



UNIT 5. METALS

METALS	CLASSIFICATION	SHAPING TECHNIQUES
- PROPERTIES - MINING	- FERROUS MATERIALS - NON FERROUS MATERIALS	- SHAPING - POWDER METALLURGY - CASTING

1. METALS

- Where can we use metals?

Activity: write at least five places where you can find metals.

MANUFACTURING



TRANSPORT



MACHINERY



SCHOOL



TELECOMMUNICATIONS



HOME



CONSTRUCTION

1. METALS

1.1. THE PROPERTIES OF METALS

Metals are typically:

- Heavy
- Hard
- Non-adhesive
- Cold
- Smooth
- Often shiny



Smooth (adj.): a surface that is not rough.

Shiny: reflects light off a smooth or polished surface.

1. METALS

- **PHYSICAL PROPERTIES:**

1. Strong (mechanical strength).

Can resist forces while not becoming deformed easily.

e.g. tension, shear, compression and flexural or bending force.



2. Ductile and malleable.

Can be made into wire and sheets.



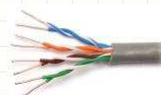
3. Plastic and elastic.

Some metals are elastic – they can bend and return to their original shape when they are affected by external forces; others are not elastic and are deformed by external forces.

1. METALS

4. Tough.

Do not break easily.



5. Electrical, thermal and acoustic conductivity.

Good conductors of electricity, heat and sound

6. Magnetic.

Magnets attract some metals.



7. Fusible.

Can be easily welded to other metallic objects.



8. Expansion and contraction.

When the temperature rises, they expand and when it falls, they contract.

1. METALS

- **CHEMICAL PROPERTIES**

Oxidation.

React with oxygen in water and air.

- **ECOLOGICAL PROPERTIES**

1. Recyclable and reusable.

Most metals are recyclable: when they have been used, they can be processed to be used again.

2. Toxic

Some metals, such as lead or mercury, present a danger to human beings and the environment.

1. METALS

1.2. WHERE AND HOW METALS ARE OBTAINED

Metals are taken from minerals contained in rocks.

E.g. copper is extracted from chalcopyrite or malachite.

- **Surface mining:**

It is used when the mineral layer is near the surface.

- **Underground mining:**

It is used when the mineral is deep below the surface.

1. METALS

In mining, we use explosives, excavators, drills and other machines to extract the mineral from the rock.

CONTAMINATION

After mining, the minerals are separated into **ore** and **gangue**.

Gangue: unusuable, waste material that surrounds or is a part of metal ores.

Ore: rock or earth from which metal can be obtained. (mena).

The metal is extracted from the ore in an **ironworks** through physical and chemical processes.

Ironworks: a factory where metals are processed. (altos hornos).

Depending on their origin, metals can be classified as ferrous and non-ferrous.

2. CLASSIFICATION

2.1. FERROUS MATERIALS.

Ferrous metals: Minerals containing IRON.

Characteristics:

- Common
- Inexpensive to extract
- Need processing to produce pure iron
- Used to make alloys

An alloy is a mixture of two or more chemical elements – the primary element is a metal.

2. CLASSIFICATION

Iron alloys are created by adding carbon.

There are three types according to the amount of Carbon that we add:

-Pure iron.

The concentration of carbon is between 0,008% and 0,03%.

-Steel.

The concentration of carbon is between 0,03% and 1,76%.

-Cast iron.

The concentration of carbon is between 1,76% and 6,67%.

2. CLASSIFICATION

PURE IRON AND CAST IRON

1. **Pure iron** is a greyish white metal with good magnetic properties.

Disadvantages:

a) **Corrodes** easily.

Corrode: deteriorate due to the effects of air, water or acid.

b) Only **melts** at very high temperature (high melting point).

Melts: change from solid into a liquid.

c) It is difficult to **machine**.

Machine (vb): shape, mould or change something using a machine. To work with.

Uses:

Electrical and electronic components.

2. CLASSIFICATION

2. **Cast iron** is extremely hard and resistant.

Uses:

Machinery parts, pistons, street lamps, drain covers (*tapas de alcantarillado*), etc.

Lower melting point. Bad electrical conductivity.

STEEL

Steel is an **alloy** of iron containing a small quantity of carbon.

It has better mechanical properties than iron because it is very hard and strong.

Alloy steels:

We add other chemical elements to steel to **improve** or achieve certain properties.

Improve: Make better.

2. CLASSIFICATION

Examples:

-**Silicon** makes the alloy magnetic and improves elasticity.

-**Manganese** makes the alloy harder and heat-resistant. It is used to make stainless steel.

-**Nickel** improves strength and prevent corrosion.

-**Tungsten** makes the steel harder, more heat-resistant and prevents corrosion.

-**Chrome** makes the alloy harder and tougher and more **rustproof**.

Rustproof: protects against rust.

-**Lead** make it easier to cut steel with machine tools.

Others metals used to make alloy steels: molybdenum, titanium, niobium or vanadium.

2. CLASSIFICATION

The steelmaking process:

Stages in the steelmaking process:

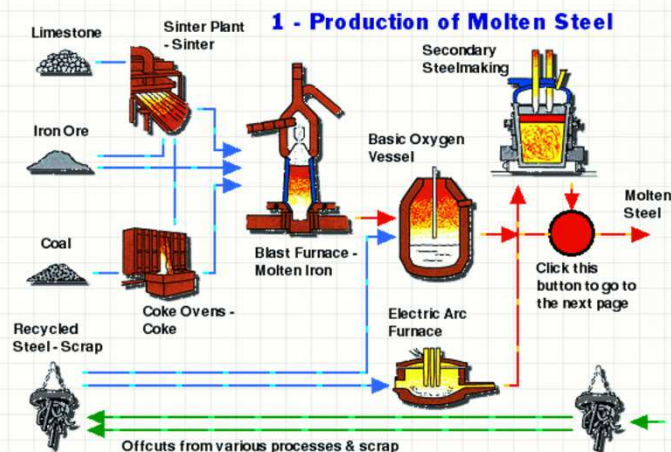
1. The iron mineral is washed to remove impurities.
2. It is crushed and **sieved** (the gangue is separated from the ore). (*Sieve (vb). Pass through a net with very small holes*)
3. The iron mineral (ore) is mixed with carbon and limestone.
Limestone: *piedra caliza*.
4. This is **smelted** at a temperature of over 1500°C in a blast furnace. (*Smelt (vb). Extract metals by heating*).
5. **Pig iron** is obtained (**molten** iron mixed with carbon and impurities). (*Molten (adj). Reduced to liquid by heating*).

Ore: *mena*.

Pig iron: *hierro en lingotes*.

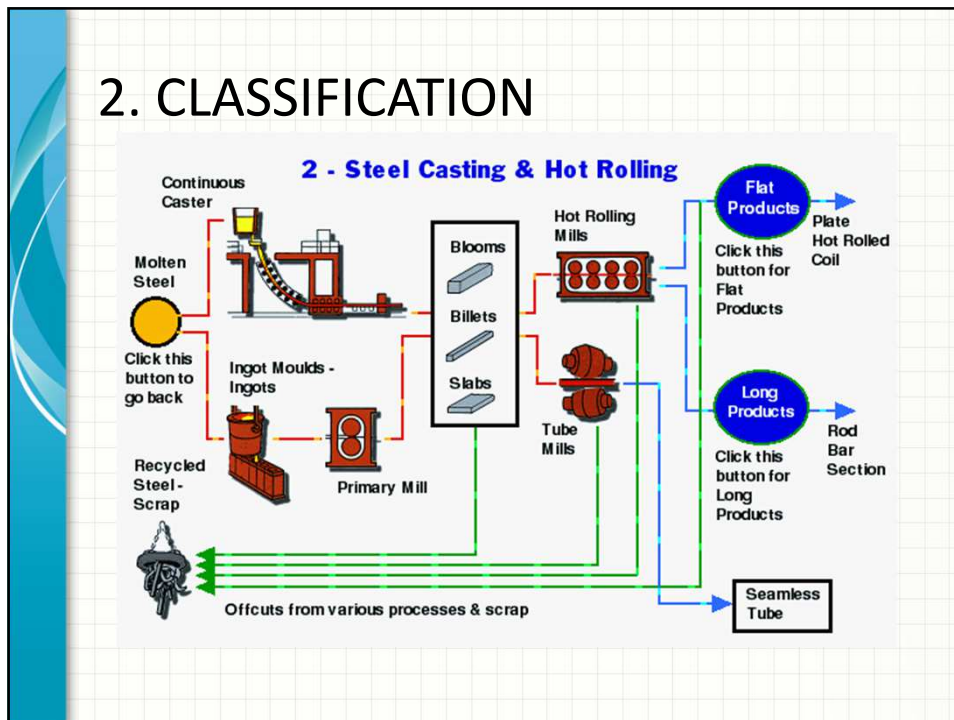
2. CLASSIFICATION

• The steelmaking process:



The pig iron is then processed to reduce percentage of carbon content and to eliminate impurities.

2. CLASSIFICATION



2. CLASSIFICATION

2.2. NON-FERROUS MATERIALS

There are other metals that don't contain iron.

They have a lot of uses but they're often expensive because they can be **rare** and are more difficult to extract.

Rare: not common.

Non-ferrous metals are classified by density: ultra light, light and heavy.

2. CLASSIFICATION

LIGHT AND ULTRA-LIGHT METALS:

Aluminium:

- Processed from bauxita.
- Silvery white.
- Highly resistant to corrosion.
- Very soft.
- Low density.
- High malleability and ductility.
- Good at conducting electricity and heat.

Uses: [high voltage power lines](#), [planes](#), [cars](#), bicycles, [light metalwork](#), [roofing](#), decoration, kitchen tools and [drinks cans](#).

Roofing: material used for the roofs of buildings. (roof: tejado)

2. CLASSIFICATION

Magnesium:

- Extract from several minerals: magnesite, dolomite, carnallite, epsomite and olivine.
- Shiny, silvery white.
- Very light, soft and malleable, but not very ductile.
- Reacts very strong with oxygen.
- Very light alloys can be achieved by combining magnesium with other metals.

Uses: pyrotechnics ([fireworks](#)), the [aerospace](#) and car industries and [bicycles](#).

2. CLASSIFICATION

Titanium.

- Extract from two minerals: rutile and ilmenite.
- Silvery white, shiny.
- Light.
- Very hard and strong.

Uses: the [aerospace industry](#), building [structures](#) and medical [prostheses](#) (artificial **limb** replacements). (*limb: miembro*)

2. CLASSIFICATION

HEAVY METALS

- LEAD:

Source: from Galena.

Silvery grey.

Soft and malleable.

It is very toxic when lead **fumes** are inhaled.

Fumes: gas, smoke, or vapour that has a strong smell or is dangerous to inhale.

¿Por qué antiguamente se utilizaba gasolina con plomo y ahora gasolina sin plomo? 5 líneas.

Uses:

[Batteries](#), [protective](#) measures against nuclear radiation.

An additive in glass to give hardness and add weight.

2. CLASSIFICATION

- TIN (*Estaño*)

Source: from Cassiterite.

Shiny white.

Very soft.

Does not oxidase at room temperature.

Uses:

Tin oil and tin plate (a sheet of steel coated on both sides with a thin layer of tin) (*Hojalata*)

Alloyed with lead, it is used for soft soldering.

2. CLASSIFICATION

- ZINC

Source: Sphalerite and hemimorphite.

Bluish grey.

Shiny.

Weak a lot temperatures.

Not very hard.

Uses: roofing, *plumbing* and in the car industry.

Plumbing: the water, gas or waste pipes in a building. (Fontanería).

A layer of zinc is used on other materials to stop corrosion.

2. CLASSIFICATION

- COPPER

Source. Cupritre, chalcopryite and malachite.

Corrodes or oxides very easily.

Uses: [electrical wire](#), [telephone lines](#), [pipes](#), [radiators](#), as decoration and in architecture, jewellery and **handicrafts**.

Handicrafts: decorative objects made by hand.

2. CLASSIFICATION

- BRONZE

Source: alloy of copper and tin.

Resistant to wear and corrosion.

Uses: [boat propeller](#), filters, [church bells](#), sculptures, [nuts](#), [bearings](#) and [cogs](#).

2. CLASSIFICATION

BRASS

Source: alloy of copper and zinc.

Very resistant to corrosion.

Uses: [handicrafts](#), jewellery, [plumbing](#), [capacitors](#) and turbines.

Capcitor: electrical device characterised by the ability to store an electric charge.

Handicrats: artesanía

Plumbing: fontanería

Capacitors: condensadores

