F133-11 Lainsa and Descon Quimica

Automated Metal Spraying at Laguna Verde Nuclear Power Plant Veracruz, Mexico

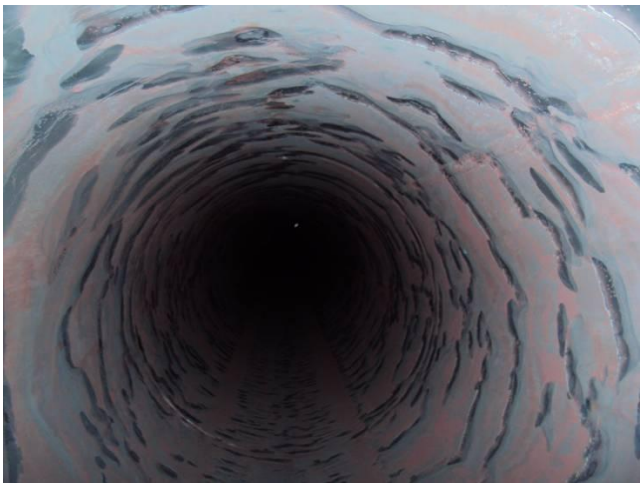
Metallisation customer, Lainsa, based in Mexico and part of Grupo Dominguis, provides metal spraying for corrosion protection of pipes used to exchange and transport dry water vapour in thermoelectric, conventional and nuclear power plants.

The application of metal spraying is critical, as the circulation of dry steam at high temperatures can lead to corrosion of the carbon steel. As a consequence of this corrosion the pipes can become perforated, which can lead to an unplanned closure of the plant resulting in a costly and inconvenient loss of electricity generation. To protect against corrosion the inner walls of the pipes are protected with a coating made up of several layers of cast metal alloys. The coating is extremely hard and resistant to abrasion, protecting against corrosion and improving the tribological properties, the resistance to wear and tear by friction of the water molecules contained in the steam.

Grupo Dominguis has developed the TIRANT 3® system, a worldwide innovative automatic system used to apply metal spraying to the inner surfaces of steam pipes. TIRANT 3® system is operated from outside the pipe, which means the only human intervention is the operation of the robot positioning and to change the metal wire. As a robotic, automated system that is pre-programmed, the metal spraying process is significantly extended without the need for rest periods and the only 'down time' is for robot maintenance.

The TIRANT 3® system also provides increased coating uniformity, therefore its resistance to corrosion, by keeping the selected parameters constant and consistent. In 2010, Lainsa successfully metal sprayed the inner surfaces of Cross Under pipes at Units I and II of the Laguna Verde Nuclear Power Plant. Using the TIRANT 3® system and the Metallisation Arcspray 140/S350 system, 300m^2 of steam pipes were metal sprayed in thirty four days. The project was commissioned by *Comisión Federal de Electricidad de México,* and had to be completed during a routine break in the refuelling of the units.

The inner surface of the steam pipes was blasted to a cleanliness SA 3 before being metal sprayed to a thickness of approximately 500 µm. The coating was applied in three layers: An anchoring layer of nickel / aluminium alloy; an intermediate layer of chrome / nickel alloy and a surface layer of chrome / nickel alloy.



Figures 1: Pipe surface corrosion-erosion

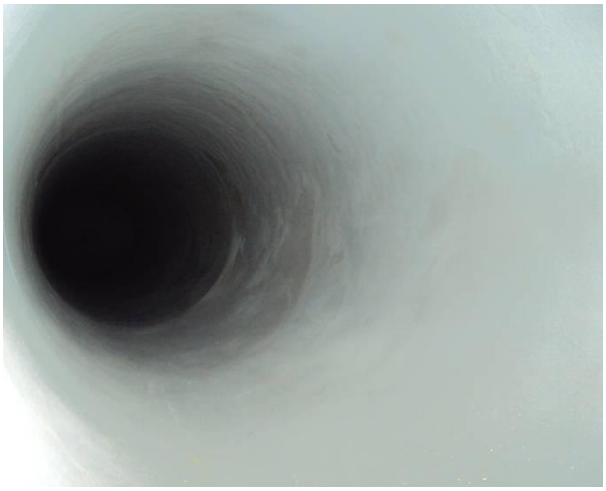


Figure 2: Pipe surface after metal spraying

The manual application of metal spraying requires a great deal of physical effort with frequent rest periods, which is mainly due to working in confined spaces, thermal stress and the need for independent and semi-independent breathing equipment and face masks.

Figure 3: Manual metal spraying

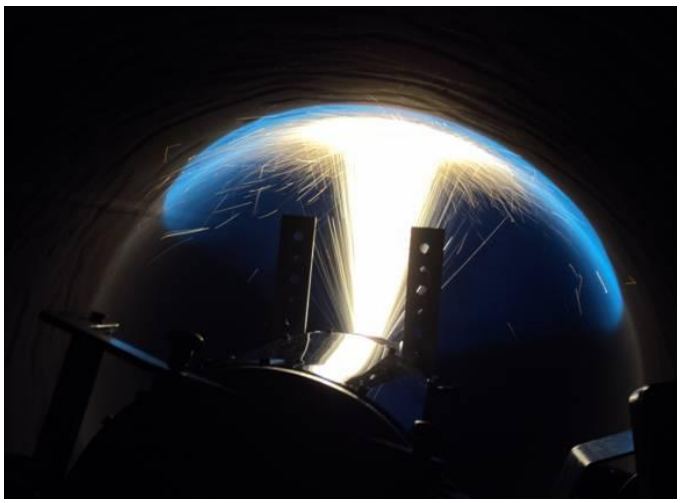


Figure 4: TIRANT 3® system metal spraying

The manual operator uses the gun to project the molten metal particles onto the surface, which can entail bending and kneeling in difficult and uncomfortable positions, while spraying pipes varying in size from 1 metre in diameter and up to 25 metres long. Due to the inaccessibility of pipes with smaller diameters, they are usually left untreated and prone to corrosion. The flexible TIRANT 3® system is the perfect solution for metal spraying small diameter pipes.

The metal spraying process also produces a large amount of fume, sparks and particles of metal dust, which means manual operators must have appropriate protection, including fireproof clothing, masks and a supply of breathing air. In certain industries additional protection must also be put in place, such as protection against ionising radiation, if the work has to be carried out in a radiological area.

Another inherent problem in manual application is the task of achieving uniformity of the coating thickness, so a reduction in thickness variations will result in greater resistance and greater surface protection. The difficulties arise due to the position of the operator inside the pipe. Movement is restricted and the visual distance or perspective of the coating application can be hampered making it more difficult to obtain a uniform layer.

While working on metal spraying the inner surfaces of the Cross Under pipes of a Boiling Water Reactor at the Nuclear Power Plant, these conditions were exacerbated with the additional risk of exposure to radiation for a manual operator. Opting for an automated process to metal spray these pipes reduced the risk of radiation by 70%. This was achieved by adopting protection measures using three basic principles - distance shield and time.

The TIRANT 3® system has been developed in direct response to the need for a simple, remote tool that removes manual application of a coating, while guaranteeing a uniform coating layer. The thickness applied to the surface of the pipe depends on four factors: The wire type used; the forward speed; the rotation speed and the distance of the Arcspray 140 from the wall of the pipe. The TIRANT 3® system, used in conjunction with Arcspray 140/S350 equipment, is versatile and appropriate for different pipe diameters, projected materials and desired thicknesses. The control software enables consistent and uniform forward and rotation speeds in relation to the thickness of the wall of the pipe. The TIRANT 3® system also has an automatic folding and unfolding system making it suitable for metal spraying pipes in all shapes and sizes.

The Metallisation Arcspray 140 system is the ultimate solution to today's demands for high performance Arcspray equipment. The patented 'Syncrodrive' push/pull system provides

constant, reliable and trouble free operation, utilising two gearboxes linked by a flexible drive. The drive system guarantees that the 'push' and 'pull' elements cannot be out of synchronisation, which ensures consistent wire feed over a long range, of up to 20 metres, making spraying at a distance much easier. The benefits of the Arc 140 system include a choice of coating textures, low running costs, high throughput, portable wire dispensing, safety interlocks and steel reinforced conduits.

In the Metallisation Arcspray process, the raw material, a pair of metal wires, is melted by an electric arc. The molten material is atomised by a cone of compressed air and propelled towards the work piece. This spray solidifies when it hits the surface of the work piece to form a dense coating, which protects against corrosion or repairs components. Sprayed coatings may also be used to provide wear resistance, electrical and thermal conductivity or for free standing shapes.

Metallisation Ltd, based in the UK, provides anti corrosion solutions to industries around the world and has done since 1922. For more information on metal spraying solutions, please contact Stuart Milton on 01384 252 464 or visit www.metallisation.com