TECHNOLOGY FOR INCREASING THE WORKING SURFACE HARDNESS OF HIGH-MANGANESE AUSTENITIC STEELS THROUGH THE FORMATION OF DISPERSED PHASES

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This research investigates the mechanisms for increasing the working surface hardness of high-manganese austenitic steels (110G13L) through the formation of dispersed phases. It was found that the formation of fine carbide and nitride particles in the structure, achieved through alloying and modification methods, significantly improves wear resistance. The obtained results are recommended for industrial application.

High-manganese austenitic steels, particularly grade 110G13L, are characterized by high impact resistance and the ability to work-harden during service. However, their initial hardness is relatively low, which limits their use in abrasive environments. Therefore, strengthening the surface layer by forming dispersed phases (carbides, nitrides, intermetallic compounds) is an important scientific and practical task.

Dispersed phases are very fine particles (nano- and micron-sized) distributed within the metal matrix. They perform the following functions: · restrict dislocation movement; hinder plastic deformation, accelerate the work-hardening process at the surface, increase resistance to wear.

These phases are typically formed by the addition of the following elements: Cr, Mo, V, Ti, Nb.

Table 1. Modification composition of 110G13L steel

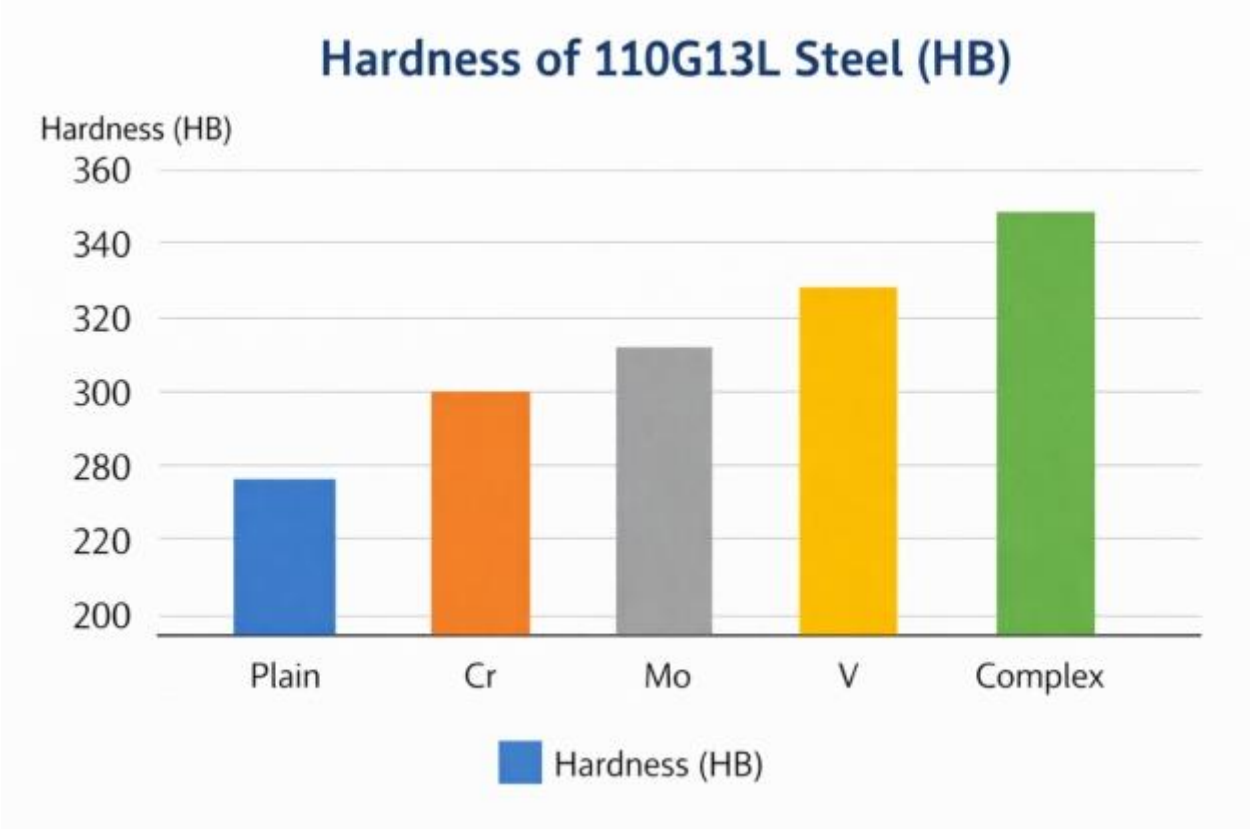
№	Alloying element	Content (%)	Expected phase
1	Cr	1.5	Cr_7C_3 carbide
2	Mo	0.5	Mo_2C
3	V	0.3	VC
4	Ti	0.2	TiC

The samples were subjected to the following treatment:
Heating at 1050–1100°C
Rapid cooling in water
Abrasive wear testing of the working surface

Table 2. Effect on hardness

Sample	Hardness (HB)	Wear reduction (%)
Conventional 110Г13Л	200–220	0
+Cr	260–280	18
+Mo	270–290	22
+V	280–310	27

Complex (Cr+Mo+V)	320–360	40



Graph 1. High effect of complex digerization.

The formation of dispersed phases leads to:refinement of austenite grain boundaries, uniform distribution of carbide particles, formation of a hardness gradient in the surface layer.

To achieve high efficiency, the following technology is recommended:

complex modification of molten metal (Cr + Mo + V);

ensuring rapid cooling during casting;

stabilization of the structure through heat treatment;

activation of work hardening under service deformation conditions.

Based on the conducted research, the following conclusions were drawn:

The formation of dispersed phases significantly increases the working surface hardness of high-manganese steels;

Complex alloying (Cr + Mo + V) is the most effective method;

Hardness can increase from 200 HB to 350 HB;

Wear resistance improves by 35–40%.

This technology is of great importance for mining, cement industry, and crushing equipment applications.

References

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