Chinese Barrel Evaluation

June 15, 2018

Executive Summary

Molders Services has requested a full analysis on a competitor's barrel imported from China. This barrel was sent to us for evaluation after a premature failure was experienced due to excessive wear in the ID. The 135mm injection barrel was sold as having a high wear Tungsten Carbide bimetallic inlay comparable to the Xaloy 800 product. After receiving the barrel, we cut off 6" from the end and prepared multiple samples for analysis including inlay chemistry, backing steel chemistry, physical properties, abrasion resistance and barrel construction methods. Results from every test showed the Chinese barrel to not only be inferior to the performance characteristics of the X800 (Tungsten Carbide) inlay, but also inferior to the X102 (standard bimetallic) inlay.

135mm Injection Barrel

Bell End Sleeve

Hardness testing revealed the Chinese barrel inlay to be 32Rc as compared to X102 or X800 which are both over 60Rc. The ASTM G65 abrasion tests showed the sample barrel to have 27% less wear life compared to Xaloy X102 and 440% less wear life than the Xaloy X800. The inlay chemistry also showed a total absence of any Tungsten Carbide, despite having been sold as such. In addition to the lack of this compound, the Chinese liner was shown to have a very high nickel content. This proportion of Nickel content in a liner absent of any Tungsten Carbide results in a very soft and poor performing inlay. The construction method of the imported barrel was a bimetallic liner pressed inside a housing or a 2-piece barrel construction which could lead to poor heat transfer, poor strength and pressure carrying capacity. The backing

steel of the liner was a low carbon, low strength steel. The liner pressed inside the housing of the imported barrel had a yield strength close to 35,000 psi as compared to the Xaloy BM58 backing steel of 85-90,000 psi. In short, this barrel represents technology used by U.S. barrel producers back in the 1960's

Bimetallic Inlay Chemistry

The chemistry of the sample barrel is measured with our Oxford X-met metal analyzer. Three spots at different locations of the barrel were measured and listed below. There is no tungsten carbide in this inlay and a very low hardness. Clearly, the imported barrel is nothing close to a high-performance abrasion and corrosion resistant inlay as in the X800 as it was represented to the customer. We can say the same to its performance compared to the Xaloy X102. The relatively high nickel and low iron content give it very low hardness properties and very poor abrasion resistance.

Barrel Inlay Chemistry

Element	Xaloy X102	Xaloy X800	Import Barrel
Ni - Nickel	4%	45%	27%
Cr - Chromium	1%	4%	5%
B - Boron	2%	2%	-
Fe - Iron	Balance (~91%)	1%	66%
Si - Silicon	2%	2%	0.9%
W - Tungsten	-	55%	-

Specimen from Imported Barrel which was a thin walled liner pressed into a housing

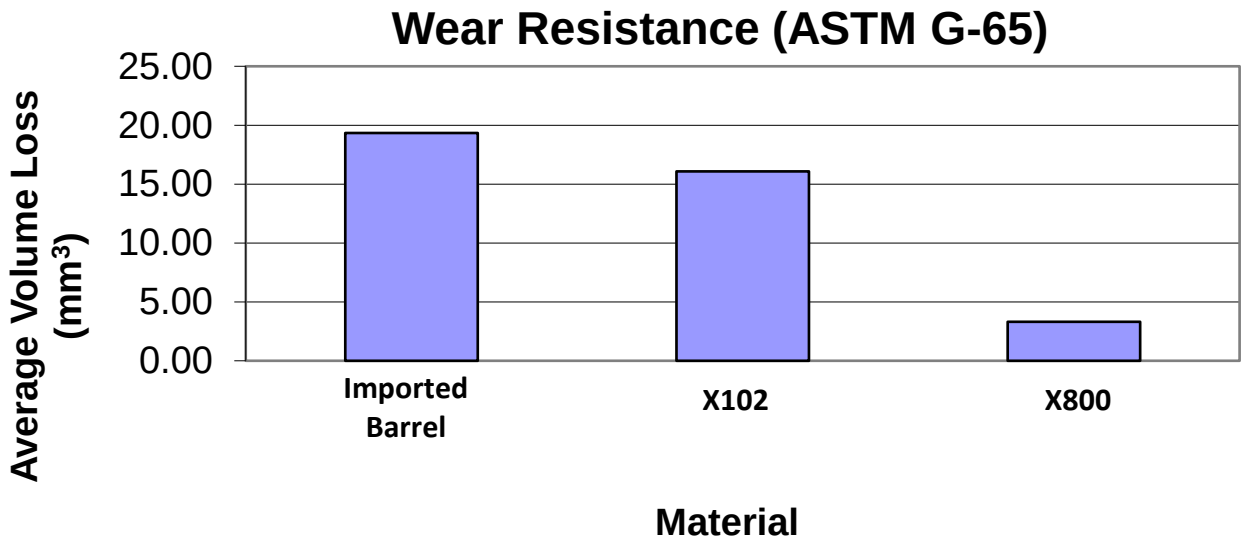
Bimetallic Inlay Hardness

Hardness value of the imported barrel was measured in 3 locations with an average hardness of 32 HRC, while standard hardness of both X102 and X800 range from 58 to 64 HRC. This softness of an inlay cannot withstand the abrasion of today's resins and will result in premature failure.

	Xaloy X102	Xaloy X800	Import Barrel
Inlay Hardness	58-64Rc	60-64Rc	32-34Rc

Wear Resistance

Specimens were cut from the barrel and run through the industry standard ASTM G65 abrasion test. This is a test that forces a spinning rubber wheel against the sample specimen while sand is fed between the two. Essentially grinding sand or abrading it against the bimetallic inlay sample. After a given number of cycles the volume of inlay removed by the sand is recorded. There are 3 samples run for each inlay to reach an average wear. The chart below shows the volume loss of all 3 inlays: X800, X102 and the imported barrel.



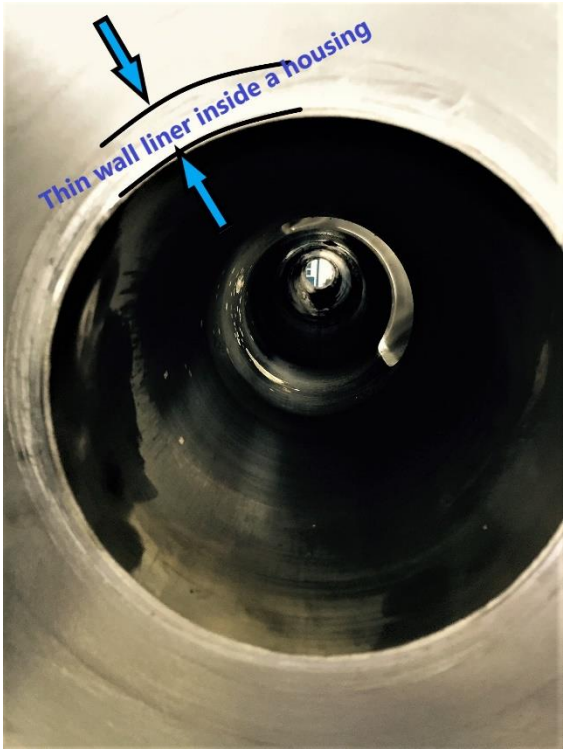
Backing steel

Chemical analysis of the imported barrel backing steel on the thin walled liner via X-met shows it is low or mild carbon steel, similar to ANSI 1020. The hardness of this backing steel is 24Rc maximum. The yield strength of this steel is 30,000 – 35,000 psi. The comparative yield strength for the Xaloy BM58 steel is 85,000-90,000 psi. Using a backing steel for an injection barrel with this low of strength will greatly diminish the pressure carrying capacity for a barrel of this size.

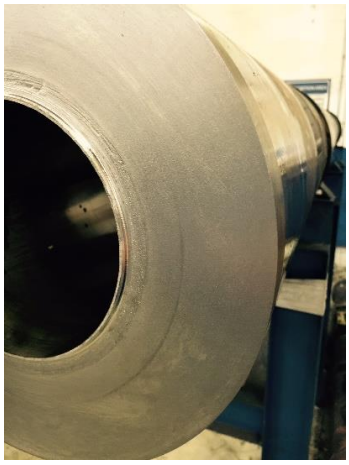
Backing Steel Properties	Xaloy BM58	Xaloy BM 63	Import Barrel
Hardness	28-32Rc	30-36Rc	24Rc max.
Tensile strength (psi)	115,000 min	128,000 min	65,000
Yield strength (psi)	80-85,000	90-95,000	35,000

Construction Methods

The last 6” of the barrel was cut off to run all these tests, after which it was clear there was a thin wall bimetallic liner pressed inside a housing. This is an unacceptable method to construct a barrel of this size.



There are many well documented problems with this method. The strength of the barrel is now compromised as compared to a single piece construction method. The thermal heat transfer from the outside heater bands to the melt stream inside the barrel has now been reduced since there are gaps between the liner and housing.



Additionally, there is a high risk of molten plastic getting between the liner and housing through thermocouple holes and discharge barrel end face that is under high pressure. These are all common problems associated with poorly constructed barrels.

Conclusion

The performance of this imported barrel is nothing close to the performance of the Xaloy product in every category: wear resistance, pressure carrying capacity, reliable construction materials, and construction methods. There is an increasing presence of barrels being imported into the Americas none of which have been at the quality and performance levels of Xaloy barrels. The facts above are representative of many other barrels we have inspected as well. The demands and expectations of the American processors and OEM machine builders have developed over time as have the materials and manufacturing methods of U.S. barrel producers, while the quality and hence durability of Chinese barrels appears to continually get worse.