



## TECHNICAL SUMMARY

Slag is a by-product formed during the manufacturing of steel. In Blast Furnace Slag, calcium sulfide is a predominant impurity that results in environmental concerns, specifically when used for trails, road beds and embankments. The calcium sulfide leaches from the slag and results in a greenish/yellow liquid runoff that has an aesthetically undesirable odor and color, and could cause environmental concerns.

In the production of iron, limestone is added to help remove sulfur from the iron. This sulfur removing reaction is:



The calcium sulfide becomes part of the slag along with silica, alumina, magnesia or calcia.

In addition to effectively oxidizing the calcium sulfide, preventing any undesirable runoff, permanganate is also used to control any undesirable odors due to the formation of hydrogen sulfide.

## APPLICATION

Permanganate is effectively used to treat calcium sulfide containing slag generated from blast furnace operations used in the manufacture of steel. As the slag is processed into various aggregate sizes, liquid permanganate is sprayed onto the slag to oxidize sulfide impurities, specifically, calcium sulfide.

## CHEMISTRY



## DOSAGE

While there is variability in the amount of calcium sulfide, in most applications 0.25 pounds of permanganate per ton of slag has provided effective control.

## FACILITY REQUIREMENTS

- Proper feed equipment specially designed to handle permanganate is recommended and available from Carus Corporation. The product must be put into solution before being introduced into the system.
- Carrier water is needed with the low dosage of permanganate to assure adequate dispersion.

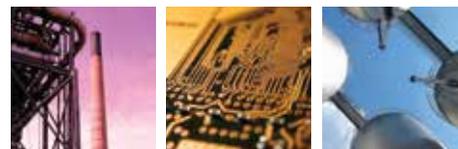
## BENEFITS

- Effective control of colored leachate and reduction in undesirable runoff
- Can result in 90% improvement in slag storage time and slag throughput
- Reduction of odors due to sulfide
- No danger of toxic gas releases

## REFERENCES

Ricketts, John A., Ispat Inland, Inc. "How a Blast Furnace Works", American Iron and Steel Institute, Steel Works, Learning Center, [www.steel.org/learning/howmade/blast\\_furnance.htm](http://www.steel.org/learning/howmade/blast_furnance.htm) .

Carus Corporation, "Permanganate Controls H2S Emissions during Slag Quenching" (1999).  
*Carus Form No. CX-5550*



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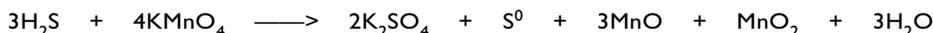
Foundries are major consumers of waste materials (scrap iron and steel). Unfortunately, the recycling of these materials results in the generation of toxic substances that must be managed properly. CAIROX® potassium permanganate is specifically used to control gas emissions such as toxic hydrogen sulfide and explosive acetylene gas that are released during the treatment of reactive calcium carbide desulfurization slag. Acetylene, a flammable gas is produced when excess calcium carbide, used for desulfurization of iron, reacts with the quenching water.

### APPLICATION

Calcium carbide desulfurization slag is removed from the molten iron and placed into a hopper. Rapid cooling (quenching) of the slag with water generates and releases acetylene gas from the slag and cools the slag within a reasonable amount of time. Control of acetylene and hydrogen sulfide can be achieved with the addition of CAIROX to the quench water. Another quenching method involves covering the slag with a mixture of CAIROX and spent sand from the mold pouring area. The reduction of sulfide emissions when using CAIROX is dependent upon pit filling rates, air cooling period prior to quenching, and the sulfur content of the slag.

### CHEMISTRY

For hydrogen sulfide:



### DOSAGE

The dosage will need to be determined at each site, taking into account sulfur content, pit filling rates and air cooling periods. A Carus Technical Sales Representative can assist with the dosages.

### FACILITY REQUIREMENTS

To effectively introduce permanganate into the system, proper feed equipment is necessary and available from Carus. No other changes are needed. Operators should be properly trained to handle permanganate and be aware of safety and emergency procedures.

### BENEFITS

CAIROX can effectively oxidize both hydrogen sulfide and acetylene. Permanganate reacts rapidly with the functional groups of the odorous compounds, destroying the odor without having to fully mineralize (degrade) the compound. Operators are no longer subjected to toxic hydrogen sulfide. Corrosion of cement and steel pipes is minimized. Neighbor complaints are reduced or eliminated.

### REFERENCES

Oman, D.; Waste Minimization in the Foundry Industry, Journal of the Air Pollution Control Association, Volume 38, No 7 (1988)

Rahmus, F.H.; Control of H<sub>2</sub>S Emissions During Slag Quenching, JAPCA Volume 23, No 10 (1973)