Cleaning Boiler Pipe External Surfaces with Dry Ice Blasting

Introduction

Dry ice blasting can be a very effective method of cleaning the external surfaces of watertube boiler pipes. However there are situations where the effectiveness is limited and alternatives must be considered. This paper discusses the advantages of dry ice blasting, the limitations that can occur and what can be done to mitigate these limitations, and what alternatives exist.

Dry Ice Blasting

Cleaning with dry ice pellets is non abrasive and produces no secondary waste. The pellets sublimate to gas on contact with the surface material, expanding by 750 times. It is the energy released by this process that is largely responsible for removal of surface contaminants.

Advantages

No secondary waste, the only material to be cleaned up is what has been removed for the pipe surfaces.
Non abrasive: no impact to or abrasion of metal surfaces, preventing risk of damage to tube walls, no matter how often cleaning is performed.
Dry: no risk of heat transfer surface corrosion and erosion of tube metal surfaces. Also avoids creating hard deposits from wet ashes and contaminants.

Limitations

Because it is a non abrasive process, dry ice blasting will not effectively remove material that is imbedded into a metal surface. For example, it will not remove rust or paint that is well keyed into the surface.
If boiler operation produces deposits that become very hard and the pipe surface is rough enough to provide a key for the material, it will be difficult to remove with dry ice blasting. Dry ice blasting is most effective when the underlying surface is smooth and unscratched, for example deposits on stainless steel are generally easily removed.

Examples:
Gilsen Ltd has routinely cleaned boiler pipes in wood fired boilers, generally on an annual basis. The results have been good, even though other cleaning methods were used previously. However a recent attempt to clean a coal fired boiler was not successful. This was because of the presence of a hard cement like deposit that covered about 40% of the surface, and was well keyed to the surface.

Mitigation
In the first instance, the inspection of the pipes prior to cleaning needs to be sufficient to determine if hard deposits exist under the softer deposits. This requires at least 1 square metre of surface is cleared and inspected. If hard deposits are found, these should be gently probed to determine how well adhered they

are to the pipe surface. Note that if the pipe surface is rough perhaps from previous abrasive cleaning methods, it is likely that the deposits will be well keyed on and dry ice blasting will not be effective.

However, if dry ice blasting is introduced at the first cleaning and maintenance cycle after installation it may be possible to maintain a cleaning programme that does not allow hard deposits to form. This can only be determined by inspection at the first opportunity after commissioning and operation, to check how quicly those deposits are forming, and then ensuring that no other cleaning method is used that could roughen the pipe surface e.g. abrasive blasting, or create a water-deposit interaction producing hard deposits e.g. high pressure water.

The ongoing effectiveness of dry ice blasting would also be determined by the initial smoothness of the pipe surfaces, and how that smoothness deteriorates over time with the normal operation of the border.

Other Cleaning Methods

High pressure water

This can be effective and is non abrasive, but with a number of disadvantages:

- Water-deposit interaction with risk of corrosion and creation of harder deposits
- Unless carefully performed, risk of damage to insulation, penetration seals and fittings in hard to reach locations.
- Removal of contaminated water can be difficult and may require special disposal methods.

Abrasive blasting

Effective in removing hard well adhered deposits, but again with major disadvantages:

- Risks damage to tube walls
- Effectively encourages greater adherence of future deposits
- Large amounts of secondary material to be removed

If abrasive blasting is considered, using blast media with the minimum hardness to remove the material will reduce risk of damage and abrasion, e.g. glass beads are about 30% softer than standard blasting garnet, as measured on the Mohs scale.

Blasting Media	Hardness (Mohs Scale)
Aluminium Oxide	9.0
Garnet	7.0
Glass	5.5
Plastic particles	3.5
Walnut Shell	3.0

Wet-abrasive blasting

Wet-abrasive blasting mixes abrasive media with water in a pressurised blast pot. It is very effective in removing hard deposits even at relatively low pressure when compared to dry abrasive blasting. It also uses about 1/3rd the quantity of blasting media when compared with dry abrasive blasting reducing the waste removal costs. With wet-abrasive blasting the risk of tube wall damage is mitigated by operating at low pressure, and using glass based media with the water which reduces the abrasive levels. However water does introduce the risk of corrosion. This can be mitigated to some degree by use of a rust inhibitor such as Hold Tight 102, and the removal of all softer materials prior to blasting. As such, wet-abrasive blasting may

be an option, but is likely to require a pre-clean using dry ice blasting to remove the softer materials and mitigate water deposit interaction and corrosion. This two stage process will likely be more expensive when compared to other methods.

Dry Ice Grit Blasting

Dry ice grit blasting combines both dry ice and a minimum quantity of abrasive agent. It is likely to be very effective on hard deposits, but being abrasive introduces the risk of damage to tube walls. It would also be more expensive than standard dry ice blasting. It has the advantage of being a completely dry process, and uses the least amount of media of any of the abrasive blasting methods, about 1/10th that of standard dry blasting.

Chemical Cleaning

Chemical product designed to soften hard deposits are sprayed onto the tubes, then once soft the deposits are removed using wet vacuum cleaning methods. These products are generally alkaline, designed to neutralise the more acidic deposits, and some are claimed to leave a corrosion inhibiting film on the metal surface. If this method is used, it would be advantageous to remove the softer deposits first, ideally with dry ice blasting, before applying the chemical, making this a two stage process and thus more expensive. The products used are generally classed as hazardous substances and therefore there may other costs involved in the disposal of the waste material.

Conclusion

Dry ice blasting is likely to be the most effective cleaning method, if introduced from the start of the maintenance programme, does not follow abrasive cleaning attempts, and is frequent enough to prevent cumulative build up of very hard deposits.

Chemical softening combined with dry ice blasting is a realistic alternative where any abrasive process needs to be avoided, and the accumulation of hard deposits prevents a total clean with dry ice blasting.

Other cleaning methods have more disadvantages, particularly relating to risk of damage to tubes and other fittings and creation of corrosion. Therefore use of these methods should be carefully considered and managed to mitigate the risks.

For more information visit the Gilsen Ltd website www.gilsen.com or email us at: contact@gilsen.co.nz