbon }
- Cast iron
- stainless steel (Fe, Cr, Ni + C)
- Bronze (Cu + Tin) 12%

(d) uses : → metals are used to make ~~ferrous~~ standard materials.
→ uses for conductivity
→ uses in our household items or industrial use for construction etc.

Category . 2 Organics materials

→ Because of catenation property of carbon, carbon forms

(a) Define : carbon and its derivatives

(b) Typical properties :- difference in properties of organic materials are not given general statment.

RDX → Royal Demolitation Explosive

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(c) further classification → funtional groups

ex- petrol, sugar, paracetamol, RDX (cyclonite) or hexogen

$-C-C-C-C-C-$

→ because of catenation property of carbon its exibits a wide variations in structure, properties etc

(d) uses :-

Category - 3 : Ceramics → A ceramics is a material that is neither metallic nor organic. It may be crystalline, glassy

(a) define → hard, heat resistance ↓ maximum tolerence temp.

(c) Refractory materials → Fire clay, SiC (maxm tolerence)

* SiC → silicon carbide maintain its property upto 2000°C

Furnace की wall 42 lining में use

(b) properties → typically hard and chemically non-reactive and can be formed or densified with heat

(d) uses - • Furnance
• ladles → molten material को store करने के लिए
• Crucibles
• Incinerators → waste comes out (भस्मक)

Landfilling → use at high temp

focus

of stiffness ?

strength → directional in nature

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Category - 4 Composite materials

mixture

Keywords : new-gen-materials, tailored materials
engineered materials (man-made)
R&D materials, team-work materials,
Synergy of materials

(a) define :

→ composite materials are mixture of two or more different types of materials working together.

or working as a single unit

(b) properties : durable, cost effective, user friendly.

→ on basis of structure

(i) FRC → Fibre Renforced Composite ex; RCC steel rods

capability, strength increase

→ nylon fibres are embeded with in the bulk rubber. fiber glass and wood. Tuffen glasses

अंदर धसा होना।

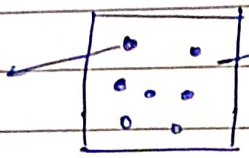
• steel radial tyres → Toughness ↑ durability ↑ properties are good than nylon. but costly.

(ii) LRC → Laminated Renforced Composite eg. Layers, sic, boron glass. etc

(iii) PRC → particulate Renforced Composite

eg Cermets cements (rock and gravel)

IPR → Intellectual Property Rights



→ Cermets

→ 2400°C

Q. what is the difference b/w alloys and composite?

Q. scope of tailoring more in alloys and composites?

Ans →

	Alloys	Composite
	define	define
(a)	metals only	(a) applicable all types of materials.
(b)	homogenous mixture	(b) heterogenous mixture
(c)	alloys are solid solution.	(c) composites are mechanically mixed mixtures.
(d)	its individual identity is lost.	(d) individual identity is retained.
(e)	seperation is not possible	(e) seperation is possible.
(f)	scope of tailoring is limited in alloys.	(f) scope of tailoring is vast in composites
(g)	ex. steel, Copper brass, amalgam bronze etc	(g) ex, Laminated Marksheet, steel rods, RCC, LRC.

tech.?

Ans → Composites are known for their high strength to / weight ratio, enabling the certain of light weight structures and components resulting weight reduction

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~~Category - 5~~ ~~Semiconductors~~

Q.1 Explain the various essential requirements of engg. materials with example?

Ans- (i) Materials should have the required combination of properties properties are the basis of selection.
→ properties are tested experimently.

(ii) product should be easily manufactured.

(iii) should be cost effective.

(iv) There should be effective compromise b/w technical and economic properties of the material.

(v) Eco-friendly

imp

Q.2 * What useful information are obtained by material testing? Explain classification of material testing

→ नाम पता करना

Ans- (i) Identification of unknown material -
latest reliable — Spectroscopic methods are best presently
Chromatography

(ii) Quantity - (amount कितना है)

(iii) Mixture - Analysis of mixture both Qualitative & Quantitative
of Testing

* (iv) Impurities - (or defects / flaws) eg: Steel has impurities of S and P which decrease its toughness

Reasons for flows:

(a) Natural

(b) During handling {coal eg} → हेराफेरी करना Deliberation of Impurities.

(c) Doping / Adulteration

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Category - 5 Semi conductors

Category - 6 Water

Quality and Quantity

↓

Olden days population ↓, availability ↑

population ↑, availability ↓

→ permit

→ (v) Permissible limits, (Tolerance limits)

ASTM international

↳ American Society for Testing and Material

→ material की property, Testing, use करना

और ASTM control करता है।

Guidelines, regulate होता है → (ASTM govern body)

Regulating Bodies eg - AICTE, WHO, ICC

→ If limits is crossed then we -

- reject the material
- or repair the material

Q- Role of ASTM in materials ?

(vi) To numerically (evaluate) different properties of material.

↳ परीक्षण

(vii) Compare / Ranking, selection

series of experiment

(viii) To establish relationship between structure and properties of material.

'structure ↔ properties'

(ix) To frame / reduce working specification of materials.

Q. Classification of Material Testing ?

done by (ASTM)

Ans- (1) on the basis of methodology

means procedure

- Procedure — three types

(i) Physical Method, at least (1,2) ex -

(ii) Chemical Method

(iii) Instrumental testing / Sophisticated method, faster, accurate methods - identification, quantification. etc

ex - Spectroscopy

(2) On the basis of Information obtained :

(i) Qualitative

(ii) Quantitative

eg → litmus colour. Red or Blue, India wins against Pakistan

eg → lime in water, its pH = 5.2

hardness of water = 40 ppm.

representative of bulk material.

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on the Basis of

(3) → What happens with the sample ?

- sample must be ideal representative of bulk material

→ types

(i) Destructive testing

(ii) Non- Destructive testing (NDT)

or sample

eg testing during which substance loose their properties so, sample can't be used again.

or physical तोड़ना, titration, impact strength of glass (hammer test)

eg NDT : sample do not loose their property (मतलब sample खराब नहीं होता)

& we can use sample after testing.

(PH) eg : measuring viscosity with viscometer.

→ economically Beneficial, faster, easier etc

(4) on basis of Sampling environment

two types -

(i) Laboratory Test → 110 km/l 40-50 km/h

रात्र - perfect है।

(ii) Field Test → 70 km/l

not perfect at all

eg. Bajaj Platina

110 cc

110 km/l * standard conditions

Lab test define → is test perform under standard, well defined, well-documented set of conditions.

* Both tests are good. It depends on our use which is superior.

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→ users have full control on the conditions of environment.

Field test → test perform under practical, real world conditions

Reliable test

→ users have no control over the conditions. It is always possible to perform prior field test.

→
- Best performance
- reproducable result
- economically easy or friendly
- for marketing
- easy for testing

Result Reliable होता है ?

- field test give variable result

Q. ~~Test perform under practicle and~~

ASTM → guidelines to set across suitable conditions to give better result.

साथ मिलकर दोनों काम करता है।

BIS → Board of
Bureau of Indian standards

Refractory Materials

Q.1 Define and classify refractory materials ? why and where these materials are used ?

* Imp Q.2 Explain various, essential, requirements (characteristics) of refractory materials.

* Q.3 What factors are to be considered for selection of refractory materials.

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define

Ans - 1 (i) Refractory materials are heat resistance material which can resist high temp. without softening, weakning or deformation.

define By ASTM →

Refractory materials are inorganic ceramics with those combination of Physical, chemical and Mechanical Properties that made them able to be used as structure's or components of a system which are exposed to temperature more than 1000° F.

Furnace walls are lined with refractory material. These materials also acts as insulators. They minimize heat loses. They increase the ~~dur~~ durability of the furnaces. example of usage of refractory materials : Crucible, Incinerator.

Ans - 2 Characteristics of Refractory material -

(i) Temperature tolerance of refractory should be more than its working temperature this property is known a

(ii) Refractory material should resist ~~load~~ the load of the raw ~~of~~ materials present. (RUL)

→ (Refractoriness) → property

↓ ↳ refractory की कितनी temp tolerance करती है।

property ability to
relate with resist high temp.

over designing

~~over designing~~ → ~~engineering~~ world

Over designing
↓
engineering world

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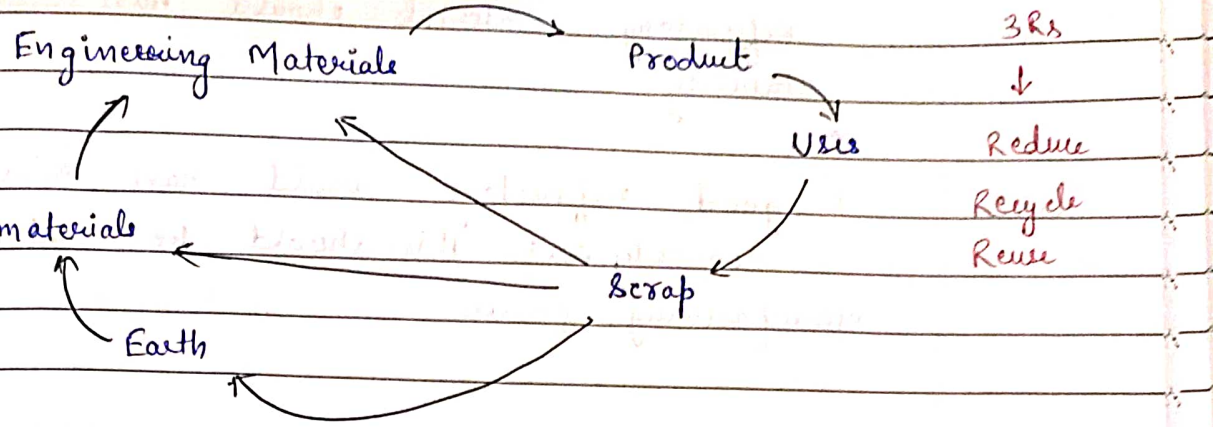

3Rs
↓
Reduce
Recycle
Reuse

RUL → Refractories Under load

(ii) imp Q. Compare b/w Refractories and RUL?

Ans → RUL is more reliable rather than Refractories.

(iii) chemical inertness Refractory and Raw Materials should be in chemically inert with respect to each other.

(iv) Abrasion resistance Refractory material should have high Abrasion resistance

- Rotary Kiln → large process unit is used in cement manufacturing.
  - 1750°C tolerance
  - Fatigue → internal stress

(v) Thermal expansion and thermal contraction with temp. rise and falls should be minimum and uniform this property is called Thermal spalling resistance.

↓

cracking, Breaking of material

(vi) Refractory material should have dimensional stability.

(vii) A good refractory would have minimum or low porosity and this should be controlled during manufacturing process. only

Ans-3 Classification of Refractory material.

(i) Temperature tolerance →
- Low heat duty
- Moderate heat duty
- High heat duty
- Super high heat duty

(ii) On the basis of chemical nature of refractory

- Acidic Nature → They are not attacked by acidic materials, but easily attacked by basic material.
- Basic Nature
- Neutral

They are made up of large proportion of lime or magnesia or mixture of basis.

example → Fire Clay, Silica Refractory, Alumina Refractory (Al2O3) 1850°C
cheaper

example → Dolomite, Magnesia (2250°C)
$CaCO_3 + MgCO_3$ (MgO)
चूना पत्थर
(cheaper) सस्ता
RUL value is more ↑ as comp. to Dolomite
cost effective सस्ती है।

Neutral Refractory materials :

Temp tolerance is very high
max in all these
→ material upto 2150°C, but costly

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example → SiC, ZrO_2 (Zirconium oxide), chromite ($FeO \cdot CrO_2$)
(silicon carbide)
↓
tolerance upto 2000°C
Graphite

→ Natural Ref. are made from weakly acid / weakly basic materials like Carbon, Chromium

Q. Compare Various properties of Fire clay, Magnesia and SiC refractory ?

Ans -

Ans-3 Factors are to be considered for selection of refractory material.

(i) Temperature tolerance

(ii) RUL → Refractoriness under load

(iii) Rotary kiln → used for cement manufacturing

75 % → CaO in cement

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Ordinary Portland Cements (OPC)

Q.1 Define and differentiate b/w OPC, Mortar, Concreate, RCC.

Q.2 Explain chemical composition of OPC including role of individual constituents.

Q.3 Describe industrial manufacturing of cement?

Q.4 Explain the process of setting and hardening of cement and factors affectioning it?