中南大學
CENTRAL SOUTH UNIVERSITY

Unit 1 Extractive Metallurgy

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New words and expressions

- **extractive metallurgy** [ik'stræktiv]['metlɜ:rdʒi] 提取冶金
- **mine** 采矿
- **deposit** [dɪ'pɑ:zɪt]存款，矿床
- **gangue material** [gæŋ]**脉石材料**
- **raw material** **原料**
- **metal ingot** ['ɪŋgət]金属锭
- **mineral dressing** 选矿
- **decomposition**分解
- **flotation**浮选
- **Pyrometallurgy**[ˌpaɪrəʊ'metəˌlɜ:dʒɪ]火法冶金
- **hydrometallurgy** [ˌhaɪdrəʊ'metəlˌɜ:dʒɪ]湿法冶金
- **electrometallurgy** [ɪˌlektrəʊ'metəlˌɜ:dʒɪ]电冶金

New words and expressions

- **electromotive series** [ɪˌlektrə'moʊtɪv]电化学序
- **beneficiation** [ˌbenɪˌfɪʃɪ'eɪʃən]富集，选矿
- **impurities** [ɪm'pjʊərɪtɪs] 杂质
- **crude metal (oil)**
- **exploit ore** [ɪk'splɔɪt]开采矿物
- **end-products** 最终产品
- **semiproducts** 半成品
- **by-products** 副产品
- **solvent** ['sɑːlvənt]溶剂
- **distillation**[ˌdɪstɪ'leɪʃn]蒸馏

New words and expressions

- **refining** 精炼
- **high melting point metals** 高熔点金属
- **refractory metals** [rɪ'fræktəri] 耐火金属
- **refractory crucible materials** ['kruːsɪbl]耐火材料
- **molten state** ['məʊlt(ə)n]熔融态
- **valuable mineral components** 组分
- **high-and low-grade高低品位**
- **non-ferrous metals** ['nʌn'ferəs]有色金属
- **aluminum** [ə'luːmɪnəm] 铝
- **magnesium** [mæg'niːziəm]镁
- **nickel** ['nɪkl] 镍
- **lead** 铅

[ˈmæŋgəniz]

A

New words and expressions

- titanium [tɪˈteɪniəm] 钛
- zirconium[zɜːrˈkoʊniəm]锆
- chromium ['kroʊmiəm]铬
- niobium [naɪˈoʊbiəm]铌
- tungsten ['tʌŋstən]钨
- Tin [tɪn]锡
- Zinc [zɪŋk]锌
- **free energy** 自由能
- **sulfide** ['sʌlfaɪd]硫化物
- **sulphate** ['sʌlfeɪt]硫酸盐
- **zinc oxide** 氧化锌
- **manganese oxide** ['mæŋgəniːz]氧化锰
- **waste disposal** [dɪ'spoʊzl]废物处理

New words and expressions

- **molybdenum** [mə'lɪbdənəm]钼
- **cobalt** ['koʊbɔːlt]钴
- **volatile metals** ['vɑːlətl]易挥发金属
- **heavy metal** 重金属
- **lightweight metals** 轻金属
- **precious metal** 贵金属
- **rare metal** 稀有金属
- **rare earth elements** 稀土
- **rare scatter elements** 稀散元素
- **semimetals** 半金属

- **Definition of extractive metallurgy**
- **Flowsheet**
  - Mining
  - Concentration
  - Extractive metallurgy: pyrometallurgy, hydrometallurgy, electrometallurgy
    - How to select a method: nature and stability, purity, facilities
  - Refining: fire refining, electrolytic deposition, distillation, chemical purification

- **Refining of the metal**
  - Remove impurities
  - Fire refining: oxidation of the impurities by means of air or oxidation agent .
  - Electrolytic refining: high electromotive series and resistant to oxidation such as copper, gold, silver
  - Distillation: volatile metals such as zinc, mercury and cadmium
  - Other method: high melting point metal which active in the molten state.

- Followed by使用
- Parenthesis 插入语
- Usage of numerals数词的用法

- Metals are derived from ore mined from deposits which are confined to certain areas of the earth's crust. The geologist's discovery of ore and the raising of ore from the mine give the metallurgical industry its raw material.
- The function of extractive metallurgy is to process these ores, extract the metal and refine it. Between the mining of the ore and casting of the metal ingot for delivery to the fabricating industries a large number of specialized operations have to be performed.

- Ore is seldom ready to be processed when it is mined. It often contains unwanted rock and dirt. Therefore it is usually crushed into uniform size and then separated from the dirt, or gangue. This may be done magnetically, by washing(gold), by treatment with chemicals(copper ores), or by flotation.

Ore concentration

- The first stage in metallurgical practice will, in most cases, be a process of ore concentration designed to separate, by mechanical means, as much of the non-metallic gangue material from the mineral matter as possible so that a concentrate of rich material may be available to the subsequent processes of extraction.

Mineral dressing

- The mechanical operations necessary to separate the mineral from the gangue are known as mineral dressing. Their use and the variety of method adopted have increased greatly in recent years and, in fact, the modern output of metals would not be possible without the improved techniques devised to aid in concentrating both high- and low-grade raw materials.
- For example the introduction of the flotation process permits the beneficiation of copper ore containing only 0.5 percent copper, and formerly looked upon as waste.

Mineral dressing

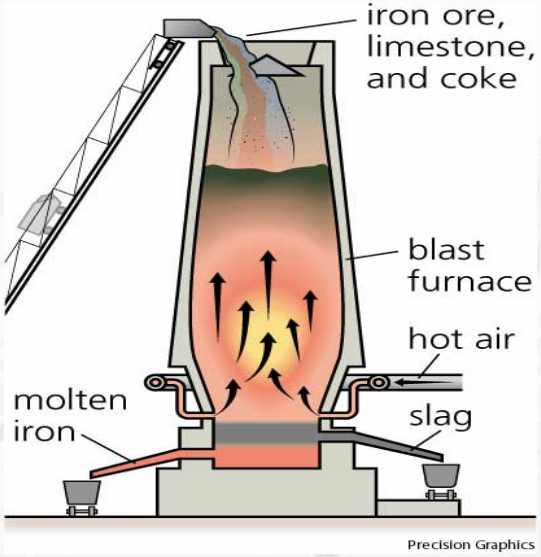
- Mineral dressing itself is only a preliminary stage in the isolation of the metal from the gangue material, and constitutes only a small part of the total effort expended in the recovery of metal.
- It concentrates the valuable mineral, and in no way effects any chemical change in its constitution.
- The removal and elimination of the remaining gangue, decomposition of the mineral and collecting and refining of the metal constitute the function of extractive metallurgy.
- isolate a from b分离，separate a from b

- Although the changes to be brought about are essentially of a chemical nature, because of the differing nature of the components of the mineral and their varying properties no one method of treatment is universally applicable; hence a diversity of methods are used.
- These may be broadly classified in three main types----

Component 组成，部件

Three types of extractive metallurgy

- Pyrometallurgy involves the extraction of metals by the application and action of heat.
- Hydrometallurgy is selective dissolution of metals from the ore by an appropriate liquid solvent, subsequently being recovered by a diversity of methods.

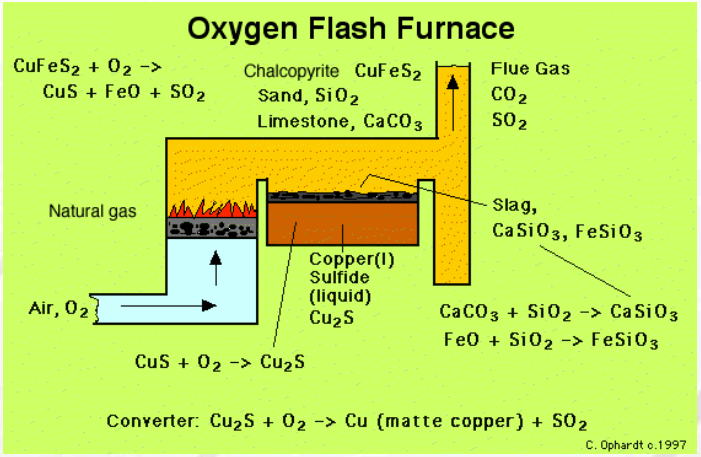


How to select a method

- Electrometallurgy covers the extraction and refining of metals by the application of electrical energy.
- The type of process applied to any particular mineral concentrate depends upon many factors, among which may be listed;
  - Nature and stability of ore or concentrate
  - stability of ore or concentrate,
  - required degree of purity of the metal
  - Facilities available in the locality

How to select a method

- Any one of the above three types of treatment may not in itself suffice for the treatment of a particular material, and in fact many ores require a combination of hydro- and electro-metallurgical methods.
- Copper and nickel are first given by pyro-metallurgical treatments followed by electrometallurgical methods.



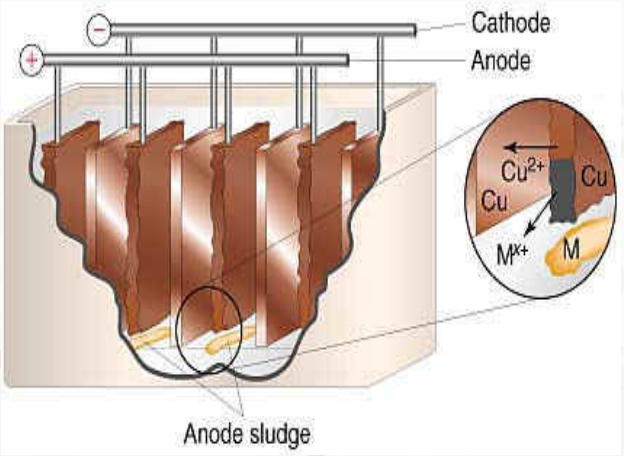
Refining of the metal

- It is largely by pyro-metallurgical methods that the major non-ferrous metals (copper, lead, tin, and nickel) are recovered.
- The final stages of refining of the crude metal may, however, involve electrolytic deposition. The two lightweight metals aluminum and magnesium are extracted by a combination of processing, a preliminary hydrometallurgical process being followed by electrolytic isolation of the metals.
- In some circumstances copper and zinc are also recovered from their ores by electrolytic reduction.
- A followed by B　A先，B随后

Refining of the metal

parenthesis

- Gold and silver, although often by-products resulting from the refining of copper and lead, are also recovered by treating their ores with suitable solvents.
- Other metals may require a highly specialized sequence of operations for their extraction.



Refining of the metal

- In order to attain a higher order of purity, further treatments have to be performed on the crude metal, and these subsequent treatments, following the first production of metal, constitute refining.
- The methods used vary with the difficulties involved in the removal of the impurities and may be classified under the following four headings—
  - Fire refining;
  - Electrolytical refining;
  - Distillation;
  - Chemical treatment

Refining of the metal

- Fire refining, which is the most widely employed of the refining treatments, depends on the oxidation of the impurities by means of air or oxidation agents followed by removal as slag of the resulting oxidized products.
- Electrolytic refining: metals are resistant to oxidation, and stand high in the electromotive series.
- Distillation is for volatile metals such as zinc, mercury and cadmium.

Refining of the metal

- On the other hand, to prepare some of the high melting point metals in a state which could be regarded as pure is a task of some difficulty.
- Elements such as titanium, zirconium, chromium, niobium, and molybdenum are so chemically active in the molten state that there are no practical refractory crucible materials to contain them.
- Not only that, but they are extremely sensitive to contamination by oxygen and nitrogen of the air.

Refining

- Ten parts per million of nitrogen, for example, renders chromium metal brittle, and two parts per million of oxygen does the same to molybdenum. Hence, for the refining of such metals special operational techniques have to be developed.
- 数值的表示方法

Ore ,mineral

- Ore 矿石
- An **ore** is a type of rock that contains sufficient minerals with important elements including metals that can be economically extracted from the rock.[1] The ores are extracted from the earth through mining; they are then refined (often via smelting) to extract the valuable element, or elements.

- Mineral矿物
- A mineral is a naturally occurring substance, representable by a chemical formula, that is usually solid and inorganic, and has a crystal structure. It is different from a rock, which can be an aggregate集合体 of minerals or non-minerals and does not have a specific chemical composition。

Translation

- 总统来了，随行的是他的私人保镖personal bodyguard。followed by
- 先高温焙烧 roasting 锌精矿，然后用硫酸浸出，最后电解精炼可以得到高纯金属锌 involve
- 铜电解过程产生的阳极泥中含有金和银，可以采用湿法冶金的方法回收。resulting from

Translation answer

- President arrived, followed by his personal bodyguard.
- Production of high purity zinc may involve roasting zinc concentrate, sulfuric acid leaching followed by electrolysis.
- The anode slime resulting from copper electrolysis contains gold and silver, which can be recovered by a hydrometallurgical process.

- 分数的表示法
  - 一般方式：分子（基数）/分母（序数）
  - 五分之三 three fifths 十分之七 seven tenths
  - 零点几，零点零几 分子为 a few or several 分母为tenths, hundredths
    - 该电阻上的电压为零点几伏。
    - The voltage across the resistance is a few tenths of a volt.
  - 科技界使用两种分数表示
    - 分子用”基数词 + parts “; 分母用 per 或 in a 或 in + 阿拉伯数字。
    - 百万分之三 3 parts in a million; 3 parts per million; 3 parts in 10^6
    - 分子用 a（an）+ 序数词 + part，分母相同。

    a third part in 10^6

- 数词在句子中作前置修饰语
  - 倍数or 分数+ { the+ 名词 / that+后置定语（多为of短语） / what从句

- 这个电压是加给放大器的信号的80倍

  This voltage is 80 times the signal applied to the amplifier.
- 其速度为光速的十分之三

  Its speed is three tenths that of light.

倍数表示

- 表示倍数增长的一个常用句型
- n times+比较级= n times as+原级+ as
  - 注意：汉语的倍数语英语相差1倍

这根导线比那根长4倍。
This wire is five times longer than that one.
该数值比理想值大 3.5 倍。
This value is nearly 4.5 times greater than the ideal one.

- 该电容器 capacitor 上的电压 voltage 为零点零几伏。
- 这两个数值之差 difference 为万分之十三。
- 这个平均速度 average velocity 是末速度 final velocity 的一半
- 这根导线 wire 比那根粗 thick 三倍
- 十年前该厂的产量仅为现在的五分之一。

THANKS

End

lecturer: Xiyun Yang

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