INCIDENT TYPE

Metal Fires

HAZARDOUS MATERIALS

Reactive combustible metals – magnesium, aluminum, titanium, and combination alloys

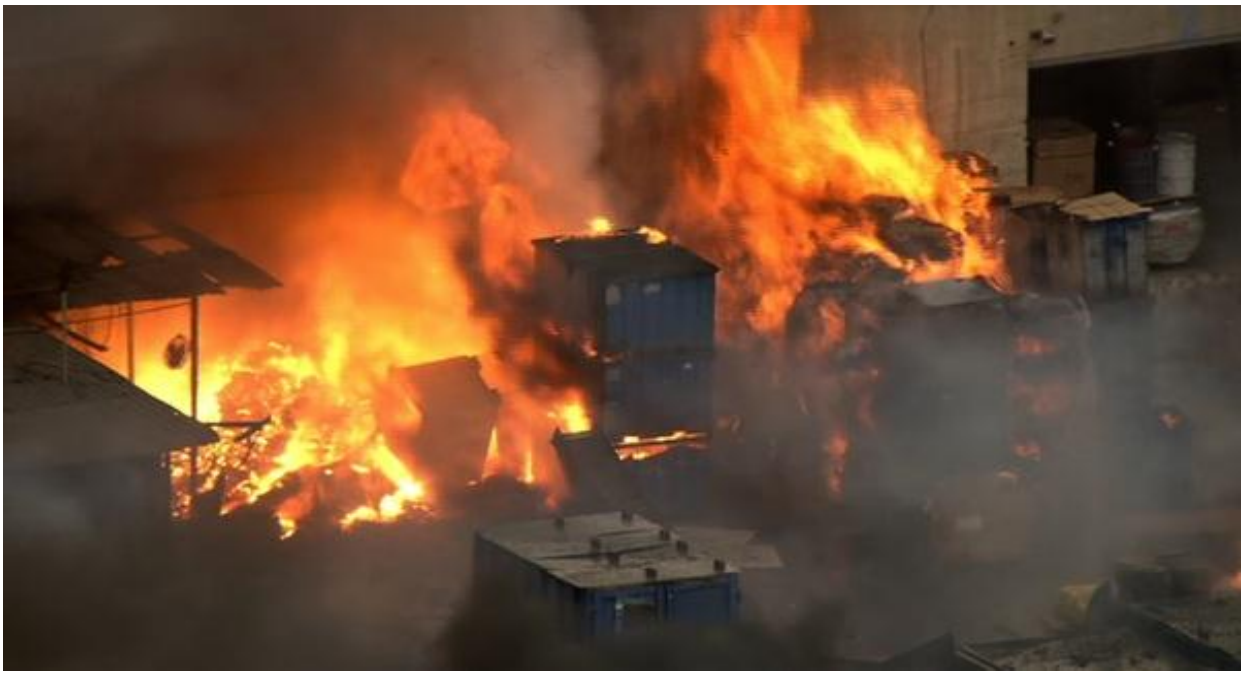
BACKGROUND

Industrial fires involving metals (shavings, chips, turnings, powder, or even solid blocks, in the case of titanium) present a complex challenge to firefighters and emergency responders because of reactivity. Explosions have been known to occur when fire suppression measures do not account for the reactivity of the metals.

Two recent fires at two separate United Alloys & Metals facilities located in Los Angeles, California, resulted in large explosions because titanium alloy was involved in both fires. The first incident occurred on June 11, 2010, when fire apparently broke out at an exterior boiler area and exploded a forklift propane tank. One employee was injured

from that explosion. When water was used to extinguish the fire, a larger explosion occurred and ejected red hot titanium chips and shavings hundreds of feet off the property.

The second fire occurred half a block away on July 14, 2010. That incident occurred at night and its cause and origin remain unknown. Water was used again to fight the titanium fire. More than one explosion occurred and three firefighters were injured as a result.



Titanium is widely used throughout various industries due to its corrosion resistance, strength and light weight. It is used in the aerospace industry for spacecraft and aircraft parts. Other applications include armored vehicles and helmets, jewelry and eyeglasses, bicycles, golf clubs and other sports equipment. Companies that store titanium usually have extinguishing media for use in case of fire.

United Alloys and Metals recycles high temperature alloys, such as titanium, nickel, and cobalt from the aerospace industry. The facility receives slab ends, nuts, bolts, or defective machine parts. Parts are cleaned using hot water rinse machines. Parts are then sorted, separated and graded using lead detectors, spark testing, and Fuess spectroscopes. Parts requiring further cleaning are washed inside a wash tank. Some

parts are further cleaned using acetone. Parts may be cut or ground and are then sent to "cobbler," or "briquetter" machines where they are stamped and compacted into brick like shapes. Parts are then packaged and shipped off site.

United Alloys and Metals utilizes "Metal X," an inert extinguishing agent similar to the media in Class D fire extinguishers.

CHEMISTRY

Nearly all metals will burn in air under certain conditions. Some are oxidized rapidly in the presence of air or moisture, generating sufficient heat to reach their ignition temperatures. Others oxidize so slowly that heat generated during oxidation is dissipated before the metal becomes hot enough to ignite.

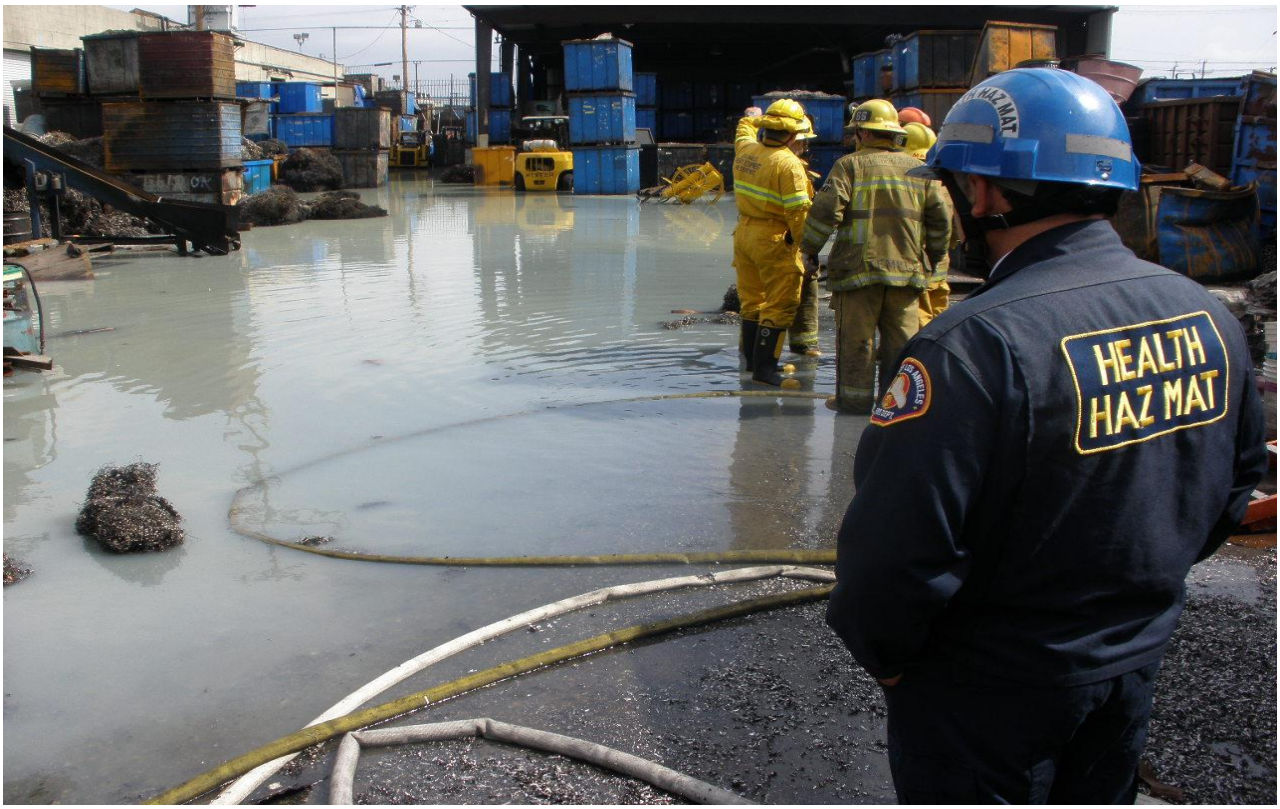
Certain metals react violently with water even when not involved in a fire. Sodium, lithium and potassium metal, for example, react with water to form hydrogen gas and the metal hydroxide (caustic). Water should not be allowed to contact these metals.

Magnesium also reacts with water, but less violently. When involved in a fire, water reacts with the unburned magnesium to form magnesium oxide and hydrogen gas. The hydrogen gas may add fuel to the fire and may even be explosive.

Aluminum is not as reactive when in solid block form. In powder form, however, aluminum is highly water reactive and forms an explosive mixture with air.

Titanium by itself is not water reactive as the surface is easily oxidized in air. That means the surface is made of a thin layer of titanium oxide, which is stable and non-reactive with water. But when titanium is already involved in a fire, it burns at a very high temperature, usually above 1500^{o}F. When water is used to extinguish titanium fires, hydrogen gas may be formed, potentially adding to the fire and creating an explosive environment.

Particle size, shape, quantity, and alloy composition are important factors to be considered when evaluating metal combustibility. Another consideration is the type of machine or cutting oil coating metal parts and surfaces. The oil may contribute to the ignition temperature of the alloy.



INSPECTOR NOTES

Though Hazardous Materials Specialists inspectors don't have an active role in mitigating metal fires, they can help prevent them. Following are some ideas to help prevent these fires from occurring:

1. A closer scrutiny of the business and/or contingency plan. Inspectors should review business and contingency plans of facilities that handle combustible metals to ensure that the plans address the hazards associated with metal fires.

2. Sharing of information to local fire stations. Inspectors can provide local fire stations with a list of companies that they have confirmed to have combustible metals. Local fire stations can then flag these businesses to make firefighters aware of the hazards when responding to these locations.

3. More detailed routine inspections. Inspectors can ensure that the appropriate type and quantity of extinguishing media is available on site for the combustible metals. They can require business operators to separate metal grinding operations from the stockpiles of combustible metals.

4. The facility should remove or clean oils from metal surfaces prior to grinding or re-surfacing. The building should post the appropriate NFPA placard at every entrance, with a sign for water reactive metals, when appropriate. Unsafe practices observed by the inspector should be addressed by the business operator. Other concerns that may not fall under hazmat jurisdiction should be referred to the appropriate agency, e.g. OSHA, Building and Safety, SCAQMD, etc.

FIREFIGHTER RECOMMENDATIONS

Do's

1. Know your district, businesses and associated hazards by using inspection reports and business plans.

2. Ensure use of proper personal protective equipment (PPE).

3. Gather as much information from the responsible party (RP) regarding the facility, hazardous materials on site, processes, etc. If a facility is unmanned, use 24 hour or emergency telephone numbers listed in the business plan. Additionally, labels and placards may be used to identify hazardous materials.

4. Utilize the expertise of facility personnel in mitigating the incident.

5. Consider the option of letting the fire burn itself out. Depending on the size of the fire, (a) surround the fire with dry salt, graphite or similar extinguishing agent, and (b) protect and monitor the surrounding area, particularly sensitive receptors like schools or day care facilities.[1]

6. Smoke contains oxides of the metals, which are primarily respiratory irritants. Consider evacuation for those who may be exposed.

[1] These considerations are intended for incident commanders to explore all options and are not intended as a dictate. The option of copious use of water versus use of dry salt/graphite will depend on availability and incident specific circumstances.

Don'ts

1. Do not rush in. Give consideration to the type and quantity of hazardous materials involved in the fire.

2. Do not use water when combustible metals are involved in the fire. Use dry salt or graphite where possible.

3. Do not ignore recommendations from facility personnel. They may have accurate information on the quantity and location of hazardous materials.

4. Do not allow firewater runoff to the storm drain without monitoring for pH. Metal hydroxides formed may produce high pH.