Oxygen Safety: The Status Quo May Not Be the Way to Go

Hazards are ever-present in the steel plant environment, and a heightened awareness and emphasis on safety is a necessary priority for our industry. This monthly column, coordinated by members of the AIST Safety & Health Technology Committee, focuses on procedures and practices to promote a safe working environment for everyone.

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Comments are welcome. If you have questions about this topic or other safety issues, please contact safetyfirst@aist.org. Please include your full name, company name, mailing address and email in all correspondence.

Editor's Note: The following article contains graphic descriptions of a workplace injury.

Case Study: Brad's Story

It was another day at the electric arc furnace for Brad, an employee of Steel Dynamics Inc. (SDI) for 12 years. Brad was on the furnace preparing to pour sand into the taphole, like he had done countless times before. Before beginning to pour the sand, he noticed the hole was blocked with unmelted scrap. While a blocked taphole is not the norm, it does happen from time to time.

Frustrated, Brad grabbed an oxygen lance without inspecting it and turned on the oxygen in order to clear the blockage. The moment the oxygen was turned on, a co-worker recalled Brad "lighting up" — the result of an oxygen lance explosion.

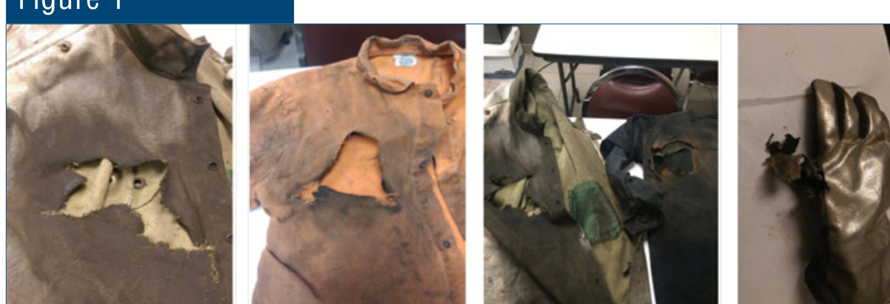
The suspected particle impingement explosion within the carbon steel lance made its way through four layers of clothing: an aluminized coat, a flame-resistant jacket and two 100% cotton shirts (Fig. 1). This doesn't include the burns sustained through his aluminized gloves, hood, neck drape, face shield and respirator. This resulted in partial-thickness and full-thickness burns to about 25% of his body, requiring extensive skin grafting.

The surgeon removed large patches of skin from both of Brad's thighs, from just above the knee to all the way up near the groin. These patches of skin were used to graft the burned right side of his pectoral area, down the side of his ribs and toward his hip. After stapling on his skin grafts, they stapled on a protective cover (pillow) to the newly grafted area. While Brad admitted that it was a rough experience, he said the skin removed from both of his thighs was the worst of all. He recalls waking up from the surgery and this area feeling like "somebody was holding a blowtorch to both legs."

Analysis and Action

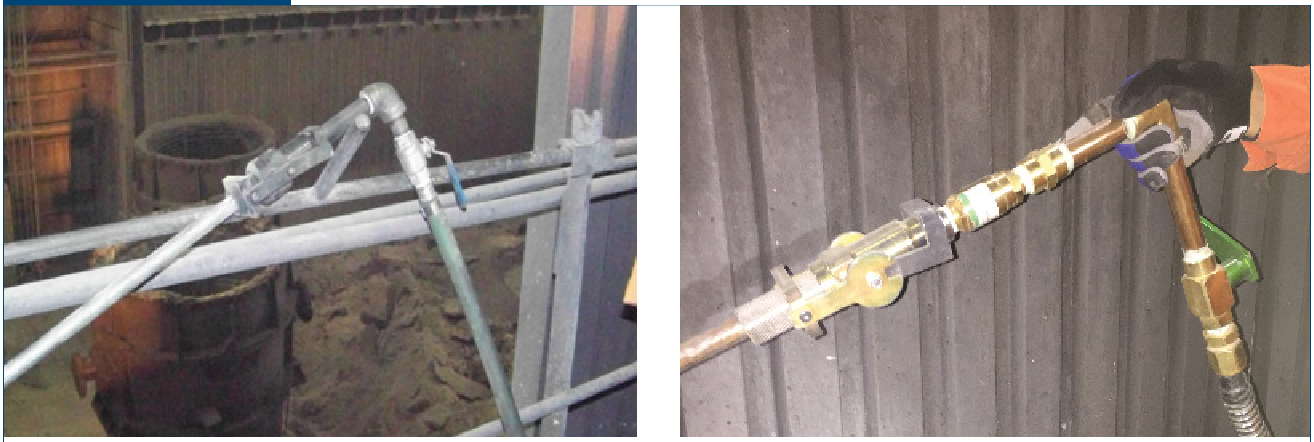
Analysis of the incident led to the determination that there were many contributing factors to Brad's incident, including: equipment being

Figure 1



Damage to personal protective equipment (PPE) as a result of Brad's oxygen lance incident.

Figure 2



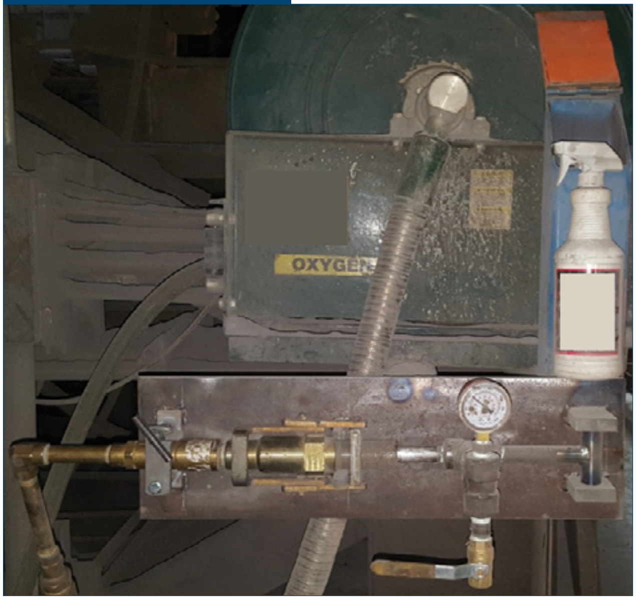
(a) (b)

Pre-incident carbon steel oxygen lance setup (a) and post-incident improved setup (b).

used by employees was not designed for oxygen use; inspections of equipment were found to be insufficient; the job safety analysis (JSA) was inadequate; additional training was needed; and personal protective equipment (PPE) had provided a false sense of security.

The response to the analysis included JSA updates, training improvements, equipment advancements, inspection improvements and momentum for a company-wide oxygen lancing subject matter expert (SME) group to identify and implement best practices.

Figure 3



Oxygen lancing system inspection station.

JSA Updates

A Taphole Lancing JSA and Oxygen Lance Pre-Use Inspection JSA were updated. These JSAs give detailed instruction on the necessary PPE, inspection requirements for oxygen lancing equipment, proper operations, correct positioning of equipment and personnel, replacing or removing equipment, and contact information for assistance.

Training Improvements

Oxygen lance training is required initially for employees new to oxygen lancing, and then refresher training annually thereafter. Training includes information on oxygen lancing system parts, installation, inspection, operation, maintenance, repair and accident prevention.

Equipment Advancements

The pre-incident carbon steel oxygen lancing setup (Fig. 2a) consisted of a simple hose, simple ball valve, simple hose barb, simple clamp and an "in-house" lance holder. This antiquated setup was replaced with a modern system consisting of CGA fittings, oxygen filter, regulator with pressure gauge, jumper hose and 3,000 psi oxygen swivel, oxygen-rated ball valve, thermal shutoff device, anti-slag safety device, and a lance holder all via a certified third-party supplier specializing in oxygen lancing equipment (Fig. 2b).

Inspection Improvements

On the day of Brad's incident, he grabbed the oxygen lance without inspecting it first. While an inspection of the oxygen lancing system by Brad (or his fellow co-workers) likely wouldn't have prevented this particular incident, the hazards of oxygen lancing system failures or leaks still remain.

During the review of Brad's incident, several oxygen lancing inspection shortcomings were identified. One inspection deficiency that improved immediately was requiring pre-shift and pre-use inspections. This improvement was complemented by monthly inspections by a qualified third party, as well as periodic inspections by a separate qualified third party.

Oxygen lancing system inspection stations were also installed to be used as a testing stand to aid inspections (Fig. 3). The stands are designed to securely hold the system in place while the oxygen lance rod holder is pressurized. Once the lance rod holder is pressurized, the pressure gauge is monitored and oxygen leak detector fluid is applied to detect leaks.

Also as a helpful inspection reminder, inspection signs were posted at oxygen lancing locations. An example of such a sign is shown in Fig. 4.

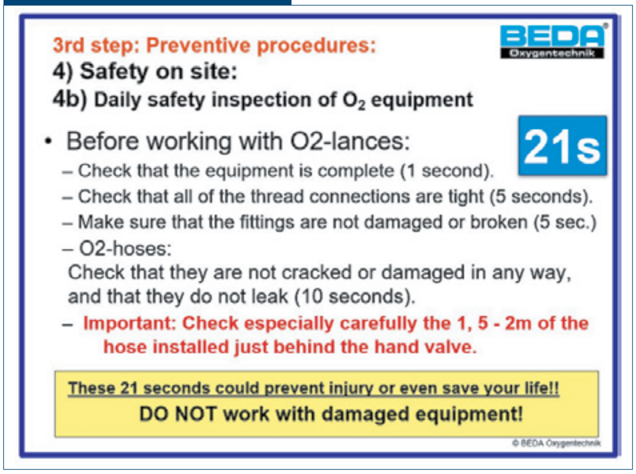
Subject Matter Expert Team: Oxygen Lancing

SDI created a Core Safety Group in 2015, made up of members from all operating platforms within SDI. Their mission is to guide SDI's overall safety program, identify best practices, establish expectations for new initiatives, establish a comprehensive auditing program and help establish SME teams.

No strangers to Brad's story and others like it across industry, SDI's Core Safety Group assisted in developing an oxygen lancing SME team. This team is made up of oxygen lancing specialists from multiple SDI locations. Its primary function is to assist in the evolution of SDI's oxygen lancing policy across all SDI platforms.

The oxygen lancing SME team meets periodically to discuss oxygen lancing successes, challenges and best practices. In 2018, this group developed and finalized an oxygen lancing safety policy and program. The following is a listing of what is included in the policy and program: oxygen safety overview, basic safety rules for oxygen lancing, practices that lead to prevention/reduction in lance use, equipment setup and selection, PPE requirements, inspections, standard operating procedures, maintenance (proper storage and repairs), and employee training requirements.

Figure 4



Example of an inspection sign posted at oxygen lancing locations at Steel Dynamics Inc.

Conclusion

Fortunately for Brad and his family, he healed well and was able to return to his job and resume a normal life. However, the result could have been much different, and for some in the iron and steel industry, that is the case. Testimonials like Brad's are continuous calls to action to critically analyze the quality of safe work procedures, safe behavior and safe equipment. It is the responsibility of everyone involved in an organization to identify and fix unsafe acts and conditions to prevent a story like Brad's, keeping in mind that the status quo may not be the way to go.

References

1. Beda Oxygentechnik, "21 Seconds Inspection" sign.

Disclaimer

SDI is sharing this story and its best practices in the hope that by focusing on safety concerns and following such best practices, similar incidents will be reduced or eliminated. SDI does not, however, warrant that such best practices will, in fact, achieve such results or will prevent such incidents or similar incidents. These suggestions, improvements and best practices are not all-inclusive, and it is wise to have multiple experienced individuals to review such suggestions, improvements and best practices before considering implementation. The choice to use or follow these suggestions, improvements and/or best practices shall be entirely that of each reader of this article, and SDI disclaims any and all responsibility or liability for personal injury or property damage that may occur as the result of any action or inaction by the reader. ✦