Permitted Uses Notes

Ore Reduction and Processing – Zone Industrial

"Ore reduction" refers to the metallurgical process of extracting a metal from its ore by chemically removing oxygen or other elements from the ore, typically through a high-temperature reaction with a reducing agent like carbon (coke) to produce a pure metal, while "ore processing" encompasses the entire sequence of steps including crushing, grinding, concentrating the ore, and then performing the reduction process to extract the desired metal.

Key points about ore reduction:

Chemical reaction:

The core of ore reduction is a chemical reaction where the metal ions in the ore gain electrons (are reduced) by reacting with a reducing agent, effectively removing oxygen atoms from the metal oxide compound in the ore.

Common reducing agents:

Carbon (in the form of coke), hydrogen, and carbon monoxide are commonly used as reducing agents depending on the specific metal ore and desired process.

Example: Iron ore reduction:

In the case of iron ore, the process involves heating iron oxide (like hematite) with coke in a furnace, where the carbon in the coke acts as a reducing agent to remove oxygen, leaving behind metallic iron.

Ore processing steps:

Mining: Extracting the ore from the earth.

Crushing and grinding: Breaking down the ore into smaller particles for easier processing.

Concentration (beneficiation): Separating the desired mineral from impurities using methods like flotation or magnetic separation.

Roasting or calcination: Heating the concentrated ore to remove volatile components like water or sulfur.

Reduction: The core process where the metal is extracted from the ore by chemical reduction.

Refining: Further purification of the extracted metal to remove remaining impurities.

Water Usage:

Depending on the process used, typically 124 to 11,300 gallons of water per ton of iron ore concentrate.

Metal Casting - Zone Industrial

Metal casting is a manufacturing process that involves pouring molten metal into a mold to create a 3D metal object. The mold is custom-made for each object, so metal casting can produce a wide variety of shapes and sizes.

How it works:

Create a mold with a cavity in the shape of the desired object

Pour molten metal into the mold

Let the metal solidify

Remove the metal from the mold

Finish the metal object by deburring, machining, or other processes

Types of metal casting:

Sand casting

A versatile process that uses sand to create the mold. It's suitable for many alloys, including steel, nickel, and titanium.

Investment casting

Also known as lost wax casting, this process uses a wax pattern of the desired object. The wax is coated with a refractory material, like ceramic, and packed into molding sand. The molten metal is then poured into the mold.

Die casting

Uses high pressure to quickly fill a reusable mold cavity with molten metal. It's suitable for mass production.

Water Usage:

In metal casting, water is primarily used for cooling purposes, particularly to cool molds and machinery during the casting process, with the majority of water usage being non-contact cooling water to prevent overheating of equipment, not directly contacting the molten metal; this can include cooling towers and closed-loop systems for recirculating water to minimize consumption and wastewater discharge.

Potential water conservation strategies:

Optimize cooling systems: Improving the efficiency of cooling systems by adjusting water flow rates and utilizing advanced cooling technologies.

Water reuse: Implementing closed-loop systems to recirculate and treat wastewater for reuse within the process.

Dry cooling technologies: Exploring alternative cooling methods like air cooling where appropriate.

Danger Issue Due to Fumes Released During Metal Casting:

"Fumes in metal casting" refers to tiny particles of molten metal vaporized during the casting process, which can be inhaled and are considered a significant health hazard due to their potential toxicity, often causing "metal fume fever" when inhaled, particularly if the metal contains elements like zinc, copper, aluminum, cadmium, or lead; these fumes can deeply penetrate the lungs and cause respiratory issues if not properly mitigated with ventilation and protective equipment.

<u>Key points about metal casting fumes:</u>

Composition:

The specific composition of fumes varies depending on the type of metal being cast, including the alloy used and any additives.

Health risks:

Inhaling metal fumes can lead to metal fume fever, characterized by symptoms like fever, chills, cough, muscle aches, and headaches.

Factors influencing fume generation:

High melting temperatures, improper ventilation, and the use of certain fluxing agents can increase fume production.

Safety measures:

To prevent exposure, proper ventilation systems, respiratory protection (like respirators), and appropriate personal protective equipment (PPE) are crucial in metal casting environments.

But how are these fumes kept from being released into the “outside” environment of the industrial buildings?