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Selection and analysis of material for boiler pipes in a steam plant

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Abstract

The problems of a material selection for making the boiler pipes in a responsible steam plant and the technology for their welding are considered in this paper. The boiler is screened, complex, radiating energetic plant, with the natural water circulation in the hanging steel structure. Based on the legal regulations, the mandatory periodic reparation of the most important components is performed. This is why the check of mechanical properties, for the used and new materials for eventual replacement and building-in was done, as well as the check of the prescribed reparation procedures. The components that were in exploitation were checked, since their properties change with time. Checking consisted of testing the tensile material properties at room and elevated temperatures, measurements of hardness and analysis of materials' microstructures. Besides the experimental tests, the numerical modeling and analysis of the workload of the fluid transporting pipes was conducted. In that way it was established which material is optimal for manufacturing the boiler pipes.

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1. Introduction

Metal materials are generally used for manufacturing the boiler components, mainly the carbon and alloyed steels. The largest number of subassemblies and assemblies of the boiler are made by various welding procedures. The manufactured parts are exposed to influence of time, what could cause degradation of some of material characteristics, so their reliability must be checked [1, 2]. According to the place of mounting, components are divided into those exposed to water or steam pressure and to high temperatures. In addition, certain components are subjected to various kinds of external loadings and chemical influences, what has additional negative effect on integrity of the structure. It is not infrequent that materials can have flaws like cracks or non-metallic inclusions, due to what the exploitation characteristics of the structure are significantly reduced [3].

Results of theoretical, experimental and numerical investigations, whose objectives were to verify various properties of the most loaded components (both existing ones and the newly made), at room and elevated temperatures, are presented in this paper. In addition, the technology of pipes joining by gas welding was checked, since the considered boiler pipes are joined by welding.

Similar boiler installations were subject of research of numerous authors. Milović et al. [4] presented estimate of integrity of the pressure vessels made of the low-alloyed steel. The integrity estimate was done by experimental measurements of the *J*-integral at the working temperature of – 40 °C. Then they performed the numerical simulation whose results were in agreement

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