



Super hard micro alloy for heavy-duty transport

45 t per wheelset in continuous operation

Starting with 30 t, the wear increases rapidly with conventional wheel steels under extreme load, and “shelling” and “spalling”, chipping of material onto the tread, make the transport more expensive. Therefore, for the purpose of saving costs, higher load limits have been requested for a long time: 50 % more, thus 45 t, are being discussed. With traditional material, this is profitably not feasible.

Therefore, MWL Brazil, a company of the GMH-Bahntechnik, developed a super hard micro alloy, which does not buckle no matter how heavy the load is. This niobium micro alloy is running in Brazil currently, and the experience is positive.

Niobium, a rare heavy metal, contributes with its extraordinary affinity to carbon to the formation of a particularly fine-grained microstructure, which is only provided by the hardest steels. From this niobium micro alloy, we forge the strong-running and durable wheels, which enable the wagons to carry more load and make the freight traffic more profitable.

Brazil and MWL are first in using heavy-duty freight traffic. We are a little proud that we are in the driver seat. Especially, because we are able to make another contribution to the economic efficiency of rail transport.

Durability
Service life
High economic efficiency



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Facts & Figures

Mechanical properties of the new micro alloy

The tests show the dominance of the new super hard micro alloy on niobium basis: All requirement criteria according to AAR were absolutely met.

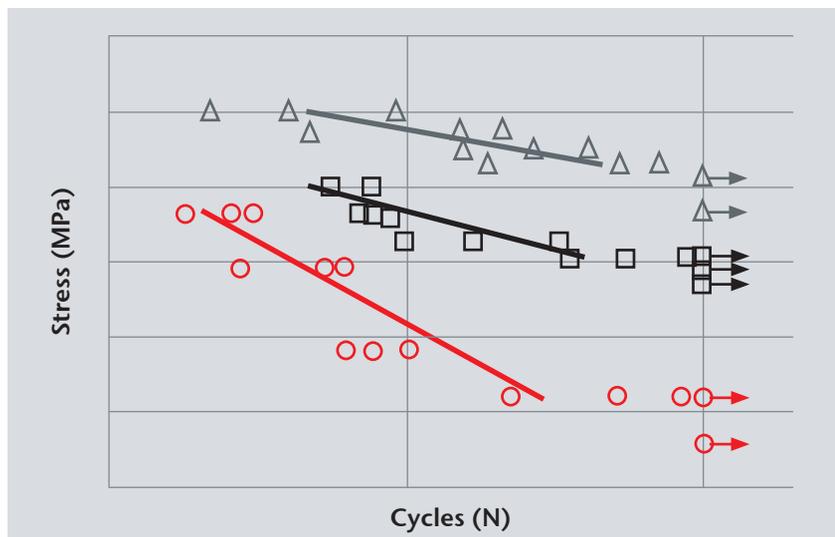
Test temperature: ambient temperature		
Material properties	AAR Requirements	Actual values
Tensile strength RM [MPa]	> 1083	1162
Yield (0,2% offset) [MPa]	> 760	900
Elongation A5 [%]	> 14	15
Aera reduction [%]	> 15	41
Rim hardness [BHN]	341 - 415	402
Fracture toughness K1c [MPa√m]	> 40	65

Test temperature: 538°C / 1000°F		
Material properties	AAR Requirements	Actual values
Tensile strength RM [MPa]	> 483	617
Yield (0,2% offset) [MPa]	> 345	500
Elongation A5 [%]	> 20	25
Aera reduction [%]	> 40	76

Result of the fatigue strength tests¹⁾

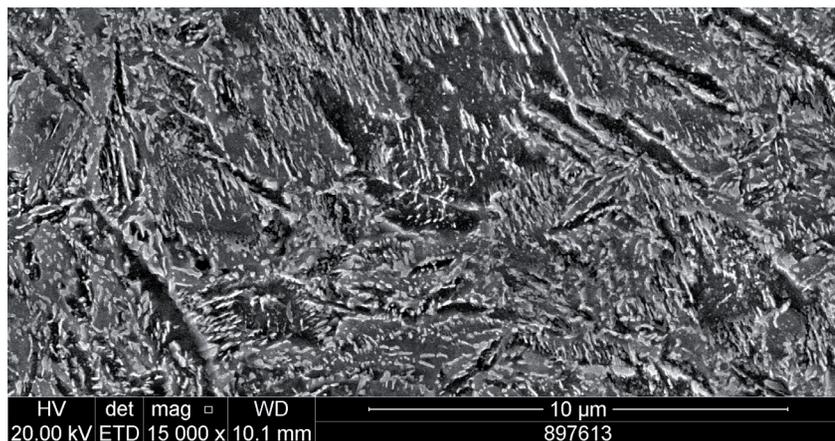
Here as well a clear result: In a direct comparison with the AAR class C materials cast steel (red) and forged steel (black), the new micro alloy on a niobium basis (light grey) shows significant improvements with regard to its dynamic strength.

- Cast steel
- Forged steel
- △ Forged micro alloy on a niobium basis



REM image of the micro-structure at a magnification of 20,000

The scanning electron microscope shows a fine-grained, bainitic-perlitic microstructure, ensuring the special hardness of the niobium alloy.



Microstructure micro alloy

1) All tests were performed in cooperation with the University of Campinas, Sao Paulo, Brazil.