

Manganese Ore Characteristics



1. Pyrolusite



2. Cryptomelane



3. Braunite



4. Rhodochrosite

Manganese ore occurs mainly as oxide, carbonate, and complex mineral assemblages.



Mineral:
Pyrolusite

- **Composition:** MnO_2
- **Hardness:** Mohs 2–6.5 depending on texture



Mineral:
Cryptomelane

- **Composition:** K-bearing manganese oxide
- **Hardness:** Mohs 5–6.5



Mineral:
Braunite

- **Composition:** Manganese oxide-silicate
- **Hardness:** Mohs 6–6.5



Mineral:
Rhodochrosite

- **Composition:** MnCO_3
- **Hardness:** Mohs 3.5–4



Processing relevance

Mineral composition, hardness, density and gangue association influence crushing, liberation and beneficiation route selection.

Oxide and Carbonate Manganese Ore Comparison

Manganese Oxide Ore



Main minerals

- Pyrolusite
- Cryptomelane
- Braunite

Typical characteristics



Higher manganese oxide content



Dense mineral phases



Suitable for gravity or magnetic evaluation depending on liberation

Manganese Carbonate Ore



Main mineral

- Rhodochrosite

Typical characteristics



Carbonate manganese phase



Different density and hardness behaviour



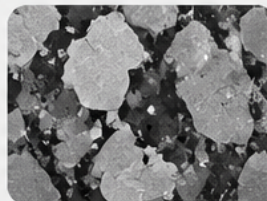
Often requires different beneficiation consideration



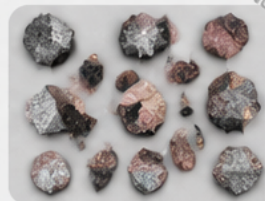
Engineering note:

Mineral phase determines crushing requirement, liberation size and beneficiation route.

Mineral Phase



Liberation Size



Crushing Requirement



Beneficiation Route



Mineral Liberation and Processing Influence

Manganese Ore Particle (Cross-Section)



Manganese Mineral

(Pyrolusite /
Cryptomelane / Braunite)

Quartz Gangue

Hard, abrasive
silicate gangue

Clay / Slime

Fine-grained clay
filling fractures
and pores

Iron-Bearing Mineral

Hematite, Goethite
and other iron oxides

Processing Influence Path



Mineral Composition

- Types of manganese minerals
- Gangue minerals present



Rock Hardness

- Mineral hardness
- Overall rock competency



Liberation Size

- Intergrowth and locking
- Required liberation degree



Crushing Requirement

- Target particle size
- Energy and wear demand

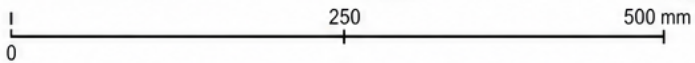


Beneficiation Route

- Gravity separation
- Magnetic separation
- Flotation or combined route



Engineering Note: The processing route depends on mineral association rather than manganese grade alone. Proper characterization and liberation assessment are essential for efficient flowsheet design.



Typical ROM manganese ore lumps (500–600 mm class)

ROM feed:

500–600 mm

class reference

Factors affecting crushing:

- Hardness
- Fracture condition
- Quartz content
- Clay content
- Weathering degree



Note: ROM = Run-of-Mine