Engineering materials classification pdf

Material Science and Technology (MSE) is an engineering field that includes the spectrum of material types and their use for manufacturing purposes. The materials cover the range: metals, ceramics, polymers (plastics), semiconductors, and a combination of materials called composites. We live in a world that depends on materials and only limits materials. Everything we see and use is made of materials. All these require materials specifically tailored to their application. Specific properties are needed that result from careful selection of materials and control of the manufacturing processes used to convert raw materials into final products. Exciting new product developments are often only possible through new materials and/or processing. Engineers deal with science and technology to produce materials whose properties and forms are suitable for practical use. The activities of these engineers range from the production of primary materials, including recycling, the design and development of new materials, to reliable and economical production of the final product. Metals Metals are materials that are usually a combination of metallic elements. These elements, combined, are usually electrons, which are not localized and have consequently general types of properties. Metals are usually good conductors of heat and electricity. They are also quite strong, but deformable, and usually have a bright look when polished. Ceramic Ceramics are usually compounds between metallic and non-metallic elements, and are compounds such as oxides, nitrides, and carbides. Typically, they are insulating and resistant to high temperatures and harsh environments. Plastics Plastics, also known as polymers, are usually organic compounds based on carbon and hydrogen. These are very large molecular structures. They are usually low density and unstable at high temperatures. Semiconductors Semiconductors have electrical properties that are intermediate between metal wires and ceramic insulators. Electrical properties strongly depend on small amounts of dirt. Composites Composites consists of several types of materials. Fiberglass, a combination of glass and polymer, is an example. Concrete and plywood are other familiar composites. Many new combinations include ceramic fibers with metal or polymer matrix. Note:-The table below contains additional information. STRUCTURAL PROPERTIES EXAMPLES Metals/ alloys ▪, any metallic element /alloy ▪ simple crystalline structure ▪metall atomic bond, decoralized electrons ▪ high conductivity ▪ opaque to visible light (i.e. opaque) ▪ bright ▪ strong, plastic ▪ iron (Fe) ▪ steel (Fe +C) ▪ aluminum (Al) ▪ copper (Cu) ▪ brass(Cu +Zn) Ceramic/, Glasses/,/ Glass-ceramic ▪ compounds metals and non-metals ▪ mainly ion atomic bond (however, these bonds may be some coves in nature) ▪ ceramic crystalline (crystalline structure can be simple or relatively complex) ▪ the glasses are amorphous (primarily made of SiO2), the glass ceramics are devitrified glass ▪ insulating ▪ refractory ▪ wear resistant ▪ fragile ▪ strong ▪ hard ▪ chemically stable ▪ high melting temps glasses with transparent ▪ oxides,(Al2O3, MgO, SiO2) ▪ nitrides (Si3N4) ▪ carbides ▪ silicates ▪ lithium alumino-silicates ▪ clay cement Polymers and plastics ▪ organic compounds mainly c and h.,(see periodic table) ▪ large molecular structures chain or network configuration, ▪ the atomic bond covalent of the chains or network, and in addition, there is also between chains or the network 5-95% crystalline, relatively simple structures, very complex ▪ very plastic (flexible and plastic) ▪ low density ▪ low strength ▪ low melting temperature ▪ ▪ high chemical reactivity ▪ polyethylene ▪ PVC ▪ rubber ▪ rubber acrylics - O ▪ rabbits - N ▪ silicon - Si Composites ▪ several types of artificial material , usually a matrix of material fibers or particles. It can be anything, depending on the components, in relative quantities and geometric ▪ fiberglass ▪ concrete ▪ asphalt ▪ wood Semi-conductors ▪ elementary (IVA group) ▪ complex ▪ covaens/ion bond, similar to ceramic ▪ intermediate conductivity, which is highly sensitive to low concentrations of impurities, ▪ precise control of chemical purity allows for precise monitoring of electrical properties, ▪ techniques exist to produce variations in chemical purity of very small spatial regions, so, sophisticated and tiny circuits can be produced in exceptionally small areas (This is what makes micro-circuitry ▪ Si, Ge, Sn ▪ CaS GaAs Basically Materials Engineering can be classified into two categories - 1. Metals 2. Non-Metals Metals metals are polycrystalline bodies that have a number of differentiated oriented fine crystals. As a rule, the main metals are in a solid state at normal temperature. However, some metals, such as mercury, are also in a liquid state at normal temperatures. All metals have high thermal and electrical conductivity. All metals have a positive temperature resistance factor. It means resistance of metals increases the temperature increase. Examples of metals - silver, copper, gold, aluminum, iron, zinc, lead, tin, etc. Metals can be further divided into two groups- 1. Ferrous metals - All ferrous metals that are iron as a common element. All iron-containing materials have a very high permeability, which makes these materials suitable for the construction of the core of electrical machines. Examples: cast iron, wrought iron, steel, silicon steel, high speed steel, spring steel, etc. Non-ferrous metals - All non-ferrous metals have a very low throughput. Example: Silver, Copper, Gold, Aluminium, etc. Non-metallic non-metallic materials are not crystalline in nature. They exist in amorphous or mesomorphic form. They are available at both solid and gaseous normal temperatures. Normally all non-metals have poor thermal conduction Electricity. Examples: plastic, rubber, leather, asbestos, etc. Since these non-metals have very high resistance, which makes them suitable for the insulation of electrical machines. Difference between metals and non-metals Other classification of technical materials: Technical materials are classified as: Ceramic materials are organic materials and alloys are metals polycrystalal bodies with multiple differentiated anamnesis fine crystals. As a rule, the main metals are in a solid state at normal temperature. However, some metals, such as mercury, are also in a liquid state at normal temperatures. Pure metals have very low mechanical strength, which sometimes does not match the mechanical strength required for each application. To overcome this draw back alloys are used. Alloys are the combination of two or more metals or metals and non-metals. The alloys have good mechanical strength and a low temperature resistance factor. Example: Steels, Brass, Bronze, Gunmetal, Invar. Super alloys, etc. Ceramic materials \ Ceramic materials are non-metallic solids. They are made from inorganic compounds such as oxides, nitrides, silicates and carbides. Ceramic materials have exceptional structural, electrical, magnetic, chemical and thermal properties. These ceramic materials are now widely used in various engineering fields. Examples: Silica, glass, cement, concrete, grenade, Mgo, Cds, Zno, SiC, etc. Organic materials all organic matter having carbon as a common element. In organic materials, carbon can be chemically combined with oxygen, hydrogen and other non-metallic substances. Usually organic substances that have complex chemical bonding. Example: Plastics, PVC, synthetic tires etc. Madhav University provides all types of engineering courses- - Mechanical Engineering - Civil Engineering - Computer Science & Engineering - Computer Applications - Electrical Engineering - Electronics & Communication Engineering It is important to choose the right material for any work you carry out. If you do not select the right material, it can have unwanted consequences, such as a metal moustache growing on metallic components. These consequences can lead to major disasters. Therefore, it is important to understand the classification of substances. And understand the properties and applications. Classification of engineering materials We can classify all engineering materials into two large categories of metals and non-metals. These two categories are further classified as follows: Metals and alloysFerrousCast IronGrey cast ironWhite cast iron Cast ironNemdularcast ironSteelAlloy steelRoot-free steelEnhe SteelCarbon SteelsMedium Carbon steelHigh carbon steelWrought ironNon-FerrousCopperCopperBronzeBronzeLeadSilverZincTin etc. Non-metalsSkinRubberPolymersThermo-setting polymersPhenolformAldehyde (Bakelite)Polyesterexi hardwoodTropical hardwoodConvention ceramicRefrakteriesAbrasivesGlassCementAdvanced CeramicsElectrosElectric ceramic CeramicBiosWear-resistant ceramic ceramicsAutomotive ceramicsMetalsMetal matrix compositesCeramic matrix compositesCeramic matrix compositesPolymer matrix compositesSemiconductorsIntrinsic semiconductorsExtrinsic semiconductorsLet's get some information on some of the materials listed above. Rubber is used as packaging material and electrical insulator. Ceramics are non-metallic solids made up of inorganic compounds such as nitrides, oxides and carbides. It has electrical, magnetic, chemical and thermal properties. These materials are used in the electronically controlled devices, computers, and aerospace fields. Example: Glass and aluminium oxide and silicon carbide. Organic polymers chemically combined with hydrogen, oxygen or other non-metallic substances. They are formed by a polymerization reaction in which simple molecules are chemically combined with long-chain molecules. They are used in packaging, insulating materials, coverings, etc. Examples: Cotton, Nylon, Terylene, PVC, etc. Composites are a mixture of materials such as metals and alloys and ceramics, metals and organic polymers, ceramic and organic polymers. They are used for electrical devices and aircraft components. Example: Plywood, fiber, cement and concrete. We use leather in bell drives and canes. Semiconductors are materials whose conductivity is between the conductor and the insulator. These materials are usually hard and brittle. These are the building blocks of modern digital electronics. We use them to make devices such as diodes, logic gates, flip-flops and locks, microprocessors, etc. Mild steel plain carbon steel containing carbon percentage is between 0.15%- 0.3%. Easy to counterfeit, fluid and fluid. We can weld it pretty easily. If special properties are required, some of the alloying elements are added from carbon steel. These elements are nickel, chromium, vanadium, etc. Steel obtained by the addition of alloyed elements is known as alloy steel. Grey cast iron is a combination of coal and steel. It also contains iron. Composition: Carbon (2.5%3.8%), silicon (1.1-2.8%), mangan (0.4%1%) phosphorus (0.15%). Cast iron is abrasion resistant. He's got a low level of fluidity. And compared to steel, it's low impact resistance. Its machinability is better than steel. Gray cast iron is recognized by the presence of carbon in the form of graphite flakes. Copper is high corrosion resistant. Moreover, pure copper is one of the best wires for electricity. Copper is reddish brown. Aluminum is also a good driver for electricity. It's very fluid and fluid. It forms useful alloys of copper, zinc and iron. Aluminium is very high corrosion resistant steel. Composites are a combination of two or more materials with composition variables. They show properties other than custom components. Composite material is better than any component in terms of strengths, heat resistance and rigidity. Wood consists of strong and flexible cellulose fibers. Plywood is a composite thin sheet of wood. It hs grains alternate sheets perpendicular to each other and glued together a polymer between them. RCC steel rods are embedded in a concrete mixture consisting of a composite cement, sand aggregate, and water. Properties of technical materialsThe different material properties: Mechanical properties: Mechanical propertiesPhysical propertiesChemical propertiesThe mechanical properties of the material determine the behavior of the materials under the influence of external forces. These properties are: Strength: It is defined as the ability of materials to maintain load without distortion. The stronger the material, the higher the load it can withstand. Stiffness: This is the ability of a material to withstand deformation. Flexibility: This is the property of a material that causes the deformation caused by the applied load to disappear completely when the load is removed. Alternatively, you can access it as follows. This is the property that causes the material to regain shape and size after removing the force applied externally. Plasticity: This is the ability of a material to achieve some degree of permanent deformation without fracture or failure. This is the opposite of flexibility. Plasticity: This is the property that allows you to deform to thin sheets. This can be done by rolling or hammering action without breaking. Gold has the highest level of fluidity. Copper, aluminum, silver, and nickel are some of the other metals that exhibit plasticity. Ductiousness: This property is due to show the extent to which a material can be pulled from the wires or elongated before the break occurs. Toughness: This measure of the amount of energy a material can absorb before it happens. Ductile materials are harder than fragile materials. Weldability: This is the property of the material, which indicates the ease with which two similar or different metals are put together. This is the ability of a material to get welded. Machinability: This measure is easy, with which a material can be machined or finished. Fatigue: This is an error that occurs in components subject to dynamic and fluctuating loads. Hardness: It is the property of a material, thanks to which it offers resistance to penetration and scratching. Hard materials are resistant to wear and scratches. Diamonds are the hardest material. Fragility: This is the property of materials that cause it to break without too much permanent distortion. This property is the opposite of fluidity. creep: this slow plastic deformation of metal under constant load. In general, the Temperature. Metals usually show creep at high temperatures, while plastic, rubber temperature sensitive to creep. Flexibility: This material's ability to absorb energy flexibly. This property is important in the manufacture of springs and shock absorbers, etc. The technical materials are usedThe following types of metals and their subtypes applications. SteelCast ironCopperAluminiumMild SteelIt is a good

shock absorber, so it is used to make manufacturing screws. Universal beamsCase sparring steelGearsGrey Cast IronMachine tool structure, ie frame, bed. Frames for electric motors. Cylinder blocks and heads for IC motors. Turning machine and drill. Medium carbon steel Used for the production of main drums, crankshafts, axles, gear shafts and axles. Also, anchor ships, Axe saw plates, hammers, valve strings, and self-tape screws. High Carbon SteelUsed punches and paints, rail rails, lift leaf springs, and saws cutting steel and broaches. Alloy SteelNickel steel used in the manufacture of IC engine valves, turbine blades, clock pendulums, measuring instruments. Vanadium steel is used to make springs, gears, shafts, and various other devices. It's made for copper households. It is used in the manufacture of electrical cables and wires. It's used in engine reeds. It is used in capacitors and boilers. Aluminum, which has high corrosion resistance, is used to make reflectors and telescopes. They make foil as food packaging. It is used for the manufacture of dugatna, electrical cables, kitchen utensils, car parts. Parts.