

Boronizing in Masoneilan™ Control Valves

Overview

Control valve companies have traditionally used various materials and hard coatings to protect the valve trim against wear and abrasion. Materials such as Stellite, hardenable grades such as AISI 400 series Stainless Steel and hard coatings such as nitriding, ENP and hard Chrome have been extensively used. In the 1980's Masoneilan started using a diffusion coating called Boronizing (Boriding) to deal with extreme erosion and abrasion.

What is Boronizing:

Boronizing is a diffusion coating where the element boron is diffused into a metal surface to form a metal boride of very high hardness. This process can be performed on various base metal groups (iron, nickel, cobalt and titanium based materials can be borided), with the boride being formed based on the base element of each material group. Iron based materials are most commonly borided, with iron borides having a hardness of about HV 1500 to 1800. The deepest case depths (0.006 to 0.010") are obtained on steels having minimal alloy content, with increasing amounts of nickel progressively reducing case diffusion depth. Nickel and cobalt based materials generally cannot develop a case depth of more than 0.002" but the boride compounds forming in these materials are harder (HV 2200 to 2800) than those formed in iron based materials.

How is it applied:

The most common boronizing process is pack cementation, where the component is placed in a container filled with boride salts. All surfaces in contact with the salt are subject to boron diffusion. The container is then placed into a conventional oven and heated to about 1700°F and held at this temperature for 12 to 24 hours, depending on the amount of case depth required and the material being borided. At this temperature, a halide gas containing boron forms, dissociates and boron is diffused into the workpiece. Since the part is somewhat insulated in the boron salt container, rapid cooling is not possible, so that if base material properties are important, the part must be heat treated afterwards.

Advantages over traditional Nitriding:

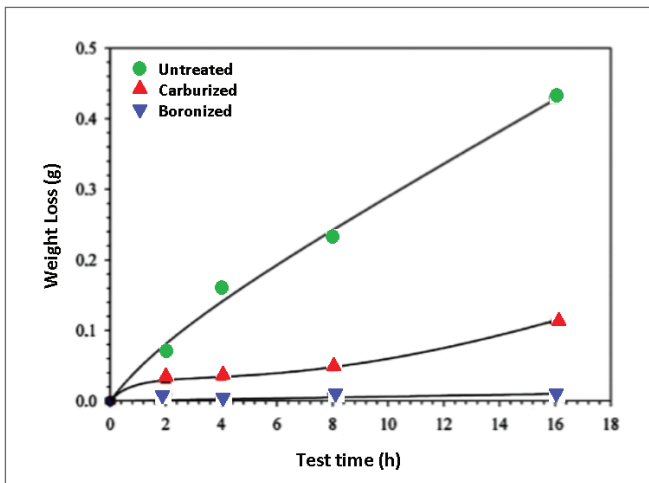
Masoneilan regularly uses Nitriding as a coating technology on its trim components while utilizing Boronizing for extreme severe erosive applications. Boronizing is applied at a higher temperature and is not a line-of-sight process thereby allowing coating on complex shapes.

The advantage of boriding is that the compound formed is not harmful and plays no role in increasing or decreasing corrosion resistance. The borides that form are part of the

matrix material, depending on whether the material is iron, nickel or cobalt based. Another advantage of boriding is that the compound is stable up to 1500°F, since that is the minimum temperature at which boriding can take place. Nitriding and carburizing would not be recommended above 1000°F.

A disadvantage is that boronizing takes place (in iron based alloys) above the transformation temperature, so that post boride heat treatment will often be necessary to restore base material properties.

The Erosive Weight Loss chart below compares Boronizing and Carburized coatings*. Carburizing has similar hardness properties to Nitriding and therefore this chart gives an indirect comparison of Boronizing and Nitriding, with Boronizing reducing material loss by about 10 fold.



Masoneilan Experience Using Boronizing:

Field experience shows that our valves with Boronized materials have been successful in resisting erosion damage and extending the life of the valves in erosive applications such as severe flashing and fluids that contain abrasive particles. The Boronized materials have been successfully used in several Masoneilan product lines such as the LincolnLog (18400/78400 Series), 77003 Series, 21000 Series, and Camflex (35002 Series).



To further discuss your severe wear application, please contact your local sales channel for Baker Hughes Valves division through valves.bakerhughes.com/contact-us

Third Party Technical References:

Boronizing is referenced as an article in the premiere materials handbook published by ASM **"Wear and Galling Resistance of Borided (Boronized) Metal Surfaces"** This reference gives the user an in-depth view into Boronizing, its application, uses and properties and shows that Boronizing is a well established and well understood wear diffusion coating.

* **"Comparison of Hardness and Wear Behaviour of Boronized and Carburized AISI 8620 Steels."** A. Calika, A. Duzgunb, A.E. Ekincic, S. Karakasd and N. Ucare