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ON THE STRUCTURE OF MOLDED STEEL THERMIC

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Abstract: *The thermic welding steel used railway tracks and is obtained by burning thermiteon the basis of aluminothermic reaction between iron oxide and aluminum, which are conducted by the reactions shown in the relations 1-3. Through these specific redox reactions resulting iron slag (Al_2O_3 - formula hereinafter referred corundum) and a significant amount of heat quantity generated. The thermite is a mixture of metal powders that contains mainly iron oxides (FeO, Fe_2O_3, Fe_3O_4), aluminum powder, ferro-alloys and moderators of response. The reaction moderators are added to the slag separation in a short time and improve flowability of the molten metal. The exothermic-burning of thermite reaction is developed the temperatures between 2500 and 3000 ºC. [1] The reaction is very violent combustion and primed by firing a magnesium strip (the ignition temperature (the flash point) of the thermite is 1550 ºC) and does not need supplemental oxygen for further combustion reaction that once started the content in any kind of the environment*

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Key words: *ferrite, micro-alloying, micro-segregation, microstructures, thermite.*

1. Introduction

This paper presents the highlighting of structural modifications that occur following a change in the chemical composition of steel thermic various alloying elements or modifying complex master alloys. The thermic steel analysis is made of French thermite and was obtained by the priming ignition of aluminothermic reaction and resulting the steel casting fully lined with a refractory crucible.

2. Microalloying Elements Influence

The micro-alloying elements were achieved with the chemical element like *Ti*, *Cu*, *V*, *B*, *Mn*, *Mo* in a ratio of 1% and the modifier complex consisting of $FeSi_{34}V_{25}Ti_{12}$ and FeB_{15} in a percentage of 0.5%, 1% and 1.5%. In Fig. 1 it is shows the microstructure of steel thermic unchanged. In Figures 2 to 6 are shown microstructures of the steel alloy thermic with *Ti*, *Cu*, *V*, *B*, *Mn*, *Mo* in a percentage of 1% for each element.

The thermic steel resulting from unmodified thermite, is a pearlitic structure

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which has a relatively non-uniform pearlitic grain size, morphology having slightly degenerate compared to the lamellar. In Figure 2 we see the effect of structural titanium finishing, the latter being materialized and the appearance of the titanium nitride (*TiN*).

After the micro-alloying the copper with the thermite pearlitic effect is observed, which is manifested in meaning to one lamellar pearlite morphology change and the appearance of traces of secondary cementite.

At the micro-alloying the steel with the vanadium it is observed the finishing and uniformity for grain size, while shorter distances interlaminate pearl, sees a "lacing" them and local the appearance of cementitious.

The microstructure of steel microalloyed with boron has a tendency to "acicular needle form" of the ferrite in pearlite (Widmanstatten type structure) and finishing of grain size.

The micro-alloying with the manganese has revealed an effect of increasing the grain size and its non-smoothing. It is noted the appearance of the cementitious and acicular needle phenomenon of ferrite. It is also observed a kind of patchy attack as a result of the micro-segregation.

At the micro-alloying with molybdenum is observed that molybdenum has a finishing and smoothing of grain size. There was thus obtained a structure with ferrite, but there is a tendency Widmanstatten structure.

In Fig. 8 are presented by changing the microstructure of steel thermic with different percentages of modifier complex pre-alloy consisting of $FeSi_{34}V_{25}Ti_{12}$ and FeB_{15}.

According to the microstructures in Figure 8 is observed the following issues:

- The steel structure is being standardized and is finishing with increasing proportion of the pre-alloys modifiers.
- The pearlite is becoming increasingly finer, with a slight tendency to "lacing", remaining at the same time continuing on the pearlitic grain section.
- A slight tendency to appearance of kind the insulartype of secondary cementitious.

The information acquired pursuant the qualitative investigations are supported by the quantitative point of view through the measurements performed grain size according to ASTM E 112 (with specialized software, calibrated, Intercept Method). In the Figure 9 are shown the comparison of the average values of the measurements of the amount of grain (G).

It is observed from Figure 9 that all items used refined grain structure, but not the same extent. The samples who is labeled on the histogram with 0.5% *M*, 1% *M* and 1.5%*M* are the samples that have the greatest influence on the grain size and are samples of steel thermic modified by adding 0.5% ($FeSi_{34}V_{25}Ti_{12}$ + FeB_{15}), 1% ($FeSi_{34}V_{25}Ti_{12}$ + FeB_{15}) and 1.5% ($FeSi_{34}V_{25}Ti_{12}$ + FeB_{15}).

3. Conclusions

In conclusion the most uniform and most finished structure is obtained by modifying the microstructure of the steel chemical composition with modifier complex ($FeSi_{34}V_{25}Ti_{12}$ + FeB_{15}), in a percentage by 1.5%. The steels with various chemical compositions have different properties.

According to research results that

microscopic steels have a finer grain structure and even more uniformity have a superior mechanical features and major grain steels and non-uniform structure.

Therefore we can say that by alloying the steel with thermic complex modifier ($FeSi_{34}V_{25}Ti_{12}$ + FeB_{15}), in a percentage by 1.5%, it is provide a kind of steel with a best mechanical properties. In the future it will be modified mechanical tests on these steels year for certification information obtained by optical microscopy.

$$3Fe_3O_4 + 8Al \rightarrow 4Al_2O_3 + 9Fe + (3009\ KJ / 3088\ ^\circ C) \quad (1)$$

$$3FeO + 2Al \rightarrow Al_2O_3 + 3Fe + (783\ KJ / 2500\ ^\circ C) \quad (2)$$

$$Fe_2O_3 + 1Al \rightarrow Al_2O_3 + 2Fe + (850\ KJ / 2960\ ^\circ C) \quad (3)$$

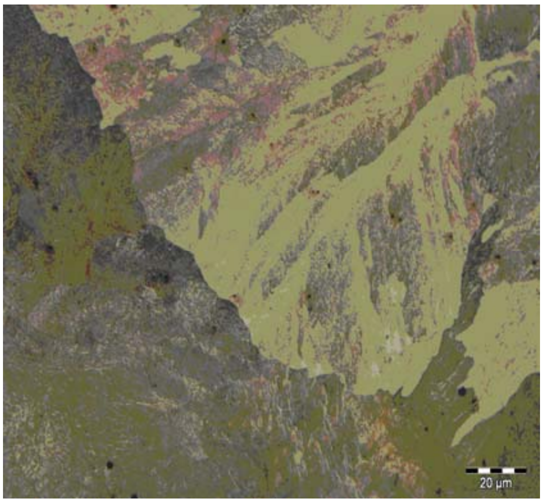

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Fig. 1. *A sample microstructure without modifier*

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Fig. 2. *Sample microstructure microalloyed with Ti*

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Fig. 3. *Sample microstructure microalloyed with Cu*

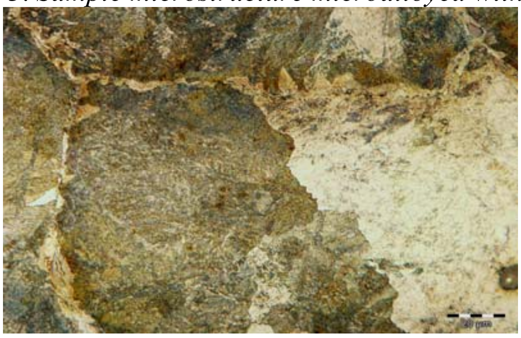

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Fig. 4. *Sample microstructure microalloyed with V*

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Fig. 5. *Sample microstructure microalloyed with B*

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Fig. 6. *Sample microstructure microalloyed with Mn*

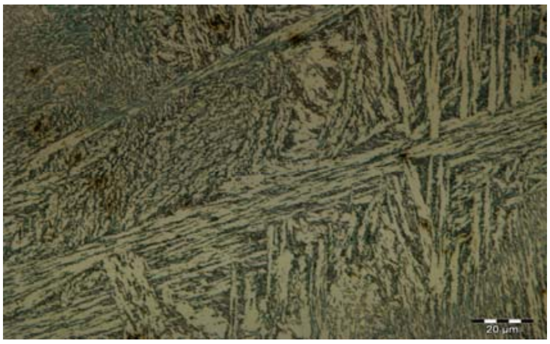

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Fig. 7. *Sample microstructure microalloyed with Mo*

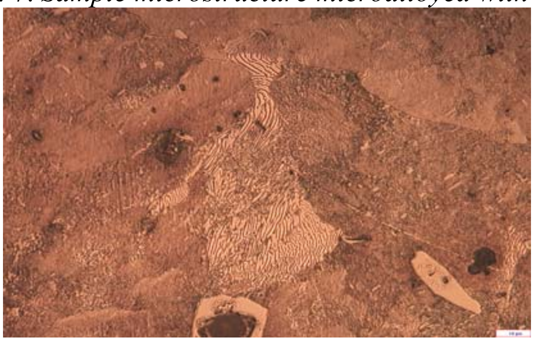

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Fig. 8. *a. Modified with 0,5 % ($FeSi_{34}V_{25}Ti_{12}$ + FeB_{15})*

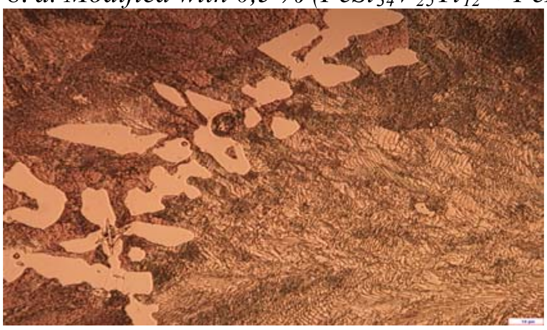

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Fig. 8. *b. Modified with 1 % ($FeSi_{34}V_{25}Ti_{12}$ + FeB_{15})*

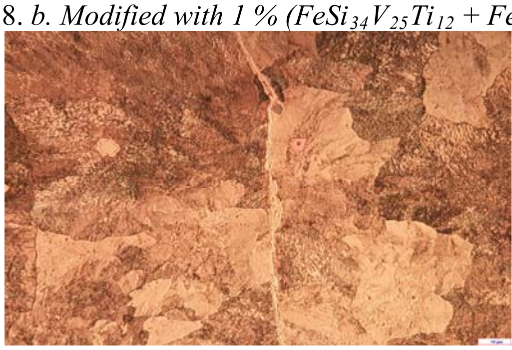

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Fig. 8. *c. Modified with 1,5 % ($FeSi_{34}V_{25}Ti_{12}$ + FeB_{15})*

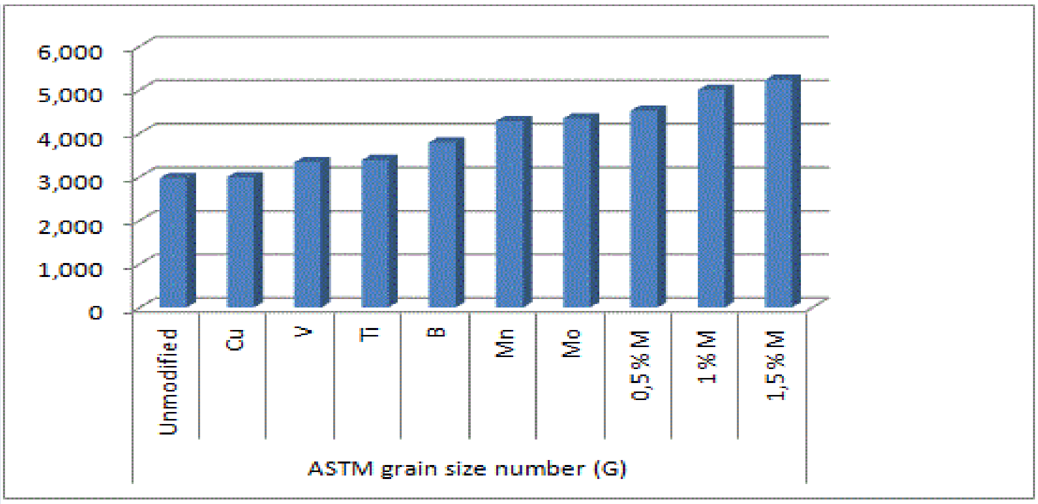

Fig. 9. *ASTME E112 Average Grain Size correlation*

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