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## Use of waste from aluminothermic welding of railroad tracks in structural materials science.

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### Abstract

The article discusses the possibility of using mineral waste from the aluminothermic rail welding in the form of waste refractory forms, and slag in construction materials in the preparation of ceramic, refractory and cement containing materials. The article provides optimal compositions using crushed and ground mineral waste and physic-mechanical studies of the obtained construction materials. For the study of the waste phase composition and structure of synthesized materials powder x-ray diffraction, differential thermal analysis and electron microscopy were used.

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### Introduction

Nowadays, the most popular method of railroad tracks' joint welding is the method of aluminothermic welding (ATW) by the way of intermediate foundry [1-3]. The world leader in ATW technology production is RAILTECH INTERNATIONAL Association founded in the late 80's of 20<sup>th</sup> century. This company is the world's leading supplier. Every year RAILTECH INTERNATIONAL supplies materials, which contribute welding of about 1,000,000 aluminothermic welding joints.

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Today “Svarochnaya naplavochnaya Company” works all-around the railroad net in Russia and this company is a leader in aluminothermic welding in our country. Since 2009 until 2016 more than 100,000 joints were welded. In 2017 due to the prospect of this industry, the amount of welded joints will be increased up to 70,000 joints per year and more in the Russian railways network.

At works of one joint ATW welding the following waste is formed in amount:

- waste casting mold– 8 kg
- waste thermopaste – 3 kg
- slag – 5 kg
- metal ingates – 12 kg

Metal ingates are recycled, other waste is digged into the the ground near the railroad.

With increasing of works amount up to 70,000 joints per year the amount of waste will be:

- waste foundry mold – 510 tons
- waste thermopaste – 210 tons
- slag – 350 tons

This waste can negatively impact on the environment.

The purpose of this work is consideration of possibility of use mineral waste from aluminothermic welding of railroad tracks in the form of waste high-heat forms, waste thermopaste and slag in structural materials science when receiving ceramic, heat-resisting and containing cement materials.

On this purpose X-ray graphical researches of railroad tracks ATW joints waste were conducted. The following crystal phases were identified: waste casting mold and waste thermopaste generally consist of quartz (fig. 1) and contain oddments of the unburnt organic binding (up to 2%). Slag consists of aluminum oxide -  $\text{Al}_2\text{O}_3$ , hercynite -  $\text{FeAl}_2\text{O}_4$  and a small amount (up to 5%) of silicon oxide -  $\text{SiO}_2$  (fig. 2). Mineral hercynite is presented by ferriteorus spinel, which is characterized by a high density –  $3.95 \text{ g/sm}^3$  and hardness 7.5 – 8 according to the Moos scale.

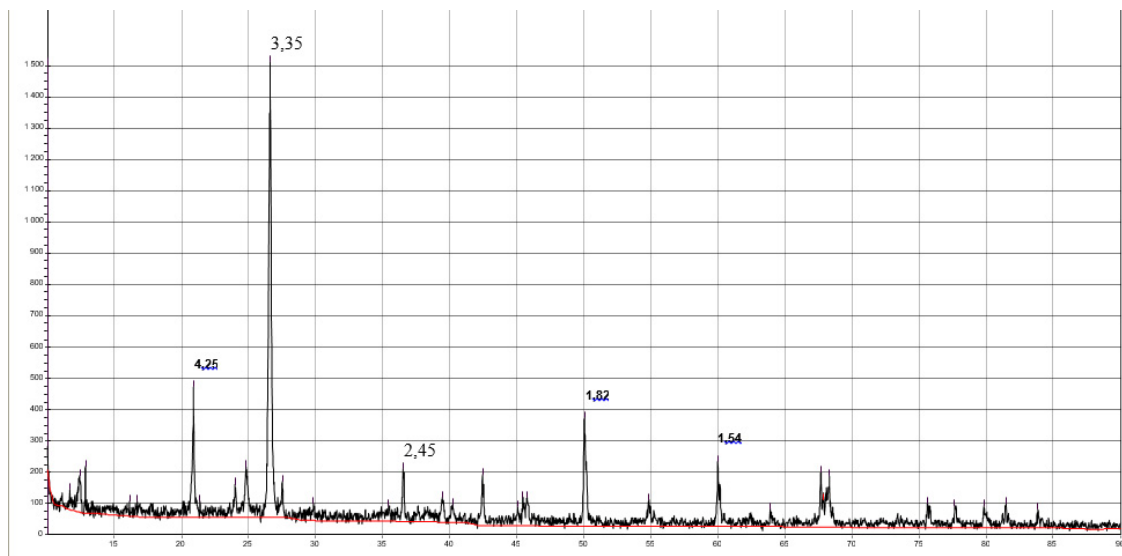


Fig. 1 – X-ray diagram of waste casting mold

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