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ACME® ChroMo Alloy-Grades L, M, H

Pearlitic Chromium-Molybdenum (Cr-Mo) Cast Steels

Low Cost Wear Solutions for Liners & Liner Plates of Beneficiation Equipment

Low alloyed steels whose carbon content is at or slightly higher than the eutectoid composition on the Fe-C Phase diagram are generally referred at "pearlitic chrome moly steels". The microstructure of a low carbon pearlitic chrome moly steel possesses well defined lamellae of ferrite and iron carbide while that of high carbon pearlitic chrome moly steel consists of unresolvable lamellae and hypereutectoid carbides. Owing to diverse properties due to varying carbon content along with Cr-Mo as cast geometries, it is apparently difficult to achieve benchmarked standard compositions that would enable evolving of a standard specification. IS: 4896 has attempted to standardize Cr-Mo steel into several grades based on carbon content of alloy with practical limitations.

ACME® ChroMo-Grades L, M and H represent low, medium and high carbon contents of cast chrome moly pearlitic steels. Chromium content varies from 2.0 to 2.5% (unlike IS: 4896 which contains 0.75-1.50 max Cr) with higher molybdenum content ranging from 0.30-0.40%. In addition, presence of nickel helps increase fracture toughness and abrasion resistance. Brinell hardness range typically lies between BHN 275 to 400. Depending upon carbon and alloying elements, quenching medium for cast alloy steels can be- water, oil and air.

ChroMo-L, a low carbon grade has a carbon content around 0.60%, which after austenizing and air cooling, shows a completely pearlitic microstructure with a brinell hardness range of 275-325 (29-35 HRC).

ChroMo-H, the high carbon grade has a carbon content around 0.80% that after heat treatment, does show hypereutectoid carbides and extremely fine unresolvable pearlite resulting in brinell hardness range of 352-401 (38-43 HRC). However, measured values of fracture toughness decrease with increasing carbon content. It is imperative to control cooling of this class of abrasion-resistant steels to produce a pearlite microstructure since high hardness, low toughness bainite, and martensite can form during phase transformations, if cooling rates are rapid. Presence of lower transformation microstructures is frequently the reason of premature failure of pearlitic chrome moly steel castings. This is why there are no ASTM or other public specification to adequately describe cast pearlitic steels.

The pearlitic microstructure consists of alternate lamellae of ferrite and cementite, Fe_3C. Under equilibrium conditions, the carbide phase makes up only 11% of the volume of the microstructure, but its effects are far reaching. Compared to low alloy steels, the presence of 11% Fe_3C increases both yield and tensile strength to 90-150 Ksi (620-1030 MPa) respectively, but does reduce tensile elongation below 5%. Therefore, conventionally measured toughness is relatively low. It is understood that carbide phase does contribute to improving abrasion resistance. Research reveals that pearlite has an equivalent abrasion resistance to a martensitic steel that is several points higher in hardness.

A less known or reported characteristic of pearlitic chrome moly steel is its ability to work harden. In a particular case, it has been observed that repeated impact action of 3.5 inch (9 cm) diameter balls against the grates resulted in work hardening from the original BHN 310 (HRC 33) up to approximately BHN 480 (HRC 50). Upon examining the microstructure photographs, actual hardness traverse will reveal differing appearance of un-deformed and deformed pearlite. Large ductile values can be observed on metallographic evaluations in conventionally low ductility steels such as pearlitic chrome moly steels when subjected to service conditions of stress produces large shear stresses without formation of large tensile stress. When this occurs, it results in unexpected high work hardening. This work hardening ability combined with the presence of carbides are the reasons pearlitic chrome moly steel has been successful in cement and mineral processing industry. Thus, they often result in an economical solution to many diverse abrasive wear problems.