

Course Name: MME 102

Group No.:01

Experiment No.: 1(a), 1(b)

Name of the Experiment:

1(a): IDENTIFICATION AND USE OF MATERIALS IN COMMON ENGINEERING APPLICATIONS

1(b):SPOT AND SPARK IDENTIFICATION OF METALS AND ALLOYS

Date of Performance:

1(a): 01. 09. 2024

1(b): 01. 09. 2024

Date of Submission:

07. 09. 2024

Submitted To
Ahsiu Rahman Nirjhar
Lecturer, Dept of MME, BUET

Submitted By
Praggo Pabon
Student ID: 202311002
Department: MME
Section: A

Experiment No: 01 (a)

Name of the Experiment: Introduction to common engineering materials.

Materials Used:

Copper wire, Zinc ingot, Tin ingot, Magnesium ingot, Pig Iron, Aluminium ingot, Antimony, Hard Coke, Fire Bricks, Ferromanganese, Ferrosilicon, TMT Steel Bar, Chromium, Bentonite Clay, Steam Coal, Sodium Silicate, Graphite Shaft, Aluminium Casting, Poly Styrene, Pure Lead, Ferrozine, Green Sand, Parting Sand, Jute fiber, Glass Mat.

Methodology:

For each material, careful observation of its color, weight and if applicable, its crystalline appearance was carried out both sight and touch.

1. Copper Wire: Reddish

Type: Non-ferrous

Chemical Formula: Cu, O₂ (0.02% - 0.04%)

Applications:

- Electrical conductors for power transmission and distribution.
- Telecommunication cables for telephone, internet, and data transmission.
- Manufacturing components such as printed circuit boards, motors, and transformers.
- Electrical wiring in buildings, appliances, and vehicles.
- Heat exchangers and radiators in HVAC systems.



Fig 01: Copper Wire

2. **Zinc Ingot:** Gray, heavy.

Type: Non-ferrous Zn (99.9%)

Applications:

- Galvanizing steel to protect against corrosion.
- Brass alloys for plumbing fixtures, doorknobs, and musical instruments.
- Die-casting for automotive components, hardware, and toys.
- Zinc-air batteries for hearing aids and medical devices.



Fig 02: Zinc Ingot

3. **Tin Ingot:** Gray in color, shiny

Type: Non-ferrous

Chemical formula: 99.99% pure Sn

Applications:

- Tin plating for food cans and containers.
- Solder for joining metals in electronics, plumbing, and construction.
- Bronze alloys for statues, bells, and bearings.
- Food packaging as a protective coating.



Fig 03: Tin Ingot

4. **Magnesium:** Lightweight

Type: Non-ferrous

Chemical formula: 99.99% Mg

Applications:

- Lightweight alloys for aerospace components, such as aircraft parts and rocket bodies.
- Automotive components, including wheels, engine blocks, and transmission cases.
- Consumer goods, such as laptops, cameras, and sports equipment.
- Fire protection materials, as magnesium oxide is a flame retardant.



Fig 04: Magnesium

5. **Pig Iron:** Grayish-black

Type: Ferrous

Chemical formula: Fe, carbon, silicon, sulfur

Applications:

- Raw material for steel production in blast furnaces.
- Cast iron products, such as pipes, radiators, and cookware.
- Ferrous alloys for various industrial applications.



Fig. 05: Pig Iron

6. **Aluminum Ingot:** Heavy

Type: Non-ferrous

Chemical formula: Aluminum (99.99%)

Applications:

- Lightweight alloys for aerospace components, such as aircraft frames and wings.
- Automotive components, including engine blocks, transmission housings, and wheels.
- Construction materials, such as building frames, siding, and windows.
- Consumer goods, including cookware, cans, and appliances.
- Packaging materials, such as foil and cans.



Fig 06: Aluminum Ingot

7. **Antimony:** Sparkling gray

Type: Non-ferrous

Chemical formula: Sb (99.9%)

Applications:

- Alloys for batteries, especially lead-acid batteries.
- Flame retardants for plastics and textiles.
- Pigments for paints, ceramics, and glass.
- Semiconductors for electronic devices.



Fig 07: Antimony

8. **Hard Coke:** Black

Type: Carbon-made

Chemical formula: Carbon, low-sulfur

Applications:

- Fuel for blast furnaces in steel production.
- Metallurgical processes, such as smelting and refining metals.
- Carbon electrodes for electric arc furnaces and batteries.
- Production of activated carbon for filtration and purification.



Fig 08: Hard Coke

9. **Fire Brick:** Heavy, yellowish

Type: Non-ferrous

Chemical formula: Al_2O_3 , SiO_2 , SiC_4 (1-15%)

Applications:

- Alloying element for steel production, especially for high-strength steels.
- Improves the mechanical properties of steel, such as hardness, toughness, and wear resistance.
- Used in the production of manganese dioxide for batteries and pigments.



Fig 09: Fire Brick

10. **Ferromanganese:** Pale grayish

Type: Ferrous

Chemical formula: Fe Mn

Applications:

- Alloying element for steel production, especially for high-strength steels.
- Improves the mechanical properties of steel, such as hardness, toughness, and wear resistance.
- Used in the production of manganese dioxide for batteries and pigments.



Fig 10: Ferromanganese

11. **Ferro Silicon:** Bluish gray

Type: Ferrous

Chemical formula: FeSi

Applications:

- Alloying element for steel production, especially for electrical steels and cast iron.
- Improves the electrical properties of steel, such as permeability and magnetic loss.
- Used in the production of silicon for semiconductor devices and solar panels.



Fig 11: Ferro Silicon

12. TMT Steel Bar: Heavy

Type: Ferrous

Chemical formula: Fe, Carbon, Sulfur and Phosphorus

Applications:

- Reinforcement for concrete structures, such as buildings, bridges, and dams.
- Provides strength and durability to concrete structures.
- Available in various grades to meet different engineering requirements.



Fig 12: TMT Steel bar

13. Chromium: Bright silver

Type: Non-ferrous

Chemical formula: 99.99% Cr

Applications:

- Alloying element for stainless steel, providing corrosion resistance and a shiny finish.
- Plating for decorative purposes and corrosion protection.
- Pigments for paints, ceramics, and glass.
- Catalysts for chemical reactions.



Fig 13: Chromium

14. **Bentonite Clay:** Yellowish

Type: Ceramic

Chemical Formula: $\text{Al}_2\text{H}_2\text{O}_{12}\text{Si}_4$

Applications:

- Drilling muds for oil and gas exploration and production.
- Foundry binders for molding sand in metal casting.
- Pet litter due to its absorbent properties.
- Cosmetics and personal care products, such as face masks and hair conditioners.
- Construction materials, such as waterproofing agents and soil stabilizers.



Fig 14: Bentonite Clay

15. **Steam Coal:** Black or dark brown

Type: Non-ferrous

Chemical formula: Carbon, oxygen, nitrogen

Applications:

- Fuel for power plants to generate electricity.
- Industrial boilers for heating and processing steam.
- Residential heating in some regions.
- Production of coke for steelmaking and other metallurgical processes.



Fig 15: Steam Coal

16. **Sodium Silicate:** Translucent (in liquid form), colorless (in solid form)

Type: Non-ferrous

Chemical formula: Na₂O, SiO₂, H₂O

Applications:

- Adhesives for paper, cardboard, and ceramics.
- Detergents and cleaning agents.
- Water glass for preservation of eggs and wood.
- Refractory materials for high-temperature applications, such as furnace linings.
- Production of silica gel for drying and moisture absorption.



Fig 17: Sodium Silicate

17. **Graphite Shaft:** Dark gray

Type: Composite material

Chemical formula: composition of C, N, O, H

Applications:

- Electrodes for electric arc furnaces in steelmaking and other metallurgical processes.
- Batteries, especially lithium-ion batteries.
- Lubricants for machinery and automotive components.
- Nuclear reactors as a moderator to slow down neutrons.
- Pencil lead.



Fig 17: Graphite Shaft

18. Aluminum Casting: Heavy, silvery-white

Type: Non-ferrous

Chemical formula: Al, Si, Cu, Zn

Applications:

- Manufacturing components for automotive, aerospace, and consumer goods industries.
- Engine blocks, transmission housings, and other automotive parts.
- Aircraft components, such as landing gear and engine casings.
- Consumer goods, such as cookware, toys, and electronics.
- Structural components for buildings and bridges.



Fig 18: Aluminum Casting

19. Poly Styrene: Hard, Granule

Type: Polymer

Chemical Formula: $(C_8H_8)_n$

Applications:

- Packaging materials, such as foam cups, plates, and trays.
- Insulation for buildings and appliances.
- Toys and consumer products.
- Electronics components, such as CD cases and television housings.
- Foam cups and plates for food service.



Fig 19: Poly Styrene

20. **Lead:** Dark gray

Type: Non-ferrous

Chemical Formula: Pb (99.9%)

Applications:

- Batteries, especially lead-acid batteries.
- Ammunition, such as bullets and shot.
- Plumbing pipes and fittings.
- Radiation shielding materials.
- Solder for joining metals.



Fig 20: Lead

21. **Ferrozine:** Dark Red

Type: Organic compound

Chemical formula: C₂₀H₁₃N₂O₄SNa

Applications:

- Analytical reagent for the determination of iron in water, soil, and biological samples.
- Used in environmental monitoring and quality control.
- Available as a powder or solution for laboratory use.



Fig 21: Ferrozine

22. Green Sand: Gray

Type: Composite Chemical

Formula: Mixture of sand, clay, water and additives like coal dust or sea coal.

Applications:

- Molding material for casting metals, such as iron, steel, and aluminum.
- Made from a mixture of sand, clay, and water.
- Provides the shape and support for the molten metal during the casting process.
- Used in foundries and metalworking industries.



Fig 22: Green Sand

23. Parting Sand: Grayish

Type: Composite

Chemical Formula: Grained clay free dried silica sand, sea sand or burnt sand

Applications:

- Used to prevent sticking between the mold and the casting during the metal casting process.
- Applied to the mold surfaces to create a barrier between the metal and the mold.
- Helps to ensure a smooth and clean finish on the casting



Fig 23: Parting Sand

24. Jute Fiber: Fibrous, clay-colored

Type: Polymer

Chemical Formula: Cellulose ($C_6H_{10}O_5$), lignin, hemicellulose.

Applications:

- Ropes, sacks, and bags for packaging and storage.
- Carpets and floor coverings.
- Textiles for clothing and home furnishings.
- Geotextiles for erosion control and soil stabilization.
- Industrial applications, such as filter media and insulation.



Fig 24: Jute Fiber

25. Glass Mat

Type: Polymer

Chemical Formula: $(SiO_2)_n$

Applications:

- Reinforcement for fiberglass products, such as insulation, boat hulls, and wind turbine blades.
- Provides strength and durability to fiberglass materials.
- Available in various thicknesses and densities to meet different engineering requirements.
- Used in construction, automotive, and marine industries.
-



Fig 25: Glass Mat

Result: Depending on the data stated above, a successful identification of materials has been done with casual efficiency.

Discussion: During the course of experiment, a multitude of materials were identified. The process posed quite a challenge as certain materials shared similar visible characteristics, such as: Steam Coal and Ferrosilicon looked almost the same in daylight, making it difficult to differentiate between them. To overcome this situation, convenient tags were placed in front of each example, facilitating accurate identification

Experiment No. 01 (b)

Name of the Experiment: Spot and spark identification of metals and alloys.

Materials used: Ferrous and non-ferrous metals, grinding wheel.

Methodology: To conduct this experiment, different materials, such as metals were selected and positioned in front of the grinding wheel. The interaction between them resulted in sparks due to the friction created.

| Sample No | Name of the Metal Sample | Characteristics of Spark | | |
|-----------|------------------------------|--------------------------|-------------------|-----------------|
| | | Color | Density | Length/Range |
| 1 | Tool Steel/ High Speed Steel | Reddish | Dense | Small Range |
| 2 | High Carbon Steel | Yellow | Very Dense | Not bright, Low |
| 3 | Low Carbon Steel/ Mild Steel | Yellow | Not So Dense | Long Stream |
| 4 | Aluminum | No Spark | No Spark | No Spark |
| 5 | Stainless Steel | Reddish | Very Small Stream | Small Range |
| 6 | Brass | No Spark | No Spark | No Spark |

Sample pictures from the spark experiment:



High Carbon Steel



High Speed Steel



Aluminum



Brass



Stainless Steel



Mild Steel

Result: The judgment after finishing the experiment is that the observational experiment was a success.

Discussion: The experiment was conducted with some precautions followed. For example— holding the metal with firm hands, maintaining a safe distance from the grinding wheel. The metals had very slight change or variation while showing the sparks, that is because of the carbon amount differences, otherwise, almost all metal sparks were identical. Metals with no Ferrum or non-ferrous metals displayed very low spark or absence of spark.